Supplementary Materials for

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This file includes:

Tables S1a-S18b

Guidance on How to Use the Enclosed Supplementary Materials for Replication

**Table S1a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 42.7862 | 2.7977 | 15.293 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.0730 | 0.7996 | 0.091 | .9273 |
| Year 2011 | 0.9926 | 0.8003 | 1.240 | .2149 |
| Year 2012 | 1.1092 | 0.7910 | 1.402 | .1609 |
| Year 2013 | 2.1312 | 0.7990 | 2.667 | .0077 |
| Year 2014 | 4.9015 | 0.8104 | 6.049 | .0000 |
| Year 2015 | 8.3643 | 0.8422 | 9.932 | .0000 |
| Year 2016 | 12.2977 | 0.8877 | 13.853 | .0000 |
| Year 2017 | 18.2479 | 1.0144 | 17.989 | .0000 |
| Year 2018 | 26.1191 | 1.2343 | 21.161 | .0000 |
| Opioid prescription rate | 0.2529 | 0.0209 | 12.105 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0136 | 0.0270 | 0.506 | .6131 |
| Opioid prescription rate × Year 2011 | 0.0271 | 0.0271 | 0.997 | .3186 |
| Opioid prescription rate × Year 2012 | 0.0499 | 0.0266 | 1.875 | .0609 |
| Opioid prescription rate × Year 2013 | 0.0903 | 0.0270 | 3.339 | .0008 |
| Opioid prescription rate × Year 2014 | 0.1176 | 0.0276 | 4.266 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1698 | 0.0286 | 5.936 | .0000 |
| Opioid prescription rate × Year 2016 | 0.2191 | 0.0294 | 7.453 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2883 | 0.0311 | 9.265 | .0000 |
| Opioid prescription rate × Year 2018 | 0.3785 | 0.0339 | 11.164 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 379.488 | | | |
| Observation-level | 176.688 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 1 in Table 2 in the main text.

**Table S1b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0136 | .0270 | -0.506 | 1.0000 |
| Year 2009 – Year 2011 | -.0271 | .0271 | -0.998 | .9924 |
| Year 2009 – Year 2012 | -.0499 | .0266 | -1.876 | .6858 |
| Year 2009 – Year 2013 | -.0903 | .0270 | -3.340 | .0291 |
| Year 2009 – Year 2014 | -.1176 | .0276 | -4.268 | .0009 |
| Year 2009 – Year 2015 | -.1698 | .0286 | -5.939 | <.0001 |
| Year 2009 – Year 2016 | -.2191 | .0294 | -7.456 | <.0001 |
| Year 2009 – Year 2017 | -.2883 | .0311 | -9.269 | <.0001 |
| Year 2009 – Year 2018 | -.3785 | .0339 | -11.168 | <.0001 |
| Year 2010 – Year 2011 | -.0134 | .0260 | -0.517 | 1.0000 |
| Year 2010 – Year 2012 | -.0363 | .0255 | -1.425 | .9196 |
| Year 2010 – Year 2013 | -.0766 | .0259 | -2.959 | .0905 |
| Year 2010 – Year 2014 | -.1040 | .0265 | -3.930 | .0035 |
| Year 2010 – Year 2015 | -.1561 | .0275 | -5.675 | <.0001 |
| Year 2010 – Year 2016 | -.2055 | .0283 | -7.249 | <.0001 |
| Year 2010 – Year 2017 | -.2746 | .0301 | -9.119 | <.0001 |
| Year 2010 – Year 2018 | -.3648 | .0330 | -11.060 | <.0001 |
| Year 2011 – Year 2012 | -.0228 | .0256 | -0.891 | .9968 |
| Year 2011 – Year 2013 | -.0632 | .0261 | -2.423 | .3123 |
| Year 2011 – Year 2014 | -.0905 | .0266 | -3.399 | .0240 |
| Year 2011 – Year 2015 | -.1427 | .0277 | -5.155 | <.0001 |
| Year 2011 – Year 2016 | -.1920 | .0285 | -6.737 | <.0001 |
| Year 2011 – Year 2017 | -.2612 | .0303 | -8.630 | <.0001 |
| Year 2011 – Year 2018 | -.3514 | .0331 | -10.609 | <.0001 |
| Year 2012 – Year 2013 | -.0403 | .0255 | -1.582 | .8569 |
| Year 2012 – Year 2014 | -.0677 | .0261 | -2.597 | .2196 |
| Year 2012 – Year 2015 | -.1199 | .0271 | -4.415 | .0004 |
| Year 2012 – Year 2016 | -.1692 | .0280 | -6.045 | <.0001 |
| Year 2012 – Year 2017 | -.2383 | .0298 | -8.002 | <.0001 |
| Year 2012 – Year 2018 | -.3286 | .0327 | -10.050 | <.0001 |
| Year 2013 – Year 2014 | -.0273 | .0265 | -1.033 | .9903 |
| Year 2013 – Year 2015 | -.0795 | .0275 | -2.889 | .1092 |
| Year 2013 – Year 2016 | -.1288 | .0284 | -4.544 | .0002 |
| Year 2013 – Year 2017 | -.1980 | .0301 | -6.573 | <.0001 |
| Year 2013 – Year 2018 | -.2882 | .0330 | -8.736 | <.0001 |
| Year 2014 – Year 2015 | -.0522 | .0280 | -1.861 | .6958 |
| Year 2014 – Year 2016 | -.1015 | .0289 | -3.518 | .0160 |
| Year 2014 – Year 2017 | -.1707 | .0306 | -5.580 | <.0001 |
| Year 2014 – Year 2018 | -.2609 | .0334 | -7.809 | <.0001 |
| Year 2015 – Year 2016 | -.0493 | .0298 | -1.655 | .8204 |
| Year 2015 – Year 2017 | -.1185 | .0315 | -3.764 | .0066 |
| Year 2015 – Year 2018 | -.2087 | .0342 | -6.100 | <.0001 |
| Year 2016 – Year 2017 | -.0692 | .0322 | -2.150 | .4917 |
| Year 2016 – Year 2018 | -.1594 | .0348 | -4.576 | .0002 |
| Year 2017 – Year 2018 | -.0902 | .0362 | -2.492 | .2730 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 1 in Table 2 in the main text.

**Table S2a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 0-5 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 53.4881 | 3.2644 | 16.385 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.2469 | 1.0085 | 0.245 | .8066 |
| Year 2011 | 1.5383 | 1.0097 | 1.524 | .1277 |
| Year 2012 | 1.6212 | 0.9984 | 1.624 | .1045 |
| Year 2013 | 2.9995 | 1.0098 | 2.970 | .0030 |
| Year 2014 | 5.6414 | 1.0254 | 5.502 | .0000 |
| Year 2015 | 9.8589 | 1.0677 | 9.234 | .0000 |
| Year 2016 | 14.9520 | 1.1268 | 13.270 | .0000 |
| Year 2017 | 22.9888 | 1.2885 | 17.842 | .0000 |
| Year 2018 | 33.2530 | 1.5685 | 21.200 | .0000 |
| Opioid prescription rate | 0.4179 | 0.0263 | 15.915 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0163 | 0.0339 | 0.481 | .6303 |
| Opioid prescription rate × Year 2011 | 0.0331 | 0.0341 | 0.972 | .3311 |
| Opioid prescription rate × Year 2012 | 0.0568 | 0.0334 | 1.698 | .0896 |
| Opioid prescription rate × Year 2013 | 0.1088 | 0.0340 | 3.205 | .0014 |
| Opioid prescription rate × Year 2014 | 0.1422 | 0.0347 | 4.103 | .0000 |
| Opioid prescription rate × Year 2015 | 0.2163 | 0.0360 | 6.009 | .0000 |
| Opioid prescription rate × Year 2016 | 0.2863 | 0.0370 | 7.731 | .0000 |
| Opioid prescription rate × Year 2017 | 0.3798 | 0.0392 | 9.682 | .0000 |
| Opioid prescription rate × Year 2018 | 0.4986 | 0.0428 | 11.650 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 512.248 | | | |
| Observation-level | 282.614 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 0-5 child populations. This model is corresponding to the results of Model 2 in Table 2 in the main text.

**Table S2b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among Age 0-5 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0163 | .0339 | -0.481 | 1.0000 |
| Year 2009 – Year 2011 | -.0331 | .0341 | -0.972 | .9937 |
| Year 2009 – Year 2012 | -.0568 | .0334 | -1.699 | .7965 |
| Year 2009 – Year 2013 | -.1088 | .0339 | -3.206 | .0444 |
| Year 2009 – Year 2014 | -.1422 | .0347 | -4.105 | .0017 |
| Year 2009 – Year 2015 | -.2163 | .0360 | -6.011 | <.0001 |
| Year 2009 – Year 2016 | -.2863 | .0370 | -7.734 | <.0001 |
| Year 2009 – Year 2017 | -.3798 | .0392 | -9.686 | <.0001 |
| Year 2009 – Year 2018 | -.4986 | .0428 | -11.655 | <.0001 |
| Year 2010 – Year 2011 | -.0168 | .0327 | -0.516 | 1.0000 |
| Year 2010 – Year 2012 | -.0405 | .0320 | -1.266 | .9610 |
| Year 2010 – Year 2013 | -.0925 | .0325 | -2.844 | .1224 |
| Year 2010 – Year 2014 | -.1259 | .0333 | -3.786 | .0061 |
| Year 2010 – Year 2015 | -.2000 | .0346 | -5.774 | <.0001 |
| Year 2010 – Year 2016 | -.2700 | .0357 | -7.561 | <.0001 |
| Year 2010 – Year 2017 | -.3635 | .0380 | -9.571 | <.0001 |
| Year 2010 – Year 2018 | -.4823 | .0417 | -11.578 | <.0001 |
| Year 2011 – Year 2012 | -.0236 | .0322 | -0.734 | .9993 |
| Year 2011 – Year 2013 | -.0757 | .0327 | -2.311 | .3819 |
| Year 2011 – Year 2014 | -.1091 | .0335 | -3.259 | .0377 |
| Year 2011 – Year 2015 | -.1831 | .0348 | -5.258 | <.0001 |
| Year 2011 – Year 2016 | -.2531 | .0359 | -7.051 | <.0001 |
| Year 2011 – Year 2017 | -.3466 | .0382 | -9.085 | <.0001 |
| Year 2011 – Year 2018 | -.4655 | .0418 | -11.132 | <.0001 |
| Year 2012 – Year 2013 | -.0520 | .0320 | -1.626 | .8357 |
| Year 2012 – Year 2014 | -.0855 | .0328 | -2.608 | .2141 |
| Year 2012 – Year 2015 | -.1595 | .0342 | -4.669 | .0001 |
| Year 2012 – Year 2016 | -.2295 | .0353 | -6.510 | <.0001 |
| Year 2012 – Year 2017 | -.3230 | .0376 | -8.600 | <.0001 |
| Year 2012 – Year 2018 | -.4418 | .0413 | -10.703 | <.0001 |
| Year 2013 – Year 2014 | -.0334 | .0333 | -1.004 | .9921 |
| Year 2013 – Year 2015 | -.1075 | .0347 | -3.101 | .0608 |
| Year 2013 – Year 2016 | -.1775 | .0357 | -4.967 | <.0001 |
| Year 2013 – Year 2017 | -.2710 | .0380 | -7.132 | <.0001 |
| Year 2013 – Year 2018 | -.3898 | .0417 | -9.355 | <.0001 |
| Year 2014 – Year 2015 | -.0740 | .0353 | -2.095 | .5310 |
| Year 2014 – Year 2016 | -.1440 | .0364 | -3.959 | .0031 |
| Year 2014 – Year 2017 | -.2375 | .0386 | -6.154 | <.0001 |
| Year 2014 – Year 2018 | -.3564 | .0422 | -8.442 | <.0001 |
| Year 2015 – Year 2016 | -.0700 | .0376 | -1.862 | .6948 |
| Year 2015 – Year 2017 | -.1635 | .0397 | -4.114 | .0016 |
| Year 2015 – Year 2018 | -.2824 | .0432 | -6.529 | <.0001 |
| Year 2016 – Year 2017 | -.0935 | .0406 | -2.301 | .3886 |
| Year 2016 – Year 2018 | -.2123 | .0440 | -4.821 | .0001 |
| Year 2017 – Year 2018 | -.1188 | .0458 | -2.595 | .2203 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 2 in Table 2 in the main text.

**Table S3a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 6-11 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 43.0981 | 2.9998 | 14.367 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.0404 | 0.8338 | 0.048 | .9614 |
| Year 2011 | 0.9179 | 0.8336 | 1.101 | .2709 |
| Year 2012 | 1.3170 | 0.8232 | 1.600 | .1097 |
| Year 2013 | 2.5721 | 0.8307 | 3.096 | .0020 |
| Year 2014 | 6.0956 | 0.8418 | 7.242 | .0000 |
| Year 2015 | 10.0785 | 0.8739 | 11.533 | .0000 |
| Year 2016 | 14.1986 | 0.9202 | 15.430 | .0000 |
| Year 2017 | 20.0949 | 1.0509 | 19.122 | .0000 |
| Year 2018 | 28.2482 | 1.2795 | 22.078 | .0000 |
| Opioid prescription rate | 0.2355 | 0.0219 | 10.767 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0146 | 0.0282 | 0.518 | .6045 |
| Opioid prescription rate × Year 2011 | 0.0333 | 0.0284 | 1.172 | .2411 |
| Opioid prescription rate × Year 2012 | 0.0577 | 0.0278 | 2.073 | .0382 |
| Opioid prescription rate × Year 2013 | 0.0991 | 0.0282 | 3.512 | .0004 |
| Opioid prescription rate × Year 2014 | 0.1304 | 0.0288 | 4.534 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1811 | 0.0298 | 6.078 | .0000 |
| Opioid prescription rate × Year 2016 | 0.2276 | 0.0306 | 7.439 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2920 | 0.0324 | 9.020 | .0000 |
| Opioid prescription rate × Year 2018 | 0.3868 | 0.0353 | 10.961 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 437.466 | | | |
| Observation-level | 189.956 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 6-11 child populations. This model is corresponding to the results of Model 3 in Table 2 in the main text.

**Table S3b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among Age 6-11 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0146 | .0282 | -0.518 | 1.0000 |
| Year 2009 – Year 2011 | -.0333 | .0284 | -1.173 | .9764 |
| Year 2009 – Year 2012 | -.0577 | .0278 | -2.074 | .5466 |
| Year 2009 – Year 2013 | -.0991 | .0282 | -3.513 | .0163 |
| Year 2009 – Year 2014 | -.1304 | .0287 | -4.536 | .0003 |
| Year 2009 – Year 2015 | -.1811 | .0298 | -6.081 | <.0001 |
| Year 2009 – Year 2016 | -.2276 | .0306 | -7.442 | <.0001 |
| Year 2009 – Year 2017 | -.2920 | .0324 | -9.024 | <.0001 |
| Year 2009 – Year 2018 | -.3868 | .0353 | -10.966 | <.0001 |
| Year 2010 – Year 2011 | -.0187 | .0271 | -0.688 | .9996 |
| Year 2010 – Year 2012 | -.0430 | .0265 | -1.621 | .8381 |
| Year 2010 – Year 2013 | -.0845 | .0270 | -3.131 | .0555 |
| Year 2010 – Year 2014 | -.1157 | .0275 | -4.203 | .0011 |
| Year 2010 – Year 2015 | -.1665 | .0286 | -5.818 | <.0001 |
| Year 2010 – Year 2016 | -.2130 | .0295 | -7.233 | <.0001 |
| Year 2010 – Year 2017 | -.2774 | .0313 | -8.866 | <.0001 |
| Year 2010 – Year 2018 | -.3721 | .0343 | -10.853 | <.0001 |
| Year 2011 – Year 2012 | -.0244 | .0267 | -0.912 | .9961 |
| Year 2011 – Year 2013 | -.0658 | .0271 | -2.425 | .3111 |
| Year 2011 – Year 2014 | -.0971 | .0277 | -3.506 | .0167 |
| Year 2011 – Year 2015 | -.1478 | .0288 | -5.139 | <.0001 |
| Year 2011 – Year 2016 | -.1944 | .0296 | -6.567 | <.0001 |
| Year 2011 – Year 2017 | -.2588 | .0314 | -8.234 | <.0001 |
| Year 2011 – Year 2018 | -.3535 | .0344 | -10.273 | <.0001 |
| Year 2012 – Year 2013 | -.0414 | .0265 | -1.564 | .8655 |
| Year 2012 – Year 2014 | -.0727 | .0271 | -2.685 | .1801 |
| Year 2012 – Year 2015 | -.1234 | .0282 | -4.381 | .0005 |
| Year 2012 – Year 2016 | -.1700 | .0290 | -5.856 | <.0001 |
| Year 2012 – Year 2017 | -.2344 | .0309 | -7.585 | <.0001 |
| Year 2012 – Year 2018 | -.3291 | .0339 | -9.697 | <.0001 |
| Year 2013 – Year 2014 | -.0313 | .0275 | -1.138 | .9808 |
| Year 2013 – Year 2015 | -.0820 | .0286 | -2.871 | .1143 |
| Year 2013 – Year 2016 | -.1285 | .0294 | -4.372 | .0005 |
| Year 2013 – Year 2017 | -.1929 | .0312 | -6.176 | <.0001 |
| Year 2013 – Year 2018 | -.2877 | .0342 | -8.402 | <.0001 |
| Year 2014 – Year 2015 | -.0507 | .0291 | -1.745 | .7696 |
| Year 2014 – Year 2016 | -.0973 | .0299 | -3.254 | .0383 |
| Year 2014 – Year 2017 | -.1617 | .0317 | -5.100 | <.0001 |
| Year 2014 – Year 2018 | -.2564 | .0347 | -7.399 | <.0001 |
| Year 2015 – Year 2016 | -.0465 | .0309 | -1.508 | .8892 |
| Year 2015 – Year 2017 | -.1110 | .0326 | -3.403 | .0237 |
| Year 2015 – Year 2018 | -.2057 | .0355 | -5.799 | <.0001 |
| Year 2016 – Year 2017 | -.0644 | .0333 | -1.934 | .6454 |
| Year 2016 – Year 2018 | -.1591 | .0361 | -4.409 | .0005 |
| Year 2017 – Year 2018 | -.0947 | .0375 | -2.524 | .2558 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 3 in Table 2 in the main text.

**Table S4a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 12-17 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 32.7723 | 2.4214 | 13.535 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.1594 | 0.6262 | -0.255 | .7991 |
| Year 2011 | 0.4248 | 0.6274 | 0.677 | .4984 |
| Year 2012 | 0.3010 | 0.6203 | 0.485 | .6275 |
| Year 2013 | 0.8237 | 0.6265 | 1.315 | .1887 |
| Year 2014 | 3.0552 | 0.6351 | 4.810 | .0000 |
| Year 2015 | 5.4278 | 0.6596 | 8.229 | .0000 |
| Year 2016 | 8.2046 | 0.6951 | 11.804 | .0000 |
| Year 2017 | 12.4277 | 0.7942 | 15.649 | .0000 |
| Year 2018 | 18.0724 | 0.9653 | 18.723 | .0000 |
| Opioid prescription rate | 0.1204 | 0.0164 | 7.362 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0088 | 0.0211 | 0.418 | .6757 |
| Opioid prescription rate × Year 2011 | 0.0142 | 0.0213 | 0.669 | .5038 |
| Opioid prescription rate × Year 2012 | 0.0354 | 0.0209 | 1.694 | .0904 |
| Opioid prescription rate × Year 2013 | 0.0656 | 0.0212 | 3.089 | .0020 |
| Opioid prescription rate × Year 2014 | 0.0850 | 0.0217 | 3.927 | .0001 |
| Opioid prescription rate × Year 2015 | 0.1193 | 0.0225 | 5.309 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1532 | 0.0231 | 6.631 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2058 | 0.0244 | 8.426 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2685 | 0.0266 | 10.101 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 286.881 | | | |
| Observation-level | 108.949 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 12-17 child populations. This model is corresponding to the results of Model 4 in Table 2 in the main text.

**Table S4b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among Age 12-17 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0088 | .0211 | -0.419 | 1.0000 |
| Year 2009 – Year 2011 | -.0142 | .0213 | -0.669 | .9997 |
| Year 2009 – Year 2012 | -.0354 | .0209 | -1.694 | .7989 |
| Year 2009 – Year 2013 | -.0656 | .0212 | -3.091 | .0626 |
| Year 2009 – Year 2014 | -.0850 | .0216 | -3.928 | .0035 |
| Year 2009 – Year 2015 | -.1193 | .0225 | -5.312 | <.0001 |
| Year 2009 – Year 2016 | -.1532 | .0231 | -6.633 | <.0001 |
| Year 2009 – Year 2017 | -.2058 | .0244 | -8.429 | <.0001 |
| Year 2009 – Year 2018 | -.2685 | .0266 | -10.105 | <.0001 |
| Year 2010 – Year 2011 | -.0054 | .0204 | -0.264 | 1.0000 |
| Year 2010 – Year 2012 | -.0266 | .0200 | -1.327 | .9476 |
| Year 2010 – Year 2013 | -.0568 | .0204 | -2.786 | .1417 |
| Year 2010 – Year 2014 | -.0762 | .0208 | -3.661 | .0097 |
| Year 2010 – Year 2015 | -.1105 | .0217 | -5.103 | <.0001 |
| Year 2010 – Year 2016 | -.1443 | .0223 | -6.472 | <.0001 |
| Year 2010 – Year 2017 | -.1970 | .0237 | -8.322 | <.0001 |
| Year 2010 – Year 2018 | -.2596 | .0259 | -10.031 | <.0001 |
| Year 2011 – Year 2012 | -.0212 | .0202 | -1.048 | .9892 |
| Year 2011 – Year 2013 | -.0514 | .0205 | -2.500 | .2686 |
| Year 2011 – Year 2014 | -.0708 | .0210 | -3.375 | .0260 |
| Year 2011 – Year 2015 | -.1051 | .0218 | -4.819 | .0001 |
| Year 2011 – Year 2016 | -.1389 | .0225 | -6.188 | <.0001 |
| Year 2011 – Year 2017 | -.1916 | .0238 | -8.046 | <.0001 |
| Year 2011 – Year 2018 | -.2542 | .0260 | -9.775 | <.0001 |
| Year 2012 – Year 2013 | -.0302 | .0201 | -1.501 | .8920 |
| Year 2012 – Year 2014 | -.0496 | .0206 | -2.414 | .3177 |
| Year 2012 – Year 2015 | -.0839 | .0214 | -3.920 | .0036 |
| Year 2012 – Year 2016 | -.1178 | .0221 | -5.337 | <.0001 |
| Year 2012 – Year 2017 | -.1704 | .0235 | -7.266 | <.0001 |
| Year 2012 – Year 2018 | -.2330 | .0257 | -9.074 | <.0001 |
| Year 2013 – Year 2014 | -.0194 | .0209 | -0.931 | .9955 |
| Year 2013 – Year 2015 | -.0537 | .0217 | -2.474 | .2830 |
| Year 2013 – Year 2016 | -.0876 | .0224 | -3.916 | .0037 |
| Year 2013 – Year 2017 | -.1402 | .0237 | -5.910 | <.0001 |
| Year 2013 – Year 2018 | -.2029 | .0259 | -7.824 | <.0001 |
| Year 2014 – Year 2015 | -.0343 | .0221 | -1.551 | .8713 |
| Year 2014 – Year 2016 | -.0681 | .0227 | -2.996 | .0819 |
| Year 2014 – Year 2017 | -.1208 | .0241 | -5.015 | <.0001 |
| Year 2014 – Year 2018 | -.1834 | .0263 | -6.988 | <.0001 |
| Year 2015 – Year 2016 | -.0339 | .0235 | -1.441 | .9143 |
| Year 2015 – Year 2017 | -.0865 | .0248 | -3.490 | .0177 |
| Year 2015 – Year 2018 | -.1491 | .0269 | -5.547 | <.0001 |
| Year 2016 – Year 2017 | -.0527 | .0253 | -2.080 | .5422 |
| Year 2016 – Year 2018 | -.1153 | .0274 | -4.213 | .0011 |
| Year 2017 – Year 2018 | -.0626 | .0284 | -2.203 | .4546 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 4 in Table 2 in the main text.

**Table S5a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Male Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 41.4513 | 2.7744 | 14.941 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.1248 | 0.7835 | 0.159 | .8734 |
| Year 2011 | 1.1301 | 0.7842 | 1.441 | .1496 |
| Year 2012 | 1.3387 | 0.7752 | 1.727 | .0842 |
| Year 2013 | 2.4527 | 0.7831 | 3.132 | .0017 |
| Year 2014 | 5.2008 | 0.7943 | 6.548 | .0000 |
| Year 2015 | 8.5283 | 0.8254 | 10.333 | .0000 |
| Year 2016 | 12.3350 | 0.8700 | 14.177 | .0000 |
| Year 2017 | 18.0260 | 0.9942 | 18.132 | .0000 |
| Year 2018 | 25.7206 | 1.2097 | 21.262 | .0000 |
| Opioid prescription rate | 0.2481 | 0.0205 | 12.117 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0111 | 0.0264 | 0.422 | .6731 |
| Opioid prescription rate × Year 2011 | 0.0265 | 0.0266 | 0.994 | .3201 |
| Opioid prescription rate × Year 2012 | 0.0477 | 0.0261 | 1.827 | .0677 |
| Opioid prescription rate × Year 2013 | 0.0894 | 0.0265 | 3.376 | .0007 |
| Opioid prescription rate × Year 2014 | 0.1152 | 0.0270 | 4.262 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1672 | 0.0280 | 5.962 | .0000 |
| Opioid prescription rate × Year 2016 | 0.2132 | 0.0288 | 7.397 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2815 | 0.0305 | 9.228 | .0000 |
| Opioid prescription rate × Year 2018 | 0.3682 | 0.0332 | 11.079 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 373.668 | | | |
| Observation-level | 169.823 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county male child populations. This model is corresponding to the results of Model 5 in Table 2 in the main text.

**Table S5b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among Male Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0111 | .0264 | -0.422 | 1.0000 |
| Year 2009 – Year 2011 | -.0265 | .0266 | -0.995 | .9926 |
| Year 2009 – Year 2012 | -.0477 | .0261 | -1.828 | .7172 |
| Year 2009 – Year 2013 | -.0894 | .0265 | -3.377 | .0258 |
| Year 2009 – Year 2014 | -.1152 | .0270 | -4.264 | .0009 |
| Year 2009 – Year 2015 | -.1672 | .0280 | -5.965 | <.0001 |
| Year 2009 – Year 2016 | -.2132 | .0288 | -7.401 | <.0001 |
| Year 2009 – Year 2017 | -.2815 | .0305 | -9.232 | <.0001 |
| Year 2009 – Year 2018 | -.3682 | .0332 | -11.084 | <.0001 |
| Year 2010 – Year 2011 | -.0153 | .0255 | -0.601 | .9999 |
| Year 2010 – Year 2012 | -.0365 | .0250 | -1.464 | .9060 |
| Year 2010 – Year 2013 | -.0783 | .0254 | -3.085 | .0636 |
| Year 2010 – Year 2014 | -.1040 | .0259 | -4.012 | .0025 |
| Year 2010 – Year 2015 | -.1560 | .0270 | -5.784 | <.0001 |
| Year 2010 – Year 2016 | -.2021 | .0278 | -7.271 | <.0001 |
| Year 2010 – Year 2017 | -.2703 | .0295 | -9.156 | <.0001 |
| Year 2010 – Year 2018 | -.3570 | .0323 | -11.041 | <.0001 |
| Year 2011 – Year 2012 | -.0212 | .0251 | -0.845 | .9979 |
| Year 2011 – Year 2013 | -.0630 | .0256 | -2.464 | .2886 |
| Year 2011 – Year 2014 | -.0887 | .0261 | -3.399 | .0240 |
| Year 2011 – Year 2015 | -.1407 | .0271 | -5.184 | <.0001 |
| Year 2011 – Year 2016 | -.1867 | .0279 | -6.682 | <.0001 |
| Year 2011 – Year 2017 | -.2550 | .0297 | -8.594 | <.0001 |
| Year 2011 – Year 2018 | -.3417 | .0325 | -10.525 | <.0001 |
| Year 2012 – Year 2013 | -.0418 | .0250 | -1.670 | .8123 |
| Year 2012 – Year 2014 | -.0675 | .0256 | -2.641 | .1992 |
| Year 2012 – Year 2015 | -.1195 | .0266 | -4.488 | .0003 |
| Year 2012 – Year 2016 | -.1655 | .0274 | -6.030 | <.0001 |
| Year 2012 – Year 2017 | -.2338 | .0292 | -8.004 | <.0001 |
| Year 2012 – Year 2018 | -.3205 | .0321 | -10.000 | <.0001 |
| Year 2013 – Year 2014 | -.0257 | .0260 | -0.992 | .9927 |
| Year 2013 – Year 2015 | -.0777 | .0270 | -2.879 | .1121 |
| Year 2013 – Year 2016 | -.1238 | .0278 | -4.450 | .0004 |
| Year 2013 – Year 2017 | -.1920 | .0295 | -6.500 | <.0001 |
| Year 2013 – Year 2018 | -.2787 | .0323 | -8.617 | <.0001 |
| Year 2014 – Year 2015 | -.0520 | .0275 | -1.890 | .6762 |
| Year 2014 – Year 2016 | -.0980 | .0283 | -3.463 | .0193 |
| Year 2014 – Year 2017 | -.1663 | .0300 | -5.543 | <.0001 |
| Year 2014 – Year 2018 | -.2530 | .0328 | -7.723 | <.0001 |
| Year 2015 – Year 2016 | -.0460 | .0292 | -1.575 | .8603 |
| Year 2015 – Year 2017 | -.1143 | .0309 | -3.703 | .0083 |
| Year 2015 – Year 2018 | -.2010 | .0335 | -5.993 | <.0001 |
| Year 2016 – Year 2017 | -.0683 | .0315 | -2.164 | .4820 |
| Year 2016 – Year 2018 | -.1550 | .0341 | -4.539 | .0003 |
| Year 2017 – Year 2018 | -.0867 | .0355 | -2.444 | .3001 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 5 in Table 2 in the main text.

**Table S6a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Female Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 43.7745 | 2.7698 | 15.804 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.0066 | 0.8058 | 0.008 | .9935 |
| Year 2011 | 0.8545 | 0.8065 | 1.059 | .2895 |
| Year 2012 | 0.8100 | 0.7970 | 1.016 | .3095 |
| Year 2013 | 1.7195 | 0.8051 | 2.136 | .0327 |
| Year 2014 | 4.4835 | 0.8164 | 5.491 | .0000 |
| Year 2015 | 7.9216 | 0.8486 | 9.335 | .0000 |
| Year 2016 | 11.8875 | 0.8944 | 13.291 | .0000 |
| Year 2017 | 17.9472 | 1.0221 | 17.560 | .0000 |
| Year 2018 | 25.9684 | 1.2437 | 20.880 | .0000 |
| Opioid prescription rate | 0.2562 | 0.0211 | 12.171 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0149 | 0.0272 | 0.549 | .5832 |
| Opioid prescription rate × Year 2011 | 0.0256 | 0.0274 | 0.936 | .3491 |
| Opioid prescription rate × Year 2012 | 0.0503 | 0.0268 | 1.875 | .0608 |
| Opioid prescription rate × Year 2013 | 0.0884 | 0.0272 | 3.246 | .0012 |
| Opioid prescription rate × Year 2014 | 0.1181 | 0.0278 | 4.255 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1687 | 0.0288 | 5.856 | .0000 |
| Opioid prescription rate × Year 2016 | 0.2199 | 0.0296 | 7.427 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2880 | 0.0313 | 9.188 | .0000 |
| Opioid prescription rate × Year 2018 | 0.3822 | 0.0342 | 11.192 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 371.254 | | | |
| Observation-level | 179.259 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county female child populations. This model is corresponding to the results of Model 6 in Table 2 in the main text.

**Table S6b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County CMR Rates among Female Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0149 | .0272 | -0.549 | .9999 |
| Year 2009 – Year 2011 | -.0256 | .0273 | -0.937 | .9953 |
| Year 2009 – Year 2012 | -.0503 | .0268 | -1.876 | .6855 |
| Year 2009 – Year 2013 | -.0884 | .0272 | -3.247 | .0391 |
| Year 2009 – Year 2014 | -.1181 | .0278 | -4.257 | .0009 |
| Year 2009 – Year 2015 | -.1687 | .0288 | -5.859 | <.0001 |
| Year 2009 – Year 2016 | -.2199 | .0296 | -7.430 | <.0001 |
| Year 2009 – Year 2017 | -.2880 | .0313 | -9.192 | <.0001 |
| Year 2009 – Year 2018 | -.3822 | .0341 | -11.197 | <.0001 |
| Year 2010 – Year 2011 | -.0107 | .0262 | -0.408 | 1.0000 |
| Year 2010 – Year 2012 | -.0354 | .0257 | -1.380 | .9336 |
| Year 2010 – Year 2013 | -.0735 | .0261 | -2.817 | .1311 |
| Year 2010 – Year 2014 | -.1032 | .0266 | -3.875 | .0043 |
| Year 2010 – Year 2015 | -.1538 | .0277 | -5.549 | <.0001 |
| Year 2010 – Year 2016 | -.2050 | .0285 | -7.181 | <.0001 |
| Year 2010 – Year 2017 | -.2730 | .0303 | -9.000 | <.0001 |
| Year 2010 – Year 2018 | -.3673 | .0332 | -11.053 | <.0001 |
| Year 2011 – Year 2012 | -.0247 | .0258 | -0.956 | .9945 |
| Year 2011 – Year 2013 | -.0628 | .0263 | -2.391 | .3318 |
| Year 2011 – Year 2014 | -.0925 | .0268 | -3.451 | .0202 |
| Year 2011 – Year 2015 | -.1431 | .0279 | -5.133 | <.0001 |
| Year 2011 – Year 2016 | -.1943 | .0287 | -6.769 | <.0001 |
| Year 2011 – Year 2017 | -.2623 | .0305 | -8.606 | <.0001 |
| Year 2011 – Year 2018 | -.3566 | .0334 | -10.689 | <.0001 |
| Year 2012 – Year 2013 | -.0381 | .0257 | -1.484 | .8989 |
| Year 2012 – Year 2014 | -.0678 | .0262 | -2.585 | .2251 |
| Year 2012 – Year 2015 | -.1184 | .0273 | -4.331 | .0006 |
| Year 2012 – Year 2016 | -.1696 | .0282 | -6.019 | <.0001 |
| Year 2012 – Year 2017 | -.2377 | .0300 | -7.922 | <.0001 |
| Year 2012 – Year 2018 | -.3319 | .0329 | -10.080 | <.0001 |
| Year 2013 – Year 2014 | -.0298 | .0266 | -1.117 | .9831 |
| Year 2013 – Year 2015 | -.0803 | .0277 | -2.898 | .1066 |
| Year 2013 – Year 2016 | -.1316 | .0286 | -4.607 | .0002 |
| Year 2013 – Year 2017 | -.1996 | .0303 | -6.578 | <.0001 |
| Year 2013 – Year 2018 | -.2939 | .0332 | -8.843 | <.0001 |
| Year 2014 – Year 2015 | -.0506 | .0282 | -1.790 | .7414 |
| Year 2014 – Year 2016 | -.1018 | .0291 | -3.504 | .0169 |
| Year 2014 – Year 2017 | -.1698 | .0308 | -5.513 | <.0001 |
| Year 2014 – Year 2018 | -.2641 | .0336 | -7.849 | <.0001 |
| Year 2015 – Year 2016 | -.0512 | .0300 | -1.707 | .7917 |
| Year 2015 – Year 2017 | -.1192 | .0317 | -3.762 | .0066 |
| Year 2015 – Year 2018 | -.2135 | .0345 | -6.197 | <.0001 |
| Year 2016 – Year 2017 | -.0680 | .0324 | -2.100 | .5274 |
| Year 2016 – Year 2018 | -.1623 | .0351 | -4.627 | .0002 |
| Year 2017 – Year 2018 | -.0943 | .0365 | -2.586 | .2248 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 6 in Table 2 in the main text.

**Table S7a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County Neglect Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 26.8004 | 2.1381 | 12.535 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.3648 | 0.6421 | 0.568 | .5699 |
| Year 2011 | 0.9217 | 0.6427 | 1.434 | .1516 |
| Year 2012 | 0.6123 | 0.6352 | 0.964 | .3351 |
| Year 2013 | 1.7683 | 0.6417 | 2.756 | .0059 |
| Year 2014 | 3.5138 | 0.6508 | 5.400 | .0000 |
| Year 2015 | 6.7919 | 0.6763 | 10.043 | .0000 |
| Year 2016 | 8.9614 | 0.7129 | 12.571 | .0000 |
| Year 2017 | 13.9794 | 0.8146 | 17.161 | .0000 |
| Year 2018 | 20.0818 | 0.9912 | 20.260 | .0000 |
| Opioid prescription rate | 0.2201 | 0.0168 | 13.118 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0171 | 0.0217 | 0.792 | .4286 |
| Opioid prescription rate × Year 2011 | 0.0237 | 0.0218 | 1.085 | .2779 |
| Opioid prescription rate × Year 2012 | 0.0280 | 0.0214 | 1.310 | .1904 |
| Opioid prescription rate × Year 2013 | 0.0633 | 0.0217 | 2.918 | .0035 |
| Opioid prescription rate × Year 2014 | 0.0787 | 0.0221 | 3.553 | .0004 |
| Opioid prescription rate × Year 2015 | 0.1371 | 0.0230 | 5.968 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1533 | 0.0236 | 6.493 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2141 | 0.0250 | 8.568 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2833 | 0.0272 | 10.404 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 220.448 | | | |
| Observation-level | 113.943 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 7 in Table 2 in the main text.

**Table S7b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County Neglect Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0171 | .0216 | -0.792 | .9987 |
| Year 2009 – Year 2011 | -.0237 | .0218 | -1.086 | .9861 |
| Year 2009 – Year 2012 | -.0280 | .0214 | -1.310 | .9515 |
| Year 2009 – Year 2013 | -.0633 | .0217 | -2.919 | .1008 |
| Year 2009 – Year 2014 | -.0787 | .0221 | -3.555 | .0141 |
| Year 2009 – Year 2015 | -.1371 | .0230 | -5.970 | <.0001 |
| Year 2009 – Year 2016 | -.1533 | .0236 | -6.496 | <.0001 |
| Year 2009 – Year 2017 | -.2141 | .0250 | -8.572 | <.0001 |
| Year 2009 – Year 2018 | -.2833 | .0272 | -10.409 | <.0001 |
| Year 2010 – Year 2011 | -.0065 | .0209 | -0.312 | 1.0000 |
| Year 2010 – Year 2012 | -.0109 | .0204 | -0.531 | 1.0000 |
| Year 2010 – Year 2013 | -.0462 | .0208 | -2.222 | .4418 |
| Year 2010 – Year 2014 | -.0615 | .0212 | -2.896 | .1071 |
| Year 2010 – Year 2015 | -.1199 | .0221 | -5.427 | <.0001 |
| Year 2010 – Year 2016 | -.1362 | .0228 | -5.982 | <.0001 |
| Year 2010 – Year 2017 | -.1969 | .0242 | -8.143 | <.0001 |
| Year 2010 – Year 2018 | -.2661 | .0265 | -10.045 | <.0001 |
| Year 2011 – Year 2012 | -.0044 | .0206 | -0.211 | 1.0000 |
| Year 2011 – Year 2013 | -.0397 | .0209 | -1.895 | .6724 |
| Year 2011 – Year 2014 | -.0550 | .0214 | -2.572 | .2314 |
| Year 2011 – Year 2015 | -.1134 | .0222 | -5.101 | <.0001 |
| Year 2011 – Year 2016 | -.1296 | .0229 | -5.663 | <.0001 |
| Year 2011 – Year 2017 | -.1904 | .0243 | -7.834 | <.0001 |
| Year 2011 – Year 2018 | -.2596 | .0266 | -9.760 | <.0001 |
| Year 2012 – Year 2013 | -.0353 | .0205 | -1.726 | .7806 |
| Year 2012 – Year 2014 | -.0507 | .0209 | -2.420 | .3139 |
| Year 2012 – Year 2015 | -.1091 | .0218 | -5.003 | <.0001 |
| Year 2012 – Year 2016 | -.1253 | .0225 | -5.574 | <.0001 |
| Year 2012 – Year 2017 | -.1861 | .0239 | -7.779 | <.0001 |
| Year 2012 – Year 2018 | -.2553 | .0263 | -9.723 | <.0001 |
| Year 2013 – Year 2014 | -.0153 | .0213 | -0.721 | .9994 |
| Year 2013 – Year 2015 | -.0737 | .0221 | -3.334 | .0297 |
| Year 2013 – Year 2016 | -.0900 | .0228 | -3.950 | .0032 |
| Year 2013 – Year 2017 | -.1507 | .0242 | -6.230 | <.0001 |
| Year 2013 – Year 2018 | -.2199 | .0265 | -8.301 | <.0001 |
| Year 2014 – Year 2015 | -.0584 | .0225 | -2.593 | .2214 |
| Year 2014 – Year 2016 | -.0746 | .0232 | -3.221 | .0424 |
| Year 2014 – Year 2017 | -.1354 | .0246 | -5.512 | <.0001 |
| Year 2014 – Year 2018 | -.2046 | .0268 | -7.626 | <.0001 |
| Year 2015 – Year 2016 | -.0162 | .0239 | -0.679 | .9996 |
| Year 2015 – Year 2017 | -.0770 | .0253 | -3.047 | .0710 |
| Year 2015 – Year 2018 | -.1462 | .0275 | -5.322 | <.0001 |
| Year 2016 – Year 2017 | -.0608 | .0258 | -2.353 | .3550 |
| Year 2016 – Year 2018 | -.1300 | .0280 | -4.647 | .0002 |
| Year 2017 – Year 2018 | -.0692 | .0291 | -2.380 | .3381 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 7 in Table 2 in the main text.

**Table S8a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County Physical Abuse Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 10.8571 | 1.1202 | 9.692 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.1841 | 0.2876 | 0.640 | .5222 |
| Year 2011 | 0.3585 | 0.2879 | 1.245 | .2131 |
| Year 2012 | 0.7802 | 0.2845 | 2.742 | .0061 |
| Year 2013 | 0.7251 | 0.2874 | 2.523 | .0117 |
| Year 2014 | 0.7193 | 0.2915 | 2.468 | .0136 |
| Year 2015 | 1.7661 | 0.3029 | 5.830 | .0000 |
| Year 2016 | 3.3981 | 0.3193 | 10.643 | .0000 |
| Year 2017 | 4.6120 | 0.3649 | 12.640 | .0000 |
| Year 2018 | 6.2691 | 0.4440 | 14.120 | .0000 |
| Opioid prescription rate | 0.0107 | 0.0075 | 1.417 | .1564 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | -0.0003 | 0.0097 | -0.036 | .9715 |
| Opioid prescription rate × Year 2011 | 0.0056 | 0.0098 | 0.578 | .5631 |
| Opioid prescription rate × Year 2012 | 0.0255 | 0.0096 | 2.667 | .0077 |
| Opioid prescription rate × Year 2013 | 0.0324 | 0.0097 | 3.332 | .0009 |
| Opioid prescription rate × Year 2014 | 0.0245 | 0.0099 | 2.466 | .0137 |
| Opioid prescription rate × Year 2015 | 0.0528 | 0.0103 | 5.131 | .0000 |
| Opioid prescription rate × Year 2016 | 0.0897 | 0.0106 | 8.488 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1065 | 0.0112 | 9.516 | .0000 |
| Opioid prescription rate × Year 2018 | 0.1272 | 0.0122 | 10.430 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 61.448 | | | |
| Observation-level | 22.858 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 8 in Table 2 in the main text.

**Table S8b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County Physical Abuse Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | .0003 | .0097 | 0.036 | 1.0000 |
| Year 2009 – Year 2011 | -.0056 | .0098 | -0.579 | .9999 |
| Year 2009 – Year 2012 | -.0255 | .0096 | -2.668 | .1874 |
| Year 2009 – Year 2013 | -.0324 | .0097 | -3.333 | .0298 |
| Year 2009 – Year 2014 | -.0245 | .0099 | -2.467 | .2869 |
| Year 2009 – Year 2015 | -.0528 | .0103 | -5.133 | <.0001 |
| Year 2009 – Year 2016 | -.0897 | .0106 | -8.491 | <.0001 |
| Year 2009 – Year 2017 | -.1065 | .0112 | -9.520 | <.0001 |
| Year 2009 – Year 2018 | -.1272 | .0122 | -10.435 | <.0001 |
| Year 2010 – Year 2011 | -.0060 | .0094 | -0.641 | .9998 |
| Year 2010 – Year 2012 | -.0259 | .0092 | -2.827 | .1280 |
| Year 2010 – Year 2013 | -.0327 | .0093 | -3.516 | .0162 |
| Year 2010 – Year 2014 | -.0248 | .0095 | -2.607 | .2149 |
| Year 2010 – Year 2015 | -.0531 | .0099 | -5.368 | <.0001 |
| Year 2010 – Year 2016 | -.0901 | .0102 | -8.837 | <.0001 |
| Year 2010 – Year 2017 | -.1068 | .0108 | -9.863 | <.0001 |
| Year 2010 – Year 2018 | -.1275 | .0119 | -10.749 | <.0001 |
| Year 2011 – Year 2012 | -.0199 | .0092 | -2.157 | .4874 |
| Year 2011 – Year 2013 | -.0267 | .0094 | -2.852 | .1200 |
| Year 2011 – Year 2014 | -.0188 | .0096 | -1.963 | .6250 |
| Year 2011 – Year 2015 | -.0471 | .0100 | -4.734 | .0001 |
| Year 2011 – Year 2016 | -.0841 | .0103 | -8.203 | <.0001 |
| Year 2011 – Year 2017 | -.1008 | .0109 | -9.264 | <.0001 |
| Year 2011 – Year 2018 | -.1215 | .0119 | -10.202 | <.0001 |
| Year 2012 – Year 2013 | -.0069 | .0092 | -0.747 | .9992 |
| Year 2012 – Year 2014 | .0011 | .0094 | 0.116 | 1.0000 |
| Year 2012 – Year 2015 | -.0272 | .0098 | -2.790 | .1403 |
| Year 2012 – Year 2016 | -.0642 | .0101 | -6.378 | <.0001 |
| Year 2012 – Year 2017 | -.0809 | .0107 | -7.555 | <.0001 |
| Year 2012 – Year 2018 | -.1017 | .0118 | -8.644 | <.0001 |
| Year 2013 – Year 2014 | .0079 | .0095 | 0.834 | .9980 |
| Year 2013 – Year 2015 | -.0204 | .0099 | -2.059 | .5567 |
| Year 2013 – Year 2016 | -.0574 | .0102 | -5.623 | <.0001 |
| Year 2013 – Year 2017 | -.0741 | .0108 | -6.838 | <.0001 |
| Year 2013 – Year 2018 | -.0948 | .0119 | -7.988 | <.0001 |
| Year 2014 – Year 2015 | -.0283 | .0101 | -2.809 | .1340 |
| Year 2014 – Year 2016 | -.0653 | .0104 | -6.292 | <.0001 |
| Year 2014 – Year 2017 | -.0820 | .0110 | -7.456 | <.0001 |
| Year 2014 – Year 2018 | -.1027 | .0120 | -8.550 | <.0001 |
| Year 2015 – Year 2016 | -.0370 | .0107 | -3.448 | .0204 |
| Year 2015 – Year 2017 | -.0537 | .0113 | -4.744 | .0001 |
| Year 2015 – Year 2018 | -.0744 | .0123 | -6.047 | <.0001 |
| Year 2016 – Year 2017 | -.0167 | .0116 | -1.447 | .9120 |
| Year 2016 – Year 2018 | -.0374 | .0125 | -2.989 | .0834 |
| Year 2017 – Year 2018 | -.0207 | .0130 | -1.590 | .8532 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 8 in Table 2 in the main text.

**Table S9a.** Unadjusted Multilevel Model of County Opioid Prescription Rates on County Sexual Abuse Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 3.5828 | 0.3169 | 11.306 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.0316 | 0.0800 | 0.395 | .6927 |
| Year 2011 | -0.0555 | 0.0801 | -0.693 | .4882 |
| Year 2012 | 0.0451 | 0.0791 | 0.570 | .5686 |
| Year 2013 | 0.0091 | 0.0800 | 0.114 | .9089 |
| Year 2014 | -0.0105 | 0.0811 | -0.129 | .8970 |
| Year 2015 | 0.1768 | 0.0843 | 2.098 | .0360 |
| Year 2016 | 0.4425 | 0.0888 | 4.981 | .0000 |
| Year 2017 | 0.8299 | 0.1015 | 8.176 | .0000 |
| Year 2018 | 1.4238 | 0.1235 | 11.527 | .0000 |
| Opioid prescription rate | 0.0231 | 0.0021 | 11.032 | .0000 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0010 | 0.0027 | 0.372 | .7102 |
| Opioid prescription rate × Year 2011 | 0.0004 | 0.0027 | 0.135 | .8930 |
| Opioid prescription rate × Year 2012 | 0.0037 | 0.0027 | 1.374 | .1695 |
| Opioid prescription rate × Year 2013 | 0.0041 | 0.0027 | 1.504 | .1326 |
| Opioid prescription rate × Year 2014 | 0.0027 | 0.0028 | 0.996 | .3193 |
| Opioid prescription rate × Year 2015 | 0.0047 | 0.0029 | 1.650 | .0989 |
| Opioid prescription rate × Year 2016 | 0.0078 | 0.0029 | 2.643 | .0082 |
| Opioid prescription rate × Year 2017 | 0.0113 | 0.0031 | 3.629 | .0003 |
| Opioid prescription rate × Year 2018 | 0.0162 | 0.0034 | 4.788 | .0000 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 4.924 | | | |
| Observation-level | 1.769 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 9 in Table 2 in the main text.

**Table S9b.** Post Hoc Tests on Pairwise Comparisons between Unadjusted Yearly Opioid Coefficients on County Sexual Abuse Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0010 | .0027 | -0.372 | 1.0000 |
| Year 2009 – Year 2011 | -.0004 | .0027 | -0.135 | 1.0000 |
| Year 2009 – Year 2012 | -.0037 | .0027 | -1.375 | .9350 |
| Year 2009 – Year 2013 | -.0041 | .0027 | -1.505 | .8906 |
| Year 2009 – Year 2014 | -.0027 | .0028 | -0.996 | .9925 |
| Year 2009 – Year 2015 | -.0047 | .0029 | -1.651 | .8226 |
| Year 2009 – Year 2016 | -.0078 | .0029 | -2.644 | .1980 |
| Year 2009 – Year 2017 | -.0113 | .0031 | -3.631 | .0108 |
| Year 2009 – Year 2018 | -.0162 | .0034 | -4.790 | .0001 |
| Year 2010 – Year 2011 | .0006 | .0026 | 0.245 | 1.0000 |
| Year 2010 – Year 2012 | -.0027 | .0026 | -1.043 | .9895 |
| Year 2010 – Year 2013 | -.0031 | .0026 | -1.183 | .9749 |
| Year 2010 – Year 2014 | -.0017 | .0027 | -0.659 | .9997 |
| Year 2010 – Year 2015 | -.0037 | .0028 | -1.351 | .9414 |
| Year 2010 – Year 2016 | -.0068 | .0028 | -2.387 | .3338 |
| Year 2010 – Year 2017 | -.0103 | .0030 | -3.417 | .0226 |
| Year 2010 – Year 2018 | -.0152 | .0033 | -4.617 | .0002 |
| Year 2011 – Year 2012 | -.0033 | .0026 | -1.284 | .9573 |
| Year 2011 – Year 2013 | -.0037 | .0026 | -1.419 | .9214 |
| Year 2011 – Year 2014 | -.0024 | .0027 | -0.894 | .9967 |
| Year 2011 – Year 2015 | -.0044 | .0028 | -1.573 | .8612 |
| Year 2011 – Year 2016 | -.0074 | .0029 | -2.597 | .2193 |
| Year 2011 – Year 2017 | -.0109 | .0030 | -3.610 | .0116 |
| Year 2011 – Year 2018 | -.0159 | .0033 | -4.791 | .0001 |
| Year 2012 – Year 2013 | -.0004 | .0026 | -0.160 | 1.0000 |
| Year 2012 – Year 2014 | .0009 | .0026 | 0.350 | 1.0000 |
| Year 2012 – Year 2015 | -.0011 | .0027 | -0.391 | 1.0000 |
| Year 2012 – Year 2016 | -.0041 | .0028 | -1.468 | .9045 |
| Year 2012 – Year 2017 | -.0076 | .0030 | -2.562 | .2363 |
| Year 2012 – Year 2018 | -.0126 | .0033 | -3.846 | .0048 |
| Year 2013 – Year 2014 | .0013 | .0027 | 0.499 | 1.0000 |
| Year 2013 – Year 2015 | -.0007 | .0028 | -0.238 | 1.0000 |
| Year 2013 – Year 2016 | -.0037 | .0028 | -1.306 | .9525 |
| Year 2013 – Year 2017 | -.0072 | .0030 | -2.399 | .3270 |
| Year 2013 – Year 2018 | -.0122 | .0033 | -3.688 | .0088 |
| Year 2014 – Year 2015 | -.0020 | .0028 | -0.704 | .9995 |
| Year 2014 – Year 2016 | -.0050 | .0029 | -1.741 | .7719 |
| Year 2014 – Year 2017 | -.0086 | .0031 | -2.794 | .1389 |
| Year 2014 – Year 2018 | -.0135 | .0033 | -4.037 | .0023 |
| Year 2015 – Year 2016 | -.0031 | .0030 | -1.023 | .9909 |
| Year 2015 – Year 2017 | -.0066 | .0032 | -2.088 | .5362 |
| Year 2015 – Year 2018 | -.0115 | .0034 | -3.365 | .0268 |
| Year 2016 – Year 2017 | -.0035 | .0032 | -1.095 | .9852 |
| Year 2016 – Year 2018 | -.0085 | .0035 | -2.430 | .3080 |
| Year 2017 – Year 2018 | -.0049 | .0036 | -1.365 | .9376 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 9 in Table 2 in the main text.

**Table S10a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 46.0429 | 2.7504 | 16.741 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.6712 | 0.5909 | -1.136 | .2561 |
| Year 2011 | -0.7548 | 0.5947 | -1.269 | .2045 |
| Year 2012 | -0.9633 | 0.5925 | -1.626 | .1041 |
| Year 2013 | -0.8046 | 0.6052 | -1.329 | .1838 |
| Year 2014 | 1.5855 | 0.6243 | 2.540 | .0111 |
| Year 2015 | 4.3447 | 0.6656 | 6.527 | .0000 |
| Year 2016 | 7.4787 | 0.7192 | 10.399 | .0000 |
| Year 2017 | 11.4309 | 0.8463 | 13.507 | .0000 |
| Year 2018 | 16.9306 | 1.0607 | 15.961 | .0000 |
| Opioid prescription rate | 0.0181 | 0.0336 | 0.537 | .5926 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0137 | 0.0199 | 0.687 | .4922 |
| Opioid prescription rate × Year 2011 | 0.0224 | 0.0201 | 1.116 | .2645 |
| Opioid prescription rate × Year 2012 | 0.0484 | 0.0198 | 2.448 | .0144 |
| Opioid prescription rate × Year 2013 | 0.0766 | 0.0201 | 3.814 | .0001 |
| Opioid prescription rate × Year 2014 | 0.0896 | 0.0205 | 4.373 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1252 | 0.0213 | 5.875 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1559 | 0.0220 | 7.084 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1972 | 0.0236 | 8.360 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2665 | 0.0263 | 10.143 | .0000 |
| Control variables |  |  |  |  |
| % children in poverty | 0.9388 | 0.0456 | 20.570 | .0000 |
| % owner-occupied housing units | -0.1913 | 0.0393 | -4.874 | .0000 |
| % Black among children | -0.1977 | 0.0227 | -8.719 | .0000 |
| % Latino among children | 0.0695 | 0.0208 | 3.347 | .0008 |
| % foreign-born among persons | -0.6767 | 0.0394 | -17.182 | .0000 |
| % children among persons | -1.0543 | 0.1188 | -8.874 | .0000 |
| % elderly (≥ age 65) among persons | -0.3645 | 0.1047 | -3.482 | .0005 |
| % male among adults aged 20-64 | 0.5627 | 0.1670 | 3.370 | .0008 |
| % with disabilities among children | 2.7587 | 0.2135 | 12.924 | .0000 |
| % moved in one year among persons | 0.3339 | 0.0756 | 4.414 | .0000 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.8694 | 0.4269 | 2.037 | .0417 |
| Rural | -0.2359 | 0.6501 | -0.363 | .7168 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 361.388 | | | |
| State-level: Opioid prescription rate | 0.036 | | | |
| Observation-level | 95.911 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 10 in Table 3 in the main text.

**Table S10b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0137 | .0199 | -0.687 | .9996 |
| Year 2009 – Year 2011 | -.0224 | .0201 | -1.116 | .9831 |
| Year 2009 – Year 2012 | -.0484 | .0198 | -2.449 | .2972 |
| Year 2009 – Year 2013 | -.0766 | .0201 | -3.816 | .0054 |
| Year 2009 – Year 2014 | -.0896 | .0205 | -4.375 | .0005 |
| Year 2009 – Year 2015 | -.1252 | .0213 | -5.877 | <.0001 |
| Year 2009 – Year 2016 | -.1559 | .0220 | -7.087 | <.0001 |
| Year 2009 – Year 2017 | -.1972 | .0236 | -8.363 | <.0001 |
| Year 2009 – Year 2018 | -.2665 | .0263 | 10.145 | <.0001 |
| Year 2010 – Year 2011 | -.0087 | .0192 | -0.455 | 1.0000 |
| Year 2010 – Year 2012 | -.0347 | .0188 | -1.841 | .7085 |
| Year 2010 – Year 2013 | -.0629 | .0192 | -3.276 | .0358 |
| Year 2010 – Year 2014 | -.0759 | .0196 | -3.863 | .0045 |
| Year 2010 – Year 2015 | -.1115 | .0205 | -5.435 | <.0001 |
| Year 2010 – Year 2016 | -.1422 | .0213 | -6.685 | <.0001 |
| Year 2010 – Year 2017 | -.1835 | .0230 | -7.993 | <.0001 |
| Year 2010 – Year 2018 | -.2528 | .0258 | -9.811 | <.0001 |
| Year 2011 – Year 2012 | -.0260 | .0190 | -1.370 | .9362 |
| Year 2011 – Year 2013 | -.0542 | .0193 | -2.804 | .1354 |
| Year 2011 – Year 2014 | -.0672 | .0198 | -3.399 | .0240 |
| Year 2011 – Year 2015 | -.1028 | .0206 | -4.982 | <.0001 |
| Year 2011 – Year 2016 | -.1335 | .0214 | -6.242 | <.0001 |
| Year 2011 – Year 2017 | -.1748 | .0231 | -7.576 | <.0001 |
| Year 2011 – Year 2018 | -.2441 | .0259 | -9.432 | <.0001 |
| Year 2012 – Year 2013 | -.0282 | .0188 | -1.499 | .8929 |
| Year 2012 – Year 2014 | -.0412 | .0193 | -2.137 | .5015 |
| Year 2012 – Year 2015 | -.0768 | .0202 | -3.806 | .0056 |
| Year 2012 – Year 2016 | -.1075 | .0210 | -5.128 | <.0001 |
| Year 2012 – Year 2017 | -.1488 | .0227 | -6.550 | <.0001 |
| Year 2012 – Year 2018 | -.2181 | .0256 | -8.517 | <.0001 |
| Year 2013 – Year 2014 | -.0130 | .0195 | -0.665 | .9997 |
| Year 2013 – Year 2015 | -.0487 | .0204 | -2.384 | .3357 |
| Year 2013 – Year 2016 | -.0793 | .0211 | -3.751 | .0069 |
| Year 2013 – Year 2017 | -.1206 | .0228 | -5.282 | <.0001 |
| Year 2013 – Year 2018 | -.1899 | .0257 | -7.399 | <.0001 |
| Year 2014 – Year 2015 | -.0357 | .0207 | -1.722 | .7829 |
| Year 2014 – Year 2016 | -.0663 | .0214 | -3.099 | .0610 |
| Year 2014 – Year 2017 | -.1076 | .0230 | -4.680 | .0001 |
| Year 2014 – Year 2018 | -.1769 | .0257 | -6.878 | <.0001 |
| Year 2015 – Year 2016 | -.0306 | .0220 | -1.393 | .9295 |
| Year 2015 – Year 2017 | -.0720 | .0234 | -3.072 | .0660 |
| Year 2015 – Year 2018 | -.1412 | .0259 | -5.443 | <.0001 |
| Year 2016 – Year 2017 | -.0413 | .0238 | -1.736 | .7747 |
| Year 2016 – Year 2018 | -.1106 | .0262 | -4.226 | .0010 |
| Year 2017 – Year 2018 | -.0693 | .0268 | -2.582 | .2269 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 10 in Table 3 in the main text.

**Table S11a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 0-5 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 57.4998 | 3.3443 | 17.193 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.6013 | 0.7324 | -0.821 | .4117 |
| Year 2011 | -0.5291 | 0.7371 | -0.718 | .4729 |
| Year 2012 | -0.6761 | 0.7346 | -0.920 | .3574 |
| Year 2013 | -0.4063 | 0.7518 | -0.540 | .5889 |
| Year 2014 | 1.7814 | 0.7777 | 2.291 | .0220 |
| Year 2015 | 4.8594 | 0.8320 | 5.841 | .0000 |
| Year 2016 | 8.6753 | 0.9009 | 9.629 | .0000 |
| Year 2017 | 13.2813 | 1.0604 | 12.525 | .0000 |
| Year 2018 | 19.2241 | 1.3282 | 14.474 | .0000 |
| Opioid prescription rate | 0.0336 | 0.0424 | 0.794 | .4296 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0176 | 0.0246 | 0.714 | .4753 |
| Opioid prescription rate × Year 2011 | 0.0266 | 0.0248 | 1.074 | .2828 |
| Opioid prescription rate × Year 2012 | 0.0544 | 0.0244 | 2.228 | .0259 |
| Opioid prescription rate × Year 2013 | 0.0901 | 0.0248 | 3.636 | .0003 |
| Opioid prescription rate × Year 2014 | 0.1015 | 0.0253 | 4.009 | .0001 |
| Opioid prescription rate × Year 2015 | 0.1475 | 0.0264 | 5.593 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1907 | 0.0272 | 6.999 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2376 | 0.0292 | 8.133 | .0000 |
| Opioid prescription rate × Year 2018 | 0.3127 | 0.0326 | 9.598 | .0000 |
| Control variables |  |  |  |  |
| % children aged 0-5 in poverty | 1.1930 | 0.0482 | 24.748 | .0000 |
| % owner-occupied housing units | -0.1190 | 0.0465 | -2.561 | .0105 |
| % Black among children | -0.3047 | 0.0278 | 10.953 | .0000 |
| % Latino among children | 0.0402 | 0.0250 | 1.610 | .1075 |
| % foreign-born among persons | -0.8496 | 0.0486 | 17.480 | .0000 |
| % children among persons | -1.5079 | 0.1465 | 10.292 | .0000 |
| % elderly (≥ age 65) among persons | -0.3977 | 0.1304 | -3.050 | .0023 |
| % male among adults aged 20-64 | 0.6006 | 0.2036 | 2.949 | .0032 |
| % with disabilities among children | 3.6011 | 0.2634 | 13.674 | .0000 |
| % moved in one year among persons | 0.3254 | 0.0933 | 3.489 | .0005 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 1.2512 | 0.5342 | 2.342 | .0192 |
| Rural | -0.0903 | 0.8155 | -0.111 | .9118 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 532.476 | | | |
| State-level: Opioid prescription rate | 0.058 | | | |
| Observation-level | 148.165 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 0-5 child populations. This model is corresponding to the results of Model 11 in Table 3 in the main text.

**Table S11b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among Age 0-5 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0176 | .0246 | -0.714 | .9994 |
| Year 2009 – Year 2011 | -.0266 | .0248 | -1.074 | .9871 |
| Year 2009 – Year 2012 | -.0544 | .0244 | -2.229 | .4369 |
| Year 2009 – Year 2013 | -.0901 | .0248 | -3.638 | .0105 |
| Year 2009 – Year 2014 | -.1015 | .0253 | -4.011 | .0025 |
| Year 2009 – Year 2015 | -.1475 | .0264 | -5.595 | <.0001 |
| Year 2009 – Year 2016 | -.1907 | .0272 | -7.002 | <.0001 |
| Year 2009 – Year 2017 | -.2376 | .0292 | -8.135 | <.0001 |
| Year 2009 – Year 2018 | -.3127 | .0326 | -9.600 | <.0001 |
| Year 2010 – Year 2011 | -.0091 | .0237 | -0.383 | 1.0000 |
| Year 2010 – Year 2012 | -.0368 | .0233 | -1.582 | .8571 |
| Year 2010 – Year 2013 | -.0726 | .0237 | -3.061 | .0681 |
| Year 2010 – Year 2014 | -.0839 | .0243 | -3.457 | .0198 |
| Year 2010 – Year 2015 | -.1299 | .0254 | -5.116 | <.0001 |
| Year 2010 – Year 2016 | -.1731 | .0263 | -6.573 | <.0001 |
| Year 2010 – Year 2017 | -.2201 | .0284 | -7.738 | <.0001 |
| Year 2010 – Year 2018 | -.2951 | .0320 | -9.236 | <.0001 |
| Year 2011 – Year 2012 | -.0277 | .0234 | -1.186 | .9746 |
| Year 2011 – Year 2013 | -.0635 | .0238 | -2.664 | .1890 |
| Year 2011 – Year 2014 | -.0749 | .0244 | -3.066 | .0671 |
| Year 2011 – Year 2015 | -.1208 | .0255 | -4.735 | .0001 |
| Year 2011 – Year 2016 | -.1640 | .0265 | -6.198 | <.0001 |
| Year 2011 – Year 2017 | -.2110 | .0286 | -7.385 | <.0001 |
| Year 2011 – Year 2018 | -.2861 | .0321 | -8.917 | <.0001 |
| Year 2012 – Year 2013 | -.0358 | .0232 | -1.542 | .8751 |
| Year 2012 – Year 2014 | -.0471 | .0238 | -1.979 | .6140 |
| Year 2012 – Year 2015 | -.0931 | .0250 | -3.729 | .0075 |
| Year 2012 – Year 2016 | -.1363 | .0259 | -5.254 | <.0001 |
| Year 2012 – Year 2017 | -.1833 | .0281 | -6.515 | <.0001 |
| Year 2012 – Year 2018 | -.2583 | .0317 | -8.139 | <.0001 |
| Year 2013 – Year 2014 | -.0113 | .0241 | -0.470 | 1.0000 |
| Year 2013 – Year 2015 | -.0573 | .0252 | -2.271 | .4085 |
| Year 2013 – Year 2016 | -.1005 | .0262 | -3.841 | .0049 |
| Year 2013 – Year 2017 | -.1475 | .0283 | -5.215 | <.0001 |
| Year 2013 – Year 2018 | -.2225 | .0318 | -6.994 | <.0001 |
| Year 2014 – Year 2015 | -.0460 | .0256 | -1.793 | .7396 |
| Year 2014 – Year 2016 | -.0892 | .0265 | -3.365 | .0269 |
| Year 2014 – Year 2017 | -.1362 | .0285 | -4.777 | .0001 |
| Year 2014 – Year 2018 | -.2112 | .0319 | -6.620 | <.0001 |
| Year 2015 – Year 2016 | -.0432 | .0273 | -1.584 | .8559 |
| Year 2015 – Year 2017 | -.0902 | .0291 | -3.104 | .0603 |
| Year 2015 – Year 2018 | -.1652 | .0322 | -5.129 | <.0001 |
| Year 2016 – Year 2017 | -.0470 | .0295 | -1.590 | .8533 |
| Year 2016 – Year 2018 | -.1220 | .0325 | -3.753 | .0069 |
| Year 2017 – Year 2018 | -.0750 | .0334 | -2.250 | .4230 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 11 in Table 3 in the main text.

**Table S12a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 6-11 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 46.4495 | 2.8956 | 16.041 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.7477 | 0.6306 | -1.186 | .2358 |
| Year 2011 | -0.8751 | 0.6340 | -1.380 | .1675 |
| Year 2012 | -0.9109 | 0.6313 | -1.443 | .1491 |
| Year 2013 | -0.6976 | 0.6440 | -1.083 | .2788 |
| Year 2014 | 2.2054 | 0.6628 | 3.327 | .0009 |
| Year 2015 | 5.2881 | 0.7045 | 7.506 | .0000 |
| Year 2016 | 8.4263 | 0.7590 | 11.101 | .0000 |
| Year 2017 | 12.2653 | 0.8925 | 13.743 | .0000 |
| Year 2018 | 18.0814 | 1.1205 | 16.137 | .0000 |
| Opioid prescription rate | 0.0144 | 0.0351 | 0.411 | .6826 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0132 | 0.0214 | 0.616 | .5378 |
| Opioid prescription rate × Year 2011 | 0.0273 | 0.0215 | 1.271 | .2036 |
| Opioid prescription rate × Year 2012 | 0.0540 | 0.0211 | 2.557 | .0106 |
| Opioid prescription rate × Year 2013 | 0.0837 | 0.0214 | 3.903 | .0001 |
| Opioid prescription rate × Year 2014 | 0.1013 | 0.0219 | 4.635 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1375 | 0.0227 | 6.051 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1659 | 0.0234 | 7.078 | .0000 |
| Opioid prescription rate × Year 2017 | 0.2054 | 0.0251 | 8.177 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2835 | 0.0280 | 10.132 | .0000 |
| Control variables |  |  |  |  |
| % children aged 6-11 in poverty | 0.7705 | 0.0450 | 17.106 | .0000 |
| % owner-occupied housing units | -0.2642 | 0.0415 | -6.372 | .0000 |
| % Black among children | -0.1706 | 0.0239 | -7.131 | .0000 |
| % Latino among children | 0.1128 | 0.0221 | 5.108 | .0000 |
| % foreign-born among persons | -0.6997 | 0.0418 | 16.721 | .0000 |
| % children among persons | -0.9854 | 0.1251 | -7.875 | .0000 |
| % elderly (≥ age 65) among persons | -0.2618 | 0.1105 | -2.368 | .0179 |
| % male among adults aged 20-64 | 0.6520 | 0.1775 | 3.672 | .0002 |
| % with disabilities among children | 3.0316 | 0.2259 | 13.421 | .0000 |
| % moved in one year among persons | 0.2686 | 0.0804 | 3.342 | .0008 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 1.3357 | 0.4511 | 2.961 | .0031 |
| Rural | 0.2909 | 0.6841 | 0.425 | .6707 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 400.257 | | | |
| State-level: Opioid prescription rate | 0.039 | | | |
| Observation-level | 107.968 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 6-11 child populations. This model is corresponding to the results of Model 12 in Table 3 in the main text.

**Table S12b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among Age 6-11 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0132 | .0213 | -0.616 | .9998 |
| Year 2009 – Year 2011 | -.0273 | .0215 | -1.272 | .9598 |
| Year 2009 – Year 2012 | -.0540 | .0211 | -2.558 | .2385 |
| Year 2009 – Year 2013 | -.0837 | .0214 | -3.904 | .0039 |
| Year 2009 – Year 2014 | -.1013 | .0218 | -4.637 | .0002 |
| Year 2009 – Year 2015 | -.1375 | .0227 | -6.053 | <.0001 |
| Year 2009 – Year 2016 | -.1659 | .0234 | -7.080 | <.0001 |
| Year 2009 – Year 2017 | -.2054 | .0251 | -8.179 | <.0001 |
| Year 2009 – Year 2018 | -.2835 | .0280 | -10.134 | <.0001 |
| Year 2010 – Year 2011 | -.0142 | .0205 | -0.692 | .9996 |
| Year 2010 – Year 2012 | -.0409 | .0201 | -2.033 | .5754 |
| Year 2010 – Year 2013 | -.0705 | .0205 | -3.446 | .0205 |
| Year 2010 – Year 2014 | -.0881 | .0209 | -4.213 | .0011 |
| Year 2010 – Year 2015 | -.1243 | .0218 | -5.692 | <.0001 |
| Year 2010 – Year 2016 | -.1527 | .0226 | -6.753 | <.0001 |
| Year 2010 – Year 2017 | -.1922 | .0244 | -7.874 | <.0001 |
| Year 2010 – Year 2018 | -.2703 | .0274 | -9.863 | <.0001 |
| Year 2011 – Year 2012 | -.0267 | .0202 | -1.322 | .9488 |
| Year 2011 – Year 2013 | -.0564 | .0206 | -2.740 | .1583 |
| Year 2011 – Year 2014 | -.0740 | .0210 | -3.519 | .0160 |
| Year 2011 – Year 2015 | -.1102 | .0219 | -5.020 | <.0001 |
| Year 2011 – Year 2016 | -.1386 | .0227 | -6.099 | <.0001 |
| Year 2011 – Year 2017 | -.1781 | .0245 | -7.263 | <.0001 |
| Year 2011 – Year 2018 | -.2562 | .0275 | -9.312 | <.0001 |
| Year 2012 – Year 2013 | -.0297 | .0200 | -1.483 | .8992 |
| Year 2012 – Year 2014 | -.0473 | .0205 | -2.308 | .3841 |
| Year 2012 – Year 2015 | -.0834 | .0214 | -3.891 | .0041 |
| Year 2012 – Year 2016 | -.1118 | .0222 | -5.027 | <.0001 |
| Year 2012 – Year 2017 | -.1514 | .0241 | -6.276 | <.0001 |
| Year 2012 – Year 2018 | -.2295 | .0272 | -8.435 | <.0001 |
| Year 2013 – Year 2014 | -.0176 | .0207 | -0.849 | .9978 |
| Year 2013 – Year 2015 | -.0538 | .0217 | -2.483 | .2782 |
| Year 2013 – Year 2016 | -.0822 | .0224 | -3.665 | .0095 |
| Year 2013 – Year 2017 | -.1217 | .0242 | -5.022 | <.0001 |
| Year 2013 – Year 2018 | -.1998 | .0273 | -7.331 | <.0001 |
| Year 2014 – Year 2015 | -.0362 | .0220 | -1.646 | .8250 |
| Year 2014 – Year 2016 | -.0646 | .0227 | -2.846 | .1218 |
| Year 2014 – Year 2017 | -.1041 | .0244 | -4.267 | .0009 |
| Year 2014 – Year 2018 | -.1822 | .0273 | -6.673 | <.0001 |
| Year 2015 – Year 2016 | -.0284 | .0233 | -1.219 | .9695 |
| Year 2015 – Year 2017 | -.0679 | .0248 | -2.736 | .1601 |
| Year 2015 – Year 2018 | -.1460 | .0275 | -5.304 | <.0001 |
| Year 2016 – Year 2017 | -.0395 | .0252 | -1.568 | .8636 |
| Year 2016 – Year 2018 | -.1176 | .0278 | -4.238 | .0010 |
| Year 2017 – Year 2018 | -.0781 | .0285 | -2.744 | .1569 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 12 in Table 3 in the main text.

**Table S13a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Age 12-17 Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 35.2343 | 2.2780 | 15.467 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.6979 | 0.4762 | -1.465 | .1428 |
| Year 2011 | -0.8409 | 0.4797 | -1.753 | .0796 |
| Year 2012 | -1.2563 | 0.4782 | -2.627 | .0086 |
| Year 2013 | -1.3647 | 0.4884 | -2.794 | .0052 |
| Year 2014 | 0.5246 | 0.5034 | 1.042 | .2974 |
| Year 2015 | 2.4939 | 0.5358 | 4.654 | .0000 |
| Year 2016 | 4.8139 | 0.5782 | 8.326 | .0000 |
| Year 2017 | 8.0517 | 0.6801 | 11.840 | .0000 |
| Year 2018 | 12.6001 | 0.8514 | 14.800 | .0000 |
| Opioid prescription rate | -0.0019 | 0.0266 | -0.071 | .9435 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0087 | 0.0161 | 0.542 | .5875 |
| Opioid prescription rate × Year 2011 | 0.0112 | 0.0162 | 0.688 | .4916 |
| Opioid prescription rate × Year 2012 | 0.0345 | 0.0160 | 2.160 | .0308 |
| Opioid prescription rate × Year 2013 | 0.0563 | 0.0162 | 3.469 | .0005 |
| Opioid prescription rate × Year 2014 | 0.0669 | 0.0166 | 4.041 | .0001 |
| Opioid prescription rate × Year 2015 | 0.0934 | 0.0172 | 5.419 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1171 | 0.0178 | 6.580 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1575 | 0.0191 | 8.259 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2138 | 0.0212 | 10.082 | .0000 |
| Control variables |  |  |  |  |
| % children aged 12-17 in poverty | 0.5793 | 0.0387 | 14.983 | .0000 |
| % owner-occupied housing units | -0.3131 | 0.0321 | -9.767 | .0000 |
| % Black among children | -0.0908 | 0.0178 | -5.094 | .0000 |
| % Latino among children | 0.1046 | 0.0168 | 6.231 | .0000 |
| % foreign-born among persons | -0.5480 | 0.0319 | -17.192 | .0000 |
| % children among persons | -0.6237 | 0.0947 | -6.583 | .0000 |
| % elderly (≥ age 65) among persons | -0.2462 | 0.0828 | -2.973 | .0030 |
| % male among adults aged 20-64 | 0.3969 | 0.1370 | 2.898 | .0038 |
| % with disabilities among children | 2.1325 | 0.1722 | 12.383 | .0000 |
| % moved in one year among persons | 0.1921 | 0.0619 | 3.104 | .0019 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.1694 | 0.3419 | 0.495 | .6204 |
| Rural | -0.0061 | 0.5174 | -0.012 | .9906 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 248.898 | | | |
| State-level: Opioid prescription rate | 0.022 | | | |
| Observation-level | 62.662 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county age 12-17 child populations. This model is corresponding to the results of Model 13 in Table 3 in the main text.

**Table S13b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among Age 12-17 Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0087 | .0161 | -0.543 | .9999 |
| Year 2009 – Year 2011 | -.0112 | .0162 | -0.688 | .9996 |
| Year 2009 – Year 2012 | -.0345 | .0160 | -2.161 | .4844 |
| Year 2009 – Year 2013 | -.0563 | .0162 | -3.470 | .0189 |
| Year 2009 – Year 2014 | -.0669 | .0166 | -4.042 | .0022 |
| Year 2009 – Year 2015 | -.0934 | .0172 | -5.421 | <.0001 |
| Year 2009 – Year 2016 | -.1171 | .0178 | -6.582 | <.0001 |
| Year 2009 – Year 2017 | -.1575 | .0191 | -8.261 | <.0001 |
| Year 2009 – Year 2018 | -.2138 | .0212 | -10.084 | <.0001 |
| Year 2010 – Year 2011 | -.0024 | .0155 | -0.157 | 1.0000 |
| Year 2010 – Year 2012 | -.0258 | .0153 | -1.691 | .8009 |
| Year 2010 – Year 2013 | -.0476 | .0155 | -3.061 | .0681 |
| Year 2010 – Year 2014 | -.0582 | .0159 | -3.659 | .0097 |
| Year 2010 – Year 2015 | -.0847 | .0166 | -5.096 | <.0001 |
| Year 2010 – Year 2016 | -.1084 | .0172 | -6.293 | <.0001 |
| Year 2010 – Year 2017 | -.1487 | .0186 | -8.007 | <.0001 |
| Year 2010 – Year 2018 | -.2051 | .0208 | -9.852 | <.0001 |
| Year 2011 – Year 2012 | -.0234 | .0154 | -1.520 | .8845 |
| Year 2011 – Year 2013 | -.0452 | .0157 | -2.884 | .1106 |
| Year 2011 – Year 2014 | -.0558 | .0160 | -3.481 | .0182 |
| Year 2011 – Year 2015 | -.0823 | .0167 | -4.916 | <.0001 |
| Year 2011 – Year 2016 | -.1059 | .0173 | -6.112 | <.0001 |
| Year 2011 – Year 2017 | -.1463 | .0187 | -7.829 | <.0001 |
| Year 2011 – Year 2018 | -.2026 | .0209 | -9.686 | <.0001 |
| Year 2012 – Year 2013 | -.0218 | .0153 | -1.428 | .9186 |
| Year 2012 – Year 2014 | -.0324 | .0156 | -2.071 | .5483 |
| Year 2012 – Year 2015 | -.0589 | .0164 | -3.594 | .0123 |
| Year 2012 – Year 2016 | -.0826 | .0170 | -4.855 | .0001 |
| Year 2012 – Year 2017 | -.1229 | .0184 | -6.676 | <.0001 |
| Year 2012 – Year 2018 | -.1793 | .0207 | -8.654 | <.0001 |
| Year 2013 – Year 2014 | -.0106 | .0159 | -0.668 | .9997 |
| Year 2013 – Year 2015 | -.0371 | .0166 | -2.239 | .4298 |
| Year 2013 – Year 2016 | -.0608 | .0172 | -3.542 | .0148 |
| Year 2013 – Year 2017 | -.1011 | .0185 | -5.462 | <.0001 |
| Year 2013 – Year 2018 | -.1575 | .0208 | -7.583 | <.0001 |
| Year 2014 – Year 2015 | -.0265 | .0168 | -1.577 | .8592 |
| Year 2014 – Year 2016 | -.0502 | .0174 | -2.891 | .1086 |
| Year 2014 – Year 2017 | -.0906 | .0186 | -4.857 | .0001 |
| Year 2014 – Year 2018 | -.1469 | .0208 | -7.058 | <.0001 |
| Year 2015 – Year 2016 | -.0237 | .0178 | -1.327 | .9476 |
| Year 2015 – Year 2017 | -.0640 | .0190 | -3.373 | .0262 |
| Year 2015 – Year 2018 | -.1204 | .0210 | -5.734 | <.0001 |
| Year 2016 – Year 2017 | -.0404 | .0193 | -2.093 | .5329 |
| Year 2016 – Year 2018 | -.0967 | .0212 | -4.567 | .0002 |
| Year 2017 – Year 2018 | -.0563 | .0217 | -2.597 | .2194 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 13 in Table 3 in the main text.

**Table S14a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Male Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 44.7246 | 2.7104 | 16.501 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.5898 | 0.5812 | -1.015 | .3102 |
| Year 2011 | -0.5554 | 0.5851 | -0.949 | .3425 |
| Year 2012 | -0.6592 | 0.5830 | -1.131 | .2582 |
| Year 2013 | -0.3880 | 0.5955 | -0.651 | .5148 |
| Year 2014 | 1.9893 | 0.6142 | 3.239 | .0012 |
| Year 2015 | 4.6283 | 0.6549 | 7.067 | .0000 |
| Year 2016 | 7.6535 | 0.7077 | 10.815 | .0000 |
| Year 2017 | 11.3963 | 0.8327 | 13.686 | .0000 |
| Year 2018 | 16.7904 | 1.0437 | 16.088 | .0000 |
| Opioid prescription rate | 0.0187 | 0.0329 | 0.569 | .5710 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0117 | 0.0196 | 0.597 | .5502 |
| Opioid prescription rate × Year 2011 | 0.0226 | 0.0198 | 1.143 | .2531 |
| Opioid prescription rate × Year 2012 | 0.0469 | 0.0195 | 2.413 | .0159 |
| Opioid prescription rate × Year 2013 | 0.0766 | 0.0198 | 3.875 | .0001 |
| Opioid prescription rate × Year 2014 | 0.0882 | 0.0202 | 4.375 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1240 | 0.0210 | 5.912 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1519 | 0.0217 | 7.013 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1931 | 0.0232 | 8.318 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2594 | 0.0258 | 10.037 | .0000 |
| Control variables |  |  |  |  |
| % children in poverty | 0.9104 | 0.0449 | 20.262 | .0000 |
| % owner-occupied housing units | -0.1905 | 0.0386 | -4.930 | .0000 |
| % Black among children | -0.2003 | 0.0223 | -8.972 | .0000 |
| % Latino among children | 0.0678 | 0.0205 | 3.313 | .0009 |
| % foreign-born among persons | -0.6682 | 0.0388 | -17.239 | .0000 |
| % children among persons | -1.0359 | 0.1169 | -8.858 | .0000 |
| % elderly (≥ age 65) among persons | -0.3645 | 0.1030 | -3.538 | .0004 |
| % male among adults aged 20-64 | 0.5079 | 0.1643 | 3.091 | .0020 |
| % with disabilities among children | 2.6662 | 0.2101 | 12.692 | .0000 |
| % moved in one year among persons | 0.3499 | 0.0745 | 4.700 | .0000 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.7661 | 0.4202 | 1.823 | .0683 |
| Rural | -0.5120 | 0.6395 | -0.801 | .4234 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 351.067 | | | |
| State-level: Opioid prescription rate | 0.035 | | | |
| Observation-level | 92.904 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county male child populations. This model is corresponding to the results of Model 14 in Table 3 in the main text.

**Table S14b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among Male Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0117 | .0196 | -0.598 | .9999 |
| Year 2009 – Year 2011 | -.0226 | .0198 | -1.143 | .9801 |
| Year 2009 – Year 2012 | -.0469 | .0194 | -2.414 | .3180 |
| Year 2009 – Year 2013 | -.0766 | .0198 | -3.877 | .0043 |
| Year 2009 – Year 2014 | -.0882 | .0201 | -4.377 | .0005 |
| Year 2009 – Year 2015 | -.1240 | .0210 | -5.914 | <.0001 |
| Year 2009 – Year 2016 | -.1519 | .0216 | -7.016 | <.0001 |
| Year 2009 – Year 2017 | -.1931 | .0232 | -8.321 | <.0001 |
| Year 2009 – Year 2018 | -.2594 | .0258 | -10.039 | <.0001 |
| Year 2010 – Year 2011 | -.0109 | .0189 | -0.576 | .9999 |
| Year 2010 – Year 2012 | -.0352 | .0185 | -1.899 | .6698 |
| Year 2010 – Year 2013 | -.0649 | .0189 | -3.433 | .0215 |
| Year 2010 – Year 2014 | -.0765 | .0193 | -3.956 | .0031 |
| Year 2010 – Year 2015 | -.1123 | .0202 | -5.560 | <.0001 |
| Year 2010 – Year 2016 | -.1401 | .0209 | -6.696 | <.0001 |
| Year 2010 – Year 2017 | -.1814 | .0226 | -8.028 | <.0001 |
| Year 2010 – Year 2018 | -.2477 | .0254 | -9.771 | <.0001 |
| Year 2011 – Year 2012 | -.0243 | .0187 | -1.304 | .9529 |
| Year 2011 – Year 2013 | -.0540 | .0190 | -2.840 | .1239 |
| Year 2011 – Year 2014 | -.0656 | .0194 | -3.373 | .0261 |
| Year 2011 – Year 2015 | -.1014 | .0203 | -4.993 | <.0001 |
| Year 2011 – Year 2016 | -.1293 | .0210 | -6.143 | <.0001 |
| Year 2011 – Year 2017 | -.1705 | .0227 | -7.509 | <.0001 |
| Year 2011 – Year 2018 | -.2369 | .0255 | -9.302 | <.0001 |
| Year 2012 – Year 2013 | -.0296 | .0185 | -1.602 | .8476 |
| Year 2012 – Year 2014 | -.0413 | .0190 | -2.175 | .4744 |
| Year 2012 – Year 2015 | -.0771 | .0199 | -3.879 | .0043 |
| Year 2012 – Year 2016 | -.1049 | .0206 | -5.086 | <.0001 |
| Year 2012 – Year 2017 | -.1461 | .0224 | -6.537 | <.0001 |
| Year 2012 – Year 2018 | -.2125 | .0252 | -8.434 | <.0001 |
| Year 2013 – Year 2014 | -.0116 | .0192 | -0.604 | .9999 |
| Year 2013 – Year 2015 | -.0475 | .0201 | -2.362 | .3497 |
| Year 2013 – Year 2016 | -.0753 | .0208 | -3.618 | .0113 |
| Year 2013 – Year 2017 | -.1165 | .0225 | -5.183 | <.0001 |
| Year 2013 – Year 2018 | -.1829 | .0253 | -7.240 | <.0001 |
| Year 2014 – Year 2015 | -.0358 | .0204 | -1.757 | .7620 |
| Year 2014 – Year 2016 | -.0637 | .0211 | -3.023 | .0758 |
| Year 2014 – Year 2017 | -.1049 | .0226 | -4.634 | .0002 |
| Year 2014 – Year 2018 | -.1713 | .0253 | -6.765 | <.0001 |
| Year 2015 – Year 2016 | -.0278 | .0216 | -1.286 | .9568 |
| Year 2015 – Year 2017 | -.0691 | .0231 | -2.995 | .0820 |
| Year 2015 – Year 2018 | -.1354 | .0255 | -5.303 | <.0001 |
| Year 2016 – Year 2017 | -.0412 | .0234 | -1.759 | .7609 |
| Year 2016 – Year 2018 | -.1076 | .0258 | -4.176 | .0013 |
| Year 2017 – Year 2018 | -.0664 | .0264 | -2.513 | .2621 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 14 in Table 3 in the main text.

**Table S15a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County CMR Rates among Female Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 46.8510 | 2.7314 | 17.153 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.7575 | 0.5935 | -1.276 | .2019 |
| Year 2011 | -0.9221 | 0.5974 | -1.544 | .1227 |
| Year 2012 | -1.2937 | 0.5951 | -2.174 | .0297 |
| Year 2013 | -1.2526 | 0.6078 | -2.061 | .0394 |
| Year 2014 | 1.1409 | 0.6269 | 1.820 | .0688 |
| Year 2015 | 3.8791 | 0.6684 | 5.803 | .0000 |
| Year 2016 | 7.0411 | 0.7222 | 9.750 | .0000 |
| Year 2017 | 11.0924 | 0.8498 | 13.053 | .0000 |
| Year 2018 | 16.7329 | 1.0652 | 15.709 | .0000 |
| Opioid prescription rate | 0.0164 | 0.0339 | 0.484 | .6295 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0144 | 0.0200 | 0.721 | .4709 |
| Opioid prescription rate × Year 2011 | 0.0205 | 0.0202 | 1.015 | .3100 |
| Opioid prescription rate × Year 2012 | 0.0480 | 0.0199 | 2.416 | .0157 |
| Opioid prescription rate × Year 2013 | 0.0738 | 0.0202 | 3.660 | .0003 |
| Opioid prescription rate × Year 2014 | 0.0892 | 0.0206 | 4.340 | .0000 |
| Opioid prescription rate × Year 2015 | 0.1234 | 0.0214 | 5.764 | .0000 |
| Opioid prescription rate × Year 2016 | 0.1558 | 0.0221 | 7.053 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1959 | 0.0237 | 8.270 | .0000 |
| Opioid prescription rate × Year 2018 | 0.2692 | 0.0264 | 10.207 | .0000 |
| Control variables |  |  |  |  |
| % children in poverty | 0.9619 | 0.0458 | 21.000 | .0000 |
| % owner-occupied housing units | -0.1803 | 0.0394 | -4.578 | .0000 |
| % Black among children | -0.1968 | 0.0227 | -8.651 | .0000 |
| % Latino among children | 0.0730 | 0.0208 | 3.502 | .0005 |
| % foreign-born among persons | -0.6718 | 0.0395 | -16.993 | .0000 |
| % children among persons | -1.0583 | 0.1193 | -8.875 | .0000 |
| % elderly (≥ age 65) among persons | -0.3764 | 0.1051 | -3.580 | .0003 |
| % male among adults aged 20-64 | 0.6258 | 0.1676 | 3.733 | .0002 |
| % with disabilities among children | 2.7637 | 0.2143 | 12.897 | .0000 |
| % moved in one year among persons | 0.3141 | 0.0759 | 4.136 | .0000 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.9400 | 0.4285 | 2.194 | .0283 |
| Rural | 0.1279 | 0.6529 | 0.196 | .8447 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 355.846 | | | |
| State-level: Opioid prescription rate | 0.037 | | | |
| Observation-level | 96.665 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county female child populations. This model is corresponding to the results of Model 15 in Table 3 in the main text.

**Table S15b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County CMR Rates among Female Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0144 | .0200 | -0.721 | .9994 |
| Year 2009 – Year 2011 | -.0205 | .0202 | -1.016 | .9914 |
| Year 2009 – Year 2012 | -.0480 | .0198 | -2.417 | .3157 |
| Year 2009 – Year 2013 | -.0738 | .0201 | -3.662 | .0096 |
| Year 2009 – Year 2014 | -.0892 | .0206 | -4.342 | .0006 |
| Year 2009 – Year 2015 | -.1234 | .0214 | -5.766 | <.0001 |
| Year 2009 – Year 2016 | -.1558 | .0221 | -7.056 | <.0001 |
| Year 2009 – Year 2017 | -.1959 | .0237 | -8.273 | <.0001 |
| Year 2009 – Year 2018 | -.2692 | .0264 | -10.209 | <.0001 |
| Year 2010 – Year 2011 | -.0060 | .0192 | -0.314 | 1.0000 |
| Year 2010 – Year 2012 | -.0335 | .0189 | -1.772 | .7530 |
| Year 2010 – Year 2013 | -.0593 | .0193 | -3.079 | .0648 |
| Year 2010 – Year 2014 | -.0748 | .0197 | -3.794 | .0059 |
| Year 2010 – Year 2015 | -.1089 | .0206 | -5.286 | <.0001 |
| Year 2010 – Year 2016 | -.1414 | .0213 | -6.621 | <.0001 |
| Year 2010 – Year 2017 | -.1814 | .0230 | -7.871 | <.0001 |
| Year 2010 – Year 2018 | -.2548 | .0259 | -9.849 | <.0001 |
| Year 2011 – Year 2012 | -.0275 | .0190 | -1.444 | .9133 |
| Year 2011 – Year 2013 | -.0533 | .0194 | -2.749 | .1550 |
| Year 2011 – Year 2014 | -.0688 | .0198 | -3.467 | .0191 |
| Year 2011 – Year 2015 | -.1029 | .0207 | -4.966 | <.0001 |
| Year 2011 – Year 2016 | -.1353 | .0215 | -6.305 | <.0001 |
| Year 2011 – Year 2017 | -.1754 | .0232 | -7.572 | <.0001 |
| Year 2011 – Year 2018 | -.2488 | .0260 | -9.576 | <.0001 |
| Year 2012 – Year 2013 | -.0258 | .0189 | -1.368 | .9369 |
| Year 2012 – Year 2014 | -.0413 | .0193 | -2.134 | .5032 |
| Year 2012 – Year 2015 | -.0754 | .0203 | -3.720 | .0078 |
| Year 2012 – Year 2016 | -.1078 | .0210 | -5.126 | <.0001 |
| Year 2012 – Year 2017 | -.1479 | .0228 | -6.486 | <.0001 |
| Year 2012 – Year 2018 | -.2213 | .0257 | -8.608 | <.0001 |
| Year 2013 – Year 2014 | -.0155 | .0196 | -0.789 | .9987 |
| Year 2013 – Year 2015 | -.0496 | .0205 | -2.421 | .3136 |
| Year 2013 – Year 2016 | -.0820 | .0212 | -3.867 | .0045 |
| Year 2013 – Year 2017 | -.1221 | .0229 | -5.326 | <.0001 |
| Year 2013 – Year 2018 | -.1955 | .0258 | -7.587 | <.0001 |
| Year 2014 – Year 2015 | -.0341 | .0208 | -1.642 | .8275 |
| Year 2014 – Year 2016 | -.0666 | .0215 | -3.100 | .0609 |
| Year 2014 – Year 2017 | -.1066 | .0231 | -4.619 | .0002 |
| Year 2014 – Year 2018 | -.1800 | .0258 | -6.972 | <.0001 |
| Year 2015 – Year 2016 | -.0324 | .0221 | -1.470 | .9039 |
| Year 2015 – Year 2017 | -.0725 | .0235 | -3.084 | .0639 |
| Year 2015 – Year 2018 | -.1459 | .0260 | -5.601 | <.0001 |
| Year 2016 – Year 2017 | -.0401 | .0239 | -1.677 | .8086 |
| Year 2016 – Year 2018 | -.1135 | .0263 | -4.318 | .0007 |
| Year 2017 – Year 2018 | -.0734 | .0269 | -2.724 | .1646 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 15 in Table 3 in the main text.

**Table S16a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County Neglect Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 29.7571 | 2.2475 | 13.240 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.1038 | 0.4946 | -0.210 | .8338 |
| Year 2011 | -0.2673 | 0.4978 | -0.537 | .5913 |
| Year 2012 | -0.7513 | 0.4959 | -1.515 | .1298 |
| Year 2013 | -0.2549 | 0.5065 | -0.503 | .6148 |
| Year 2014 | 1.1371 | 0.5224 | 2.177 | .0295 |
| Year 2015 | 3.7230 | 0.5567 | 6.687 | .0000 |
| Year 2016 | 5.1581 | 0.6015 | 8.576 | .0000 |
| Year 2017 | 8.2024 | 0.7073 | 11.597 | .0000 |
| Year 2018 | 11.7223 | 0.8852 | 13.243 | .0000 |
| Opioid prescription rate | 0.0114 | 0.0242 | 0.470 | .6393 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0139 | 0.0167 | 0.831 | .4061 |
| Opioid prescription rate × Year 2011 | 0.0162 | 0.0168 | 0.965 | .3347 |
| Opioid prescription rate × Year 2012 | 0.0256 | 0.0165 | 1.546 | .1222 |
| Opioid prescription rate × Year 2013 | 0.0499 | 0.0168 | 2.970 | .0030 |
| Opioid prescription rate × Year 2014 | 0.0510 | 0.0171 | 2.973 | .0030 |
| Opioid prescription rate × Year 2015 | 0.0918 | 0.0178 | 5.149 | .0000 |
| Opioid prescription rate × Year 2016 | 0.0906 | 0.0184 | 4.923 | .0000 |
| Opioid prescription rate × Year 2017 | 0.1221 | 0.0197 | 6.191 | .0000 |
| Opioid prescription rate × Year 2018 | 0.1629 | 0.0219 | 7.432 | .0000 |
| Control variables |  |  |  |  |
| % children in poverty | 0.7444 | 0.0382 | 19.512 | .0000 |
| % owner-occupied housing units | -0.0402 | 0.0328 | -1.226 | .2204 |
| % Black among children | -0.1672 | 0.0189 | -8.827 | .0000 |
| % Latino among children | 0.0435 | 0.0174 | 2.503 | .0123 |
| % foreign-born among persons | -0.5307 | 0.0328 | -16.161 | .0000 |
| % children among persons | -0.6298 | 0.0992 | -6.347 | .0000 |
| % elderly (≥ age 65) among persons | -0.1784 | 0.0875 | -2.039 | .0415 |
| % male among adults aged 20-64 | 0.4983 | 0.1396 | 3.570 | .0004 |
| % with disabilities among children | 2.4072 | 0.1785 | 13.486 | .0000 |
| % moved in one year among persons | 0.4071 | 0.0632 | 6.441 | .0000 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.4711 | 0.3568 | 1.320 | .1867 |
| Rural | -0.9413 | 0.5431 | -1.733 | .0831 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 241.162 | | | |
| State-level: Opioid prescription rate | 0.016 | | | |
| Observation-level | 67.201 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 16 in Table 3 in the main text.

**Table S16b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County Neglect Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0139 | .0167 | -0.831 | .9981 |
| Year 2009 – Year 2011 | -.0162 | .0168 | -0.965 | .9941 |
| Year 2009 – Year 2012 | -.0256 | .0165 | -1.546 | .8732 |
| Year 2009 – Year 2013 | -.0499 | .0168 | -2.971 | .0876 |
| Year 2009 – Year 2014 | -.0510 | .0171 | -2.974 | .0869 |
| Year 2009 – Year 2015 | -.0918 | .0178 | -5.151 | <.0001 |
| Year 2009 – Year 2016 | -.0906 | .0184 | -4.924 | <.0001 |
| Year 2009 – Year 2017 | -.1221 | .0197 | -6.192 | <.0001 |
| Year 2009 – Year 2018 | -.1629 | .0219 | -7.433 | <.0001 |
| Year 2010 – Year 2011 | -.0024 | .0160 | -0.147 | 1.0000 |
| Year 2010 – Year 2012 | -.0117 | .0158 | -0.742 | .9992 |
| Year 2010 – Year 2013 | -.0360 | .0161 | -2.243 | .4271 |
| Year 2010 – Year 2014 | -.0371 | .0164 | -2.257 | .4179 |
| Year 2010 – Year 2015 | -.0780 | .0172 | -4.541 | .0003 |
| Year 2010 – Year 2016 | -.0768 | .0178 | -4.314 | .0007 |
| Year 2010 – Year 2017 | -.1082 | .0192 | -5.640 | <.0001 |
| Year 2010 – Year 2018 | -.1491 | .0215 | -6.935 | <.0001 |
| Year 2011 – Year 2012 | -.0094 | .0159 | -0.589 | .9999 |
| Year 2011 – Year 2013 | -.0337 | .0162 | -2.084 | .5389 |
| Year 2011 – Year 2014 | -.0347 | .0165 | -2.101 | .5267 |
| Year 2011 – Year 2015 | -.0756 | .0173 | -4.380 | .0005 |
| Year 2011 – Year 2016 | -.0744 | .0179 | -4.160 | .0014 |
| Year 2011 – Year 2017 | -.1058 | .0193 | -5.490 | <.0001 |
| Year 2011 – Year 2018 | -.1467 | .0216 | -6.797 | <.0001 |
| Year 2012 – Year 2013 | -.0243 | .0157 | -1.547 | .8731 |
| Year 2012 – Year 2014 | -.0254 | .0161 | -1.574 | .8605 |
| Year 2012 – Year 2015 | -.0663 | .0169 | -3.923 | .0036 |
| Year 2012 – Year 2016 | -.0650 | .0175 | -3.711 | .0080 |
| Year 2012 – Year 2017 | -.0965 | .0190 | -5.085 | <.0001 |
| Year 2012 – Year 2018 | -.1374 | .0213 | -6.434 | <.0001 |
| Year 2013 – Year 2014 | -.0011 | .0163 | -0.064 | 1.0000 |
| Year 2013 – Year 2015 | -.0419 | .0171 | -2.456 | .2933 |
| Year 2013 – Year 2016 | -.0407 | .0177 | -2.302 | .3877 |
| Year 2013 – Year 2017 | -.0721 | .0191 | -3.781 | .0062 |
| Year 2013 – Year 2018 | -.1130 | .0214 | -5.281 | <.0001 |
| Year 2014 – Year 2015 | -.0409 | .0173 | -2.358 | .3517 |
| Year 2014 – Year 2016 | -.0397 | .0179 | -2.215 | .4464 |
| Year 2014 – Year 2017 | -.0711 | .0192 | -3.698 | .0084 |
| Year 2014 – Year 2018 | -.1120 | .0215 | -5.217 | <.0001 |
| Year 2015 – Year 2016 | .0012 | .0184 | 0.067 | 1.0000 |
| Year 2015 – Year 2017 | -.0302 | .0196 | -1.542 | .8752 |
| Year 2015 – Year 2018 | -.0711 | .0217 | -3.279 | .0354 |
| Year 2016 – Year 2017 | -.0314 | .0199 | -1.579 | .8587 |
| Year 2016 – Year 2018 | -.0723 | .0219 | -3.305 | .0326 |
| Year 2017 – Year 2018 | -.0409 | .0225 | -1.820 | .7223 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 16 in Table 3 in the main text.

**Table S17a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County Physical Abuse Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 12.2112 | 1.3350 | 9.147 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | 0.0322 | 0.2359 | 0.136 | .8914 |
| Year 2011 | -0.0276 | 0.2374 | -0.116 | .9075 |
| Year 2012 | 0.2979 | 0.2365 | 1.260 | .2079 |
| Year 2013 | 0.1166 | 0.2416 | 0.483 | .6293 |
| Year 2014 | 0.0837 | 0.2492 | 0.336 | .7369 |
| Year 2015 | 1.0378 | 0.2657 | 3.906 | .0001 |
| Year 2016 | 2.5000 | 0.2871 | 8.707 | .0000 |
| Year 2017 | 3.3593 | 0.3381 | 9.937 | .0000 |
| Year 2018 | 4.6019 | 0.4243 | 10.846 | .0000 |
| Opioid prescription rate | -0.0326 | 0.0179 | -1.819 | .0735 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0027 | 0.0080 | 0.345 | .7301 |
| Opioid prescription rate × Year 2011 | 0.0066 | 0.0080 | 0.821 | .4118 |
| Opioid prescription rate × Year 2012 | 0.0262 | 0.0079 | 3.326 | .0009 |
| Opioid prescription rate × Year 2013 | 0.0282 | 0.0080 | 3.524 | .0004 |
| Opioid prescription rate × Year 2014 | 0.0166 | 0.0082 | 2.034 | .0420 |
| Opioid prescription rate × Year 2015 | 0.0394 | 0.0085 | 4.632 | .0000 |
| Opioid prescription rate × Year 2016 | 0.0701 | 0.0088 | 7.982 | .0000 |
| Opioid prescription rate × Year 2017 | 0.0800 | 0.0094 | 8.490 | .0000 |
| Opioid prescription rate × Year 2018 | 0.0960 | 0.0105 | 9.140 | .0000 |
| Control variables |  |  |  |  |
| % children in poverty | 0.2034 | 0.0182 | 11.165 | .0000 |
| % owner-occupied housing units | -0.0007 | 0.0157 | -0.046 | .9631 |
| % Black among children | -0.0198 | 0.0091 | -2.181 | .0292 |
| % Latino among children | 0.0393 | 0.0083 | 4.735 | .0000 |
| % foreign-born among persons | -0.1195 | 0.0157 | -7.601 | .0000 |
| % children among persons | -0.3479 | 0.0474 | -7.333 | .0000 |
| % elderly (≥ age 65) among persons | -0.1498 | 0.0418 | -3.585 | .0003 |
| % male among adults aged 20-64 | -0.1726 | 0.0667 | -2.590 | .0096 |
| % with disabilities among children | 0.7651 | 0.0852 | 8.984 | .0000 |
| % moved in one year among persons | 0.1490 | 0.0302 | 4.940 | .0000 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | -0.6579 | 0.1704 | -3.860 | .0001 |
| Rural | -0.2253 | 0.2593 | -0.869 | .3850 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 87.141 | | | |
| State-level: Opioid prescription rate | 0.013 | | | |
| Observation-level | 15.283 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 17 in Table 3 in the main text.

**Table S17b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County Physical Abuse Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0028 | .0080 | -0.345 | 1.0000 |
| Year 2009 – Year 2011 | -.0066 | .0080 | -0.821 | .9983 |
| Year 2009 – Year 2012 | -.0263 | .0079 | -3.327 | .0304 |
| Year 2009 – Year 2013 | -.0283 | .0080 | -3.526 | .0156 |
| Year 2009 – Year 2014 | -.0166 | .0082 | -2.035 | .5743 |
| Year 2009 – Year 2015 | -.0394 | .0085 | -4.634 | .0002 |
| Year 2009 – Year 2016 | -.0701 | .0088 | -7.985 | <.0001 |
| Year 2009 – Year 2017 | -.0800 | .0094 | -8.493 | <.0001 |
| Year 2009 – Year 2018 | -.0960 | .0105 | -9.143 | <.0001 |
| Year 2010 – Year 2011 | -.0038 | .0077 | -0.501 | 1.0000 |
| Year 2010 – Year 2012 | -.0235 | .0075 | -3.124 | .0568 |
| Year 2010 – Year 2013 | -.0255 | .0077 | -3.328 | .0303 |
| Year 2010 – Year 2014 | -.0139 | .0078 | -1.771 | .7537 |
| Year 2010 – Year 2015 | -.0367 | .0082 | -4.476 | .0003 |
| Year 2010 – Year 2016 | -.0674 | .0085 | -7.934 | <.0001 |
| Year 2010 – Year 2017 | -.0773 | .0092 | -8.423 | <.0001 |
| Year 2010 – Year 2018 | -.0933 | .0103 | -9.052 | <.0001 |
| Year 2011 – Year 2012 | -.0197 | .0076 | -2.598 | .2191 |
| Year 2011 – Year 2013 | -.0217 | .0077 | -2.810 | .1335 |
| Year 2011 – Year 2014 | -.0101 | .0079 | -1.274 | .9594 |
| Year 2011 – Year 2015 | -.0328 | .0082 | -3.985 | .0028 |
| Year 2011 – Year 2016 | -.0635 | .0085 | -7.442 | <.0001 |
| Year 2011 – Year 2017 | -.0734 | .0092 | -7.965 | <.0001 |
| Year 2011 – Year 2018 | -.0894 | .0104 | -8.642 | <.0001 |
| Year 2012 – Year 2013 | -.0020 | .0075 | -0.266 | 1.0000 |
| Year 2012 – Year 2014 | .0096 | .0077 | 1.251 | .9639 |
| Year 2012 – Year 2015 | -.0132 | .0081 | -1.634 | .8315 |
| Year 2012 – Year 2016 | -.0439 | .0084 | -5.242 | <.0001 |
| Year 2012 – Year 2017 | -.0538 | .0091 | -5.921 | <.0001 |
| Year 2012 – Year 2018 | -.0698 | .0102 | -6.811 | <.0001 |
| Year 2013 – Year 2014 | .0116 | .0078 | 1.491 | .8962 |
| Year 2013 – Year 2015 | -.0112 | .0082 | -1.371 | .9359 |
| Year 2013 – Year 2016 | -.0419 | .0084 | -4.961 | <.0001 |
| Year 2013 – Year 2017 | -.0518 | .0091 | -5.671 | <.0001 |
| Year 2013 – Year 2018 | -.0678 | .0103 | -6.601 | <.0001 |
| Year 2014 – Year 2015 | -.0228 | .0083 | -2.756 | .1524 |
| Year 2014 – Year 2016 | -.0535 | .0085 | -6.263 | <.0001 |
| Year 2014 – Year 2017 | -.0634 | .0092 | -6.898 | <.0001 |
| Year 2014 – Year 2018 | -.0794 | .0103 | -7.719 | <.0001 |
| Year 2015 – Year 2016 | -.0307 | .0088 | -3.499 | .0172 |
| Year 2015 – Year 2017 | -.0406 | .0094 | -4.339 | .0006 |
| Year 2015 – Year 2018 | -.0566 | .0104 | -5.459 | <.0001 |
| Year 2016 – Year 2017 | -.0099 | .0095 | -1.040 | .9898 |
| Year 2016 – Year 2018 | -.0259 | .0105 | -2.477 | .2815 |
| Year 2017 – Year 2018 | -.0160 | .0107 | -1.495 | .8945 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 17 in Table 3 in the main text.

**Table S18a.** Adjusted Multilevel Model of County Opioid Prescription Rates on County Sexual Abuse Report Rates among All Children, U.S. Counties, 2009-2018.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fixed effects** | **Coefficient** | **Standard error** | **t** | **p** |
| Intercept | 3.7457 | 0.3382 | 11.076 | .0000 |
| Year fixed effects |  |  |  |  |
| Year 2009 | reference |  |  |  |
| Year 2010 | -0.0345 | 0.0632 | -0.546 | .5853 |
| Year 2011 | -0.2140 | 0.0636 | -3.367 | .0008 |
| Year 2012 | -0.1407 | 0.0633 | -2.222 | .0263 |
| Year 2013 | -0.2540 | 0.0647 | -3.927 | .0001 |
| Year 2014 | -0.3092 | 0.0667 | -4.634 | .0000 |
| Year 2015 | -0.1910 | 0.0711 | -2.684 | .0073 |
| Year 2016 | 0.0057 | 0.0769 | 0.075 | .9406 |
| Year 2017 | 0.2168 | 0.0904 | 2.398 | .0165 |
| Year 2018 | 0.5889 | 0.1132 | 5.201 | .0000 |
| Opioid prescription rate | 0.0012 | 0.0038 | 0.324 | .7471 |
| Opioid × Year interaction effects |  |  |  |  |
| Opioid prescription rate × Year 2010 | 0.0011 | 0.0021 | 0.526 | .5989 |
| Opioid prescription rate × Year 2011 | -0.0001 | 0.0021 | -0.027 | .9788 |
| Opioid prescription rate × Year 2012 | 0.0038 | 0.0021 | 1.803 | .0714 |
| Opioid prescription rate × Year 2013 | 0.0036 | 0.0021 | 1.665 | .0959 |
| Opioid prescription rate × Year 2014 | 0.0011 | 0.0022 | 0.505 | .6137 |
| Opioid prescription rate × Year 2015 | 0.0020 | 0.0023 | 0.869 | .3849 |
| Opioid prescription rate × Year 2016 | 0.0038 | 0.0024 | 1.621 | .1051 |
| Opioid prescription rate × Year 2017 | 0.0051 | 0.0025 | 2.043 | .0411 |
| Opioid prescription rate × Year 2018 | 0.0083 | 0.0028 | 2.946 | .0032 |
| Control variables |  |  |  |  |
| % children in poverty | 0.0819 | 0.0049 | 16.798 | .0000 |
| % owner-occupied housing units | -0.0008 | 0.0042 | -0.187 | .8520 |
| % Black among children | -0.0163 | 0.0024 | -6.717 | .0000 |
| % Latino among children | 0.0148 | 0.0022 | 6.654 | .0000 |
| % foreign-born among persons | -0.0652 | 0.0042 | -15.491 | .0000 |
| % children among persons | -0.1238 | 0.0127 | -9.749 | .0000 |
| % elderly (≥ age 65) among persons | -0.0438 | 0.0112 | -3.913 | .0001 |
| % male among adults aged 20-64 | 0.0655 | 0.0178 | 3.672 | .0002 |
| % with disabilities among children | 0.2106 | 0.0228 | 9.225 | .0000 |
| % moved in one year among persons | 0.0096 | 0.0081 | 1.184 | .2366 |
| Urbanicity |  |  |  |  |
| Large urban | reference |  |  |  |
| Small urban | 0.0944 | 0.0456 | 2.068 | .0386 |
| Rural | 0.2435 | 0.0695 | 3.503 | .0005 |
| **Random effect** | **Variance** | | | |
| State-level: Intercept | 5.5425 | | | |
| State-level: Opioid prescription rate | 0.0005 | | | |
| Observation-level | 1.0957 | | | |

Note. N = 6,151 county-year observations. All estimates were weighted by county child populations. This model is corresponding to the results of Model 18 in Table 3 in the main text.

**Table S18b.** Post Hoc Tests on Pairwise Comparisons between Adjusted Yearly Opioid Coefficients on County Sexual Abuse Report Rates among All Children.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contrast** | **Estimate** | **Standard error** | **t** | **p** |
| Year 2009 – Year 2010 | -.0011 | .0021 | -0.526 | 1.0000 |
| Year 2009 – Year 2011 | .0001 | .0022 | 0.027 | 1.0000 |
| Year 2009 – Year 2012 | -.0038 | .0021 | -1.804 | .7331 |
| Year 2009 – Year 2013 | -.0036 | .0021 | -1.666 | .8145 |
| Year 2009 – Year 2014 | -.0011 | .0022 | -0.505 | 1.0000 |
| Year 2009 – Year 2015 | -.0020 | .0023 | -0.869 | .9973 |
| Year 2009 – Year 2016 | -.0038 | .0024 | -1.621 | .8379 |
| Year 2009 – Year 2017 | -.0052 | .0025 | -2.044 | .5679 |
| Year 2009 – Year 2018 | -.0083 | .0028 | -2.947 | .0937 |
| Year 2010 – Year 2011 | .0012 | .0021 | 0.575 | .9999 |
| Year 2010 – Year 2012 | -.0027 | .0020 | -1.335 | .9456 |
| Year 2010 – Year 2013 | -.0025 | .0021 | -1.195 | .9732 |
| Year 2010 – Year 2014 | .0000 | .0021 | 0.008 | 1.0000 |
| Year 2010 – Year 2015 | -.0009 | .0022 | -0.391 | 1.0000 |
| Year 2010 – Year 2016 | -.0027 | .0023 | -1.184 | .9749 |
| Year 2010 – Year 2017 | -.0040 | .0025 | -1.642 | .8272 |
| Year 2010 – Year 2018 | -.0071 | .0028 | -2.597 | .2196 |
| Year 2011 – Year 2012 | -.0039 | .0020 | -1.908 | .6639 |
| Year 2011 – Year 2013 | -.0036 | .0021 | -1.759 | .7611 |
| Year 2011 – Year 2014 | -.0012 | .0021 | -0.550 | .9999 |
| Year 2011 – Year 2015 | -.0020 | .0022 | -0.923 | .9957 |
| Year 2011 – Year 2016 | -.0039 | .0023 | -1.693 | .7997 |
| Year 2011 – Year 2017 | -.0052 | .0025 | -2.112 | .5189 |
| Year 2011 – Year 2018 | -.0083 | .0028 | -3.013 | .0783 |
| Year 2012 – Year 2013 | .0002 | .0020 | 0.117 | 1.0000 |
| Year 2012 – Year 2014 | .0027 | .0021 | 1.314 | .9508 |
| Year 2012 – Year 2015 | .0018 | .0022 | 0.848 | .9978 |
| Year 2012 – Year 2016 | .0000 | .0022 | -0.001 | 1.0000 |
| Year 2012 – Year 2017 | -.0013 | .0024 | -0.552 | .9999 |
| Year 2012 – Year 2018 | -.0045 | .0027 | -1.630 | .8333 |
| Year 2013 – Year 2014 | .0025 | .0021 | 1.183 | .9750 |
| Year 2013 – Year 2015 | .0016 | .0022 | 0.731 | .9993 |
| Year 2013 – Year 2016 | -.0002 | .0023 | -0.105 | 1.0000 |
| Year 2013 – Year 2017 | -.0016 | .0024 | -0.646 | .9998 |
| Year 2013 – Year 2018 | -.0047 | .0027 | -1.712 | .7886 |
| Year 2014 – Year 2015 | -.0009 | .0022 | -0.395 | 1.0000 |
| Year 2014 – Year 2016 | -.0027 | .0023 | -1.184 | .9749 |
| Year 2014 – Year 2017 | -.0040 | .0025 | -1.646 | .8253 |
| Year 2014 – Year 2018 | -.0072 | .0028 | -2.607 | .2147 |
| Year 2015 – Year 2016 | -.0018 | .0024 | -0.780 | .9989 |
| Year 2015 – Year 2017 | -.0032 | .0025 | -1.266 | .9609 |
| Year 2015 – Year 2018 | -.0063 | .0028 | -2.268 | .4106 |
| Year 2016 – Year 2017 | -.0013 | .0025 | -0.526 | 1.0000 |
| Year 2016 – Year 2018 | -.0045 | .0028 | -1.593 | .8519 |
| Year 2017 – Year 2018 | -.0031 | .0029 | -1.087 | .9860 |

Estimate = difference in opioid coefficients between years (e.g., the opioid coefficient in 2009 – the opioid coefficient in 2010). We used the *emmeans* package (the *emtrends* function) for the post hoc tests on pairwise comparisons between yearly opioid coefficients. The p-values were adjusted by Tukey’s method to control the type I error rate by multiple comparisons. These post hoc tests are corresponding to the results of Model 18 in Table 3 in the main text.

**Guidance on How to Use the Enclosed Supplementary Materials for Replication**

This study used data linking multiple national datasets at the county level for counties in 50 States and DC from 2009 to 2018. The data had been constructed by a larger project funded by the Centers for Disease Control and Prevention (CDC), K01CE003229.

The purpose of this document is to provide guidance on how to use the enclosed supplementary materials (the SAS programs and the R script) to replicate this study’s data and analysis results.

The child maltreatment report data are available to eligible researchers with no cost. All other data are open to the public with no cost. Table S1 lists the datasets, their sources (locations), and the SAS programs for importing, managing, and merging the datasets.

**Table S1.** SAS Programs, Raw Datasets, and Sources to Construct the Present Study’s Data.

|  |  |  |
| --- | --- | --- |
| SAS Program | Dataset | Source |
| 01 CAN\_Input.sas | Child maltreatment report data | <https://www.ndacan.acf.hhs.gov/> |
| 02 Census\_Input.sas | Census ACS data | <https://www.socialexplorer.com/explore-tables> |
| 03 BIRTH\_Input.sas | Birth outcome data | <https://wonder.cdc.gov/> |
| 04 Opioid\_Input.sas | Opioid prescription rate data | <https://www.cdc.gov/drugoverdose/rxrate-maps/> |
| 05 NCHS\_RUC\_Input.sas | NCHS rural-urban codes | <https://www.cdc.gov/nchs/data_access/urban_rural.htm> |
| 06 USDA\_RUC\_Input.sas | USDA rural-urban codes | <https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx> |
| 07 Spatial\_Input.sas | Census gazetteer files | <https://www.census.gov/geographies/reference-files/time-series/geo/gazetteer-files.html> |
| 08 CHR\_Input.sas | County Health Rankings data | <https://www.countyhealthrankings.org/> |
| 09 Food\_Input.sas | Food insecurity data | <https://map.feedingamerica.org/> |
| 10 MHV\_Input.sas | MIECHV data | <https://mchb.hrsa.gov/programs-impact/programs/home-visiting/state-fact-sheets> |
| 11 NHV\_Input.sas | NHVRC data | <https://nhvrc.org/yearbook/2020-yearbook/> |
| 12 Grand\_Merge.sas | This program merges all datasets and constructs analysis data. | |

After obtaining the raw datasets, running all enclosed SAS programs from “01 CAN\_Input.sas” to “12 Grand\_Merge.sas” will produce the analysis data (“CDCK01County\_Census2.sas7bdat”). The “Dataset Contents.htm” reports the summary information about the contents of the analysis data, including the variables’ names and descriptions.

After constructing the analysis data, one can use the enclosed R script (“CDCK01Analysis\_Opioid\_year\_interaction2.R”) to replicate this study’s analysis results.

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