# California has changed social norms, dramatically reducing smoking behavior and lung cancer mortality

The rapid rise in the dependency on cigarette smoking in the United States occurred in the first half of the 20th century fueled by large mass media marketing campaigns and the provision of free cigarettes to troops during world wars Lung cancer rates also rose rapidly and the attributable fraction caused by smoking was over 90% with a lag period of 16 years. Lung cancer is modeled well by the duration of smoking (initiation, cessation) as well as it's intensity (average daily consumption) For those who start smoking, half of the health consequences experienced by continuing smokers will be avoided if smoking cessation occurs prior to age 50 years.

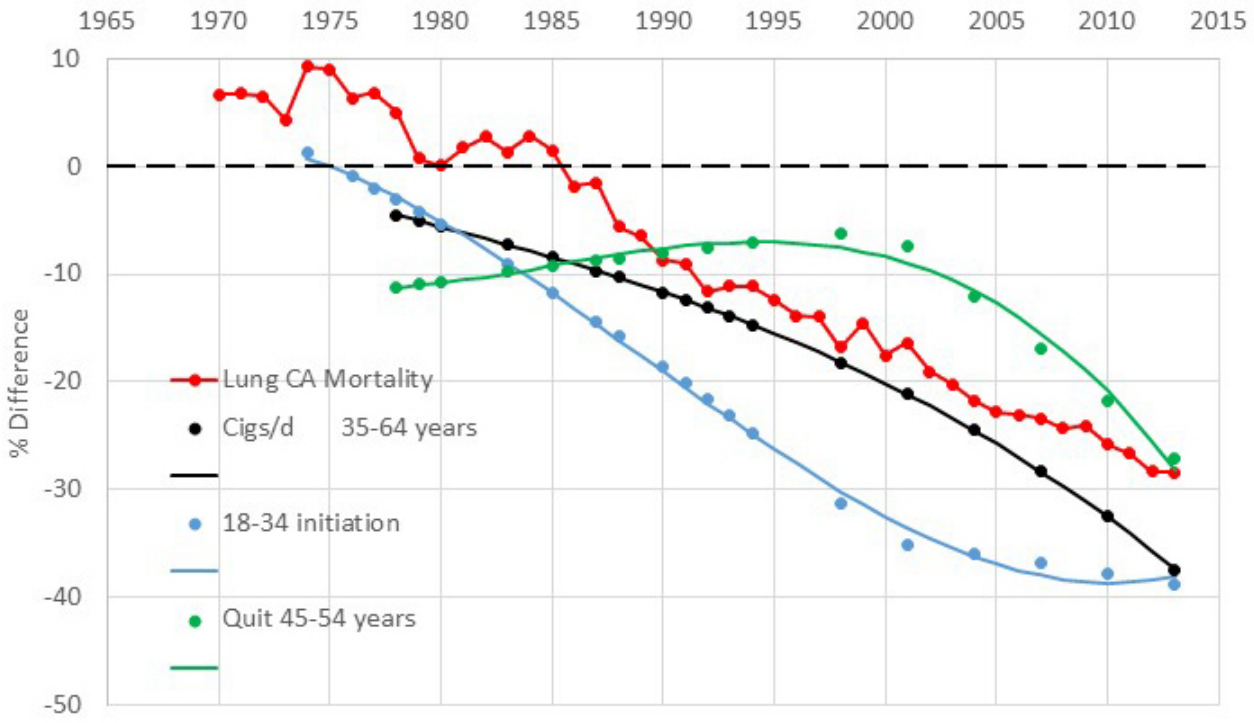


Fig. 1. Trend in the Percentage Difference in Lung Cancer Rates and Smoking Behavior Metrics in California vs Rest of United States. 1970s to 2012-14.

The US public health authorities accepted that smoking caused lung cancer in 1964 and states began taking action to reduce cigarette smoking. California, which at the time, had a higher cigarette consumption than the rest of the nation, was one of the first to implement aggressive tobacco control policies starting with a large tax increase in 1968. In 1989 it implemented the first comprehensive tobacco control program with an aim to change the social norms around smoking.

In 1994 it led the world with statewide laws for smoke-free workplace and smoke-free schools law. This paper considers the three critical smoking behaviors (initiation, intensity, cessation) that can impact lung cancer.We used the national Surveillance, Epidemiology, and End Results (SEER) Program to obtain lung cancer mortality data from 1970-2013 separately for California and the rest of the nation. Using the 1974-2014 National Health Interview Surveys (n=962,174), we used regression models to examine trends in the three smoking behaviors that influence lung cancer (*how many people start, the amount they smoke, and the age they quit*) again for California separately from the rest of the US.

Lung cancer mortality was higher in California than the Rest of the US from the start of this series in1970 until 1986 (Fig. 1). However, 1987 through to our last data point in 2013, California lung cancer mortality rates declined consistently more than in the Rest of the US, with the gap increasing at a consistent rate of .0.93%/year so that by 2012-13, California rates were 28% lower and by 2020 this gap was expected to be 35%.

Starting in 1974, smoking initiation was increasingly lower in California with a 20% gap by 1990, a gap in the mid-30s by 2000 and a stable gap ~40% from 2005-2014 when it was 18.6% in California vs 31.4 % in Rest of US (Tab. 1). For cessation in the key age group of 45-54 years California had a 10% advantage from 1978 through 2003, after which the gap widened further to over 25%. In 2012-14, 56.3% of ever-smokers in this age group had quit in California vs 46.4% in Rest of US. On intensity of smoking in the 35-64-year age group, Californian smokers consumed fewer cigarettes/day in 1978 and this gap widened consistently to ~40% in 2012-14 when the rate in California was 8.7 cigarettes/day vs 12.9 cigarettes/day in Rest of US.

| Smoking Behavior Metric | Age Group | 1970s estimate | | 2012-14 estimate | |
|---|---|---|---|---|---|
| | | California | Rest of US | California | Rest of US |
| Initiation (ever smoking) | 18-34 yrs | ~48% | ~48% | **18.6%** (16.8,20.3) | **31.4%** (30.4-32.3) |
| Smoking Intensity in working age population | 18-34 yrs | ~18 cigs/d | ~18 cigs/d | **6.3** cigs/d (5.6,7.0) | **9.2**c/d (9.0,9.5) |
| | 35-64 yrs | ~23 cigs/d | ~23 cigs/d | **8.7** cigs/d (8.1,9.3) | **12.9** c/d (12.7-13.2) |
| Smoking Cessation (Quit Ratio= former/ever smokers) | Among 30-39 yrs | ~30% | ~30% | **45.7%** (41.1-50.4) | **37.8%** (36.1-39.4) |
| | Among 45-54 yrs | ~31% | ~31% | **56.3%** (51.6,-60.9) | **46.4%** (44.7,48.1) |
| | Among 60-69 yrs | ~50% | ~50% | ~65% (63.3-66.5) | ~65% (63.3-66.5) |

Tab. 1. Smoking Behavior Estimates for California and the Rest of the United States in 1970s and 2012-14

In the 1970s, there were relatively small differences in key metrics of smoking behavior between California and the Rest of the US and lung cancer mortality was higher in California. However, gaps widened dramatically by 2012-14 when California was much lower on each important smoking metric as well as lung cancer mortality. Changes that were similar to the size of the drop

in lung cancer mortality were that California youth were much less likely to take up smoking in the first place, and smokers in California decreased their average daily consumption. The real California advantage on smoking cessation did not become apparent until after 2005 and so is an unlikely explanation for the much lower lung cancer mortality in California. The advantages that California has on smoking behavior suggest that the lung cancer gap will continue to widen into the foreseeable future.

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## Publication

Trends in Lung Cancer and Cigarette Smoking: California Compared to the Rest of the United States.
Pierce JP, Shi Y, McMenamin SB, Benmarhnia T, Trinidad DR, Strong DR, White MM, Kealey S, Hendrickson EM, Stone MD, Villasenor A, Kwong S, Zhang X, Messer K
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