

Maximizing the Impact of Tobacco 21 Laws Across the United States

 See also Macinko et al., p. 669.

Tobacco 21, the prohibition of retailers from selling cigarettes, cigars, chewing tobacco, powdered tobacco, electronic cigarettes, and other tobacco products to customers younger than 21 years, has become an increasingly popular tobacco-control strategy.¹ As of early 2018, Tobacco 21 laws exist in almost 300 separate locations across 19 different states and cover more than 25% of the US population. In this issue of *AJPH*, Macinko et al. (p. 669) found that adolescent tobacco use declined slightly in New York City after the city raised the minimum legal sales age to 21 years. Although New York City already had relatively low rates of tobacco use for adolescents, rates continued to decline during the 18 months after implementation of the new law. Macinko et al. also found that across New York State and in four comparator cities in Florida, rates of adolescent tobacco use fell at a steeper rate than that seen in New York City. Put another way, those comparator locations tended to catch up to New York City in terms of adolescent tobacco use during the short study period.

Denormalization of tobacco use in society, higher taxes on tobacco products, smoke-free laws, local point-of-sale restrictions, tobacco-control campaigns, and tobacco-cessation programs with coverage for tobacco-dependence treatment medications all play a part in the continued downward trend of adolescent and adult tobacco use in the United States.²

MODELS AND REAL-WORLD TIMING

According to the National Academies of Science, Tobacco 21 laws can be a significant contributor to an effective tobacco-control landscape, with an estimated 25% reduction in tobacco use by those aged 15 to 17 years and a 12% reduction in population tobacco use over time.³

Although those estimates were determined by mathematical models, more recent data from Needham, Massachusetts demonstrated a 47% reduction in high school smoking five years after implementation of the Tobacco 21 law.⁴ From the mathematical models and from the real-world data, time remains the first necessary component for realizing the full benefits of Tobacco 21 laws. Social norms and culture change in high schools may take time because of the behavioral-modeling tendency of 9th and 10th graders to imitate what they see in their 11th and 12th grade schoolmates.

ADEQUATE ENFORCEMENT

Adequate enforcement is a critical component of Tobacco 21 laws.³ Unfortunately, in New York City, as Macinko et al. showed, adolescent purchasers reported no increase in ID checks after the Tobacco 21 law came into effect. Previous research

looking at enforcement of the minimum sales age of 18 years may be relevant for Tobacco 21.

Best practices for enforcement include having an articulated plan for enforcement, giving enforcement responsibility to a single agency, conducting ongoing compliance check inspections, allocating funding for enforcement inspections, prosecuting violators, setting high penalties for violations, and practicing effective merchant education.⁵ Success in Needham was achieved through a combination of these best practices for enforcement. Most notable among them was a compliance check inspection program with steep penalties and a six-month suspension of the tobacco license for a subsequent violation. The news of a license suspension in Needham spread immediately to all retailers in town, and subsequent infractions dropped to near zero. Because tobacco sales to those younger than 21 years comprise only about 2% of total retail tobacco sales, merchants will not want to risk losing all tobacco sales for a few illegal transactions.⁶ Enforcing Tobacco 21 should be easier than enforcing Tobacco 18 for a few key reasons. First, in New York and many other states, the orientation of the driver's license changes when the bearer turns 21, making an underage purchaser easier to identify. Second, compliance check

personnel who are aged 18 to 20 years are easier to recruit than those aged 17 years, who require parental consent. Third, when the minimum legal age of sale for tobacco and alcohol are the same, the commercial and societal norms of that single age become mutually reinforcing.

CAP AND WINNOW

However, New York City and other densely populated cities face the particular challenge of too many tobacco retailers within easy access of high school students. Finding a noncompliant retailer in the neighborhood is much easier when there are 10 retailers on the way home from school. The imperative of adequate enforcement increases as retail density increases because potential access to tobacco products is greater in these locations. The penalty in New York City for first-offense tobacco sales to those younger than 21 years is \$1000; it is \$2000 with potential revocation of tobacco license for a second offense occurring within three years.

It is unclear in how many neighborhoods and in what percentage of retail establishments those New York City fines have been levied. For multiple repeat offenses, the only acceptable remedy is revocation of the tobacco license. Supporting this hard-line approach is the fact that a single convenience store could supply an entire high school with tobacco by selling the product to those aged 18 and 19 years

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who then resell it in school. Tobacco-control programs should retire those revoked licenses so they cannot be reissued. This strategy, known as “cap and winnow” could eventually lead to lower youth access for tobacco products even in high-density tobacco retail neighborhoods.

SEVEN RECOMMENDATIONS

On the basis of the study of Macinko et al. and the existing Tobacco 21 literature, I offer seven recommendations to help maximize Tobacco 21 as an effective tobacco-control strategy:

1. Increase random compliance check inspections by having those aged 18 to 20 years attempt to buy tobacco products multiple times per year at each location where tobacco is sold.
2. Use epidemiological mapping to track where illegal sales are occurring and where fines are being imposed to identify high-priority locations to crack down on youth access to tobacco, especially in areas where tobacco retail density is high.
3. Levy maximum penalties for each infraction to help deter illegal sales and to defray the cost of enforcement activities.
4. Publicize fines and license suspensions so that all tobacco retailers understand the severe consequences of noncompliance with Tobacco 21 laws.
5. Revoke and then retire the license to sell tobacco when multiple infractions occur within a defined period.
6. Pursue maximum criminal penalties for illicit tobacco suppliers and for selling illegal loose single tobacco products.
7. Continue studying Tobacco 21 laws in real-world settings to optimize effectiveness for different geographic and regulatory contexts.

ACROSS THE NATION

The Macinko et al. study has important implications for New York City’s tobacco-control efforts and for improving the effectiveness of the wave of Tobacco 21 legislation that is making its way through towns, cities, counties, and states across the nation. **AJPH**

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Local Health Departments’ Role in Nonprofit Hospitals’ Community Health Needs Assessment

 See also Carlton and Singh, p. 676.

Health care and public health industries have historically operated in siloes, with distinct and often contradictory approaches to health. Public health has traditionally focused on ensuring healthy outcomes and their equitable distribution in population subgroups through essential public health services consistent with public health agency mandates and community priorities.¹ By contrast, health care providers have arguably operated as part of an industrial medical complex focused primarily on treatment

and cure rather than prevention. Several recent developments have converged to encourage health care and public health to focus on population health, leading to cooperation between strange bedfellows toward this common goal.¹

HISTORICAL INTEGRATION

A growing consensus that business as usual is unacceptable has arisen in both the public

health and the health care sectors. Nonprofit hospitals are expected to provide community benefits to maintain their tax-exempt status. Certain provisions of the Patient Protection and Affordable Care Act require these hospitals to complete a community health needs assessment (CHNA) incorporating input from a broad

range of community stakeholders, including local health departments (LHDs).

Public health accreditation board accreditation standards require that LHDs complete a community health assessment in collaboration with community partners, for which the CHNA can be an important source of data. Public health accreditation board accreditation and other national initiatives, such as Public Health 3.0, are increasingly challenging public health agencies to be collaborative and accountable in their practice and services. These

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Impact of New York City's 2014 Increased Minimum Legal Purchase Age on Youth Tobacco Use

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Objectives. To assess the impact of New York City's (NYC's) 2014 increase of the minimum legal purchase age (MLPA) for tobacco and e-cigarettes from 18 to 21 years.

Methods. We performed a difference-in-differences analysis comparing NYC to the rest of New York State by using repeated cross-sections of the New York Youth Tobacco Survey (2008–2016) and to 4 Florida cities by using the Youth Risk Behavior Surveys (2007–2015).

Results. Adolescent tobacco use declined slightly in NYC after the policy change. However, this rate of change was even larger in control locations. In NYC, e-cigarette use increased and reported purchases of loose cigarettes remained unchanged, suggesting uneven policy implementation, enforcement, or compliance.

Conclusions. Increasing the MLPA to 21 years in NYC did not accelerate reductions in youth tobacco use any more rapidly than declines observed in comparison sites.

Public Health Implications. Other cities and states currently raising their MLPA for tobacco may need to pay close attention to policy enforcement and conduct enhanced monitoring of retailer compliance to achieve the full benefits of the policy. (*Am J Public Health.* 2018;108:669–675. doi:10.2105/AJPH.2018.304340)

empirical study showing modest reductions in youth cigarette smoking after an MLPA 21 law was passed in 1 small town.⁷

In August 2014, New York City (NYC) became the largest US municipality to raise the tobacco MLPA from 18 to 21 years. The change in the MLPA, passed in October 2013, was accompanied by Sensible Tobacco Enforcement legislation, which strengthened provisions and penalties for a variety of sales regulations, established minimum pricing, and set minimum pack sizes for tobacco products other than cigarettes (existing laws had already set minimum packaging requirements for cigarettes).⁸ Although NYC has had the highest cigarette taxes in the United States, the new laws were passed to stimulate additional reductions in tobacco use.^{9,10}

The purpose of this study was to assess the impact of these legal changes on adolescent tobacco use in NYC.

 See also Winickoff, p. 594.

The large reductions in adolescent smoking over the past 20 years in the United States have been attributed to an aggressive and multipronged public health strategy.¹ Still, in 2015, nearly one fifth of high-school students reported using a tobacco product in the past 30 days and use of e-cigarettes has continued to rise.² The risks of such use are considerable, given tobacco's deleterious effects on adolescent tissue and organ development and that early exposure is associated with higher risk of nicotine addiction.^{3,4}

One new strategy is to raise the minimum legal purchase age (MLPA) for tobacco products to from 18 to 21 years.⁵ To date, more than 270 localities and 5 states have already raised their tobacco MLPA to 21 years. Policymakers and advocates reason that doing so will not only make it more difficult for young people to purchase tobacco products directly but will also reduce the probability that young people will obtain tobacco through social sources—usually a friend or relative who has turned 18 years.⁶

However, evidence regarding the effects of raising the tobacco MLPA is surprisingly sparse. Although an Institute of Medicine report concluded that raising the MLPA above 18 years could substantially reduce tobacco use and its effects, it also highlighted the absence of empirical evidence.³ Simulations conducted for the report suggested that raising the MLPA to 21 years could reduce cigarette use by as much as 12% and could lead to nearly 250 000 fewer premature deaths over the next 85 years, assuming strong compliance with the law.³ The report concluded by calling for further research to establish the evidence base for the effectiveness of such laws. To date, there has only been 1

METHODS

Data for our main analyses were derived from the even-year biennial New York State Youth Tobacco Survey (YTS) 2008 to 2016. The YTS, developed by the Centers for Disease Control and Prevention (CDC), is administered with state and local health departments to public- and private-school students, grades 7 to 12. Details about the survey can be found elsewhere.¹¹ We began the time series with the earliest year that included questions regarding multiple tobacco products and note that the 2014 YTS data

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were collected in the fall school year of 2014, after the new MLPA was implemented in NYC. Because the New York YTS underwent a sample redesign (regarding oversampling of minority populations) in 2014, we accounted for these changes by controlling for year and race/ethnicity and by using appropriate weights for each model.

We also used the Youth Risk Behavior Survey (YRBS) 2007 to 2015, a cross-sectional survey developed by the CDC for use nationally and by states and localities. It samples high-school students from public and private schools, biennially on odd years. Further information about the YRBS can be found elsewhere.¹² Although the YRBS has fewer items related to tobacco use, the public-use files include 4 large urban areas in Florida—Miami (Miami-Dade County), Orlando (Orange County), Fort Lauderdale (Broward County), and Jacksonville (Duval County)—which we used as a comparison group because they share similar demographic characteristics to NYC, had lower tobacco use than the national average, exhibited a secular rate of change that closely mirrors that of the United States as a whole, and neither they nor the state of Florida passed any significant tobacco legislation during the period under observation (see Tables A–C and Figure A, available as supplements to the online version of this article at <http://www.ajph.org>, for more details).

Measures

Student-reported measures from both surveys included current (past-30-day) use of any tobacco product including cigarettes, e-cigarettes, cigars (including little cigars, pipes, bidi, and kretek), and smokeless tobacco (chew, snuff, dip, snus, and dissolvables). Cigar use in NYC was not included in the 2011 YRBS public-use data set, so we applied multiple imputation methods to estimate values for NYC for that year only. Questions regarding current (past-30-day) e-cigarette use were first included in the YTS in 2014 (and the YRBS in 2015), so although we report data on their use, we could not include these outcomes in impact analyses.

We investigated proxy measures of policy implementation by using the YTS data set only, as these are not collected in the YRBS. These questions (asked only of current

adolescent cigarette users) included reported age of tobacco initiation, reports of buying cigarettes from stores, whether current smokers were asked for identification (ID) when purchasing cigarettes, reports of attempting to quit, and reported purchases of single cigarettes (loosies).

Analysis

We present descriptive statistics as weighted proportions and, because we used complex survey data, we obtained statistical significance through an adjusted Wald test.¹³ We calculated a pre-post policy measure and tested for statistical significance by using a design-corrected *F* test.

We then estimated the impact of the NYC legislation on youth tobacco use with a difference-in-differences design with 2 control groups that allowed us to assess secular trends.¹⁴ In the YTS, the control group was composed of all adolescents in the rest of New York State, while in the YRBS, we compared NYC adolescents with those in the 4 Florida control counties. All models controlled for grade (or age when using the YRBS), gender, race/ethnicity, and disposable income (for YTS only).¹⁵ We assessed the parallel trends assumption of the difference-in-differences design by constructing, for each outcome, a separate regression model that included a coefficient for time, the treatment site (NYC), their interaction, and other control variables (age or grade, race/ethnicity, gender) for the period before the August 2014 policy change. The assumption of parallel pretreatment trends was met for both data sets, except for the case of cigar use only in the YRBS.

We estimated models by using robust Poisson regression because some outcomes have prevalence rates of greater than 10% and the assumptions of the Poisson model were met. Analyses controlled for each survey's sample design and included final sample weights.

RESULTS

Table 1 presents the weighted proportions of adolescents reporting current tobacco and e-cigarette use in NYC and the rest of New York State according to the YTS 2008 to 2016, and NYC versus the Florida counties

2007 to 2015 according to the YRBS. We calculated differences in the immediate before and after periods of NYC's legal changes.

Over the study period, combined rates of cigarette, smokeless tobacco, and cigar use declined in both NYC and the rest of New York State, although the decline in New York State was steeper with a statistically significant difference in 2016. A significantly smaller proportion of NYC respondents reported using cigarettes, smokeless tobacco, and cigars compared with those in the rest of the state in 2008 and 2010, but that gap narrowed in subsequent years. When we assessed product use individually, the proportion reporting using cigarettes and using smokeless tobacco products in NYC was significantly smaller than the rest of the state only until 2012. In 2016, a significantly larger proportion of NYC adolescents reported using cigars compared with those in the rest of the state. Current e-cigarette use, asked beginning in 2014 only, increased significantly in both locations by 2016.

A pre-post test for change in reported use of any tobacco product in the YTS samples revealed a small, but significant decrease (1.04; $P < .05$) between 2012 and 2016 in NYC. We observed this pre-post decrease for cigarette use only when we examined products individually. After the policy changes took place in NYC, the rest of New York State experienced a decrease of more than 9 percentage points in the rate of adolescent tobacco use overall, and significant ($P < .001$) decreases in the use of any individual product.

The YRBS samples demonstrate a slightly different pattern. Over the study period, the proportion of adolescents reporting the use of any tobacco product declined in the Florida counties while increasing in the middle of the period in NYC. Rates of combined product use and for individual products were significantly lower in NYC than in the Florida counties in the 2007, 2009, and 2011 surveys. By 2015, however, rates for the use of all tobacco products in NYC and the Florida counties were nearly identical, although rates of both smokeless tobacco and cigars were significantly lower in NYC. Pre-post tests for change in product use 2013 to 2015 revealed significant declines in all products, both combined and individually, in NYC. Significant declines were evident in the Florida

TABLE 1—Time Trends in Percentage of Adolescents Reporting Tobacco-Related Behaviors: 2008–2016, 2007–2015, New York City, New York State, and Selected Florida Counties

Measure	Year 1	Year 2	Year 3	Year 4	Year 5	Pre-Post Difference ^a
Youth Tobacco Survey						
Year (no.)	2008 (n = 43 292)	2010 (n = 9500)	2012 (n = 8416)	2014 (n = 8288)	2016 (n = 7192)	2016–2012
Current ^b cigarette, smokeless tobacco, or cigar use, % (95% CI)						
NY	16.01 (15.20, 17.06)	15.90 (12.57, 19.92)	16.49 (12.59, 21.32)	10.45 (7.98, 13.56)	7.1 (5.69, 8.76)	-9.39***
NYC	11.87** (9.422, 15.14)	10.92* (8.72, 13.59)	11.64 (9.31, 14.46)	9.53 (7.87, 11.50)	10.6* (8.16, 12.16)	-1.04*
Current cigarette use, % (95% CI)						
NY	11.16 (10.26, 12.13)	10.05 (7.66, 13.06)	9.81 (7.31, 13.04)	5.53 (3.85, 7.88)	3.22 (2.34, 4.42)	-6.59***
NYC	8.16* (6.18, 10.69)	6.21* (4.77, 8.04)	6.01* (4.50, 7.99)	3.75 (2.64, 5.30)	3.11 (2.29, 4.21)	-2.9**
Current smokeless tobacco use, ^c % (95% CI)						
NY	4.41 (3.87, 5.02)	5.29 (3.77, 7.36)	6.60 (4.22, 10.19)	3.18 (2.12, 4.73)	1.51 (1.01, 2.26)	-5.09***
NYC	2.41*** (1.81, 3.20)	1.33*** (0.93, 1.89)	2.88** (1.95, 4.25)	2.08 (1.48, 2.93)	2.1 (1.32, 3.32)	-0.78
Current cigar use, ^d % (95% CI)						
NY	9.73 (8.66, 10.31)	9.45 (6.95, 12.73)	10.41 (7.83, 13.70)	5.94 (4.40, 7.97)	4.49 (3.51, 5.73)	-5.92**
NYC	7.50 (5.69, 9.83)	7.78 (6.21, 9.71)	8.35 (6.63, 10.47)	6.16 (5.02, 7.52)	7.50* (5.22, 10.65)	-0.85
Current e-cigarette use, ^e % (95% CI)						
NY	...	...	...	8.1 (5.82, 11.17)	14.06 (10.01, 19.40)	...
NYC	...	...	...	6.85 (5.70, 8.22)	14.9 (11.61, 18.92)	...
Youth Risk Behavior Survey						
Year (no.)	2007 (n = 13 890)	2009 (n = 19 452)	2011 (n = 20 313)	2013 (n = 18 390)	2015 (n = 17 559)	2015–2013
Current cigarette, smokeless tobacco, or cigar use, % (95% CI)						
FL	17.03 (15.30, 18.92)	19.48 (18.16, 20.87)	18.17 (16.86, 19.55)	15.05 (12.01, 14.16)	10.93 (9.88, 12.07)	-4.12**
NYC	11.76*** (10.34, 13.35)	12.91*** (11.61, 14.32)	13.91*** (12.63, 15.30)	13.94* (12.54, 15.48)	10.19 (8.85, 11.71)	-3.75***
Current cigarette use, % (95% CI)						
FL	12.5 (10.98, 14.19)	14.08 (12.88, 15.36)	11.35 (10.31, 12.48)	7.06 (6.29, 7.93)	5.32 (4.58, 6.16)	-1.74**
NYC	8.48*** (7.35, 9.76)	8.43*** (7.39, 9.60)	8.49** (7.39, 9.72)	8.22 (7.03, 9.60)	5.76 (4.65, 7.12)	-2.46*
Current smokeless tobacco use, % (95% CI)						
FL	3.40 (2.84, 4.07)	4.89 (4.28, 5.58)	4.70 (4.06, 5.43)	4.06 (3.51, 4.69)	4.30 (3.69, 5.00)	0.24
NYC	2.18** (1.67, 2.85)	3.38** (2.84, 4.03)	3.35** (2.84, 3.95)	4.45 (3.69, 5.35)	3.14* (2.60, 3.78)	-1.31**
Current cigar use, % (95% CI)						
FL	9.48 (8.41, 10.68)	11.61 (10.64, 12.66)	10.70 (9.70, 11.78)	8.20 (7.43, 9.05)	7.54 (6.71, 8.47)	-0.66
NYC	4.46*** (3.71, 5.35)	5.85*** (5.18, 6.61)	6.81*** (6.07, 7.62)	7.69 (6.76, 8.73)	5.72** (4.86, 6.73)	-1.97**
Current e-cigarette use, % (95% CI)						
FL	...	...	...	...	20.74 (19.49, 22.04)	...
NYC	...	...	...	...	15.86*** (14.35, 17.50)	...

Note. CI = confidence interval; FL = Selected Florida counties; NY = New York State; NYC = New York City. Numbers represent weighted percentages and their 95% CIs. Difference between NYC and control groups (rest of NY State, 4 combined Florida cities) are from adjusted Wald test. Statistical significance of the pre-post difference from design-corrected *F* test.

^aPre-post difference for Youth Tobacco Survey data are between 2012 and 2016 and for Youth Risk Behavior Survey between 2013 and 2015.

^bCurrent use is defined as any use in the past 30 days. Note that because of poly use, these numbers are not simply the sum of each product's rate of use.

^cIncludes chew, snuff, dip, snus, or dissolvable tobacco.

^dIncludes cigars, little cigars, bidi, kretek, or pipes.

^eE-cigarette questions first asked in 2014.

P* < .05; *P* < .01; ****P* < .001.

sample for combined tobacco product use and cigarette use alone only.

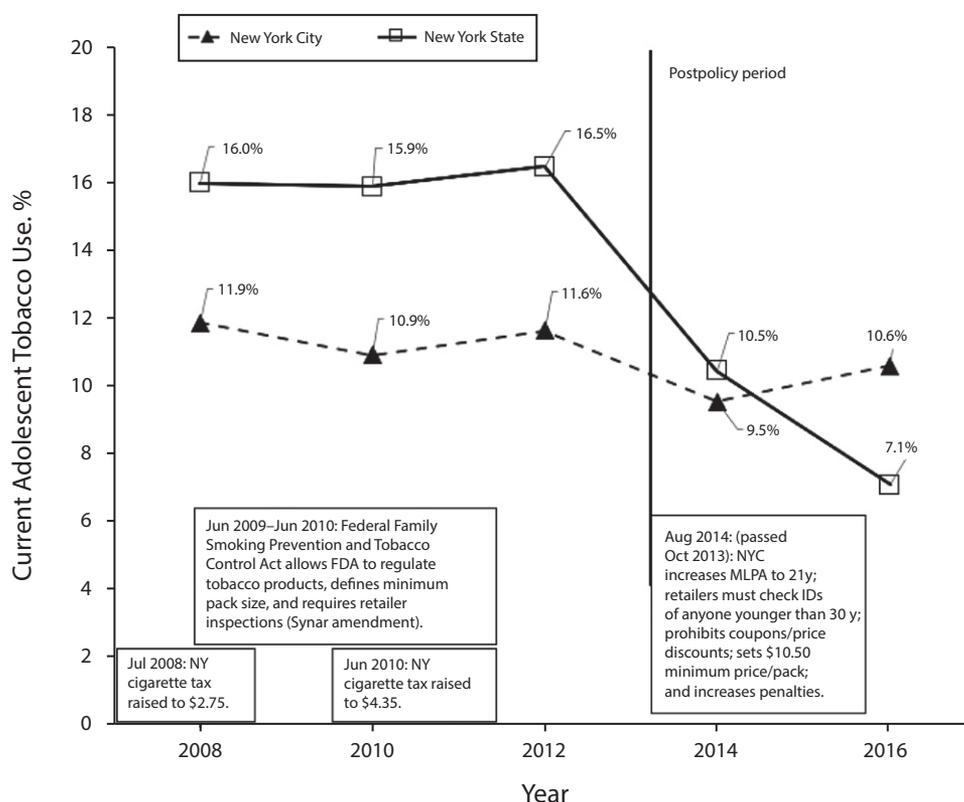
Figure 1 plots trends in NYC and New York State tobacco product use 2008 to 2016 and major federal, state, and city regulations during the same period. The figure shows that, after an initial stable period, in 2014, tobacco use declined in New York State and NYC and by 2016 New York State rates were lower than those observed in NYC. Over the same period, the price of cigarettes in New York State increased substantively, with state tax increases in 2008 and 2010 and the imposition of a federal tax in 2009. In 2010, in NYC, which had a tobacco tax of \$1.50, cigarette prices became the highest in the nation (though Chicago subsequently raised theirs even further). The federal Family Smoking Prevention and Tobacco Control Act (FSPTCA) mandated a pack size of 20 cigarettes and, through the Synar amendment, required regular inspections of retailers to enforce the minimum legal purchase age of 18 years nationally (though New York State had already established an MLPA of 18).

Table 2 presents behaviors asked of adolescent cigarette smokers only (YTS data). We observed no significant change in NYC or in the rest of New York State in the percentage reporting buying cigarettes in stores or having their ID checked from 2008 to 2016, but observed an increase in the purchase of loose cigarettes in both locations over time, albeit with no significant change before and after policy in NYC. The percentage reporting quit attempts during the study period increased in New York State and decreased in NYC. However, in the pre–post period, there was no significant change in these behaviors. The mean age of tobacco initiation also demonstrated no significant differences between NYC and New York State over time or pre–post policy change.

Table 3 presents results from the 2 difference-in-differences analyses of the impact of the NYC laws. The YTS analyses find tobacco use in NYC in the postpolicy period had a 42% higher prevalence rate, when we compared observed rates with the expected

counterfactual (i.e., the difference between expected postpolicy trends in NYC vs observed trends in New York State). In NYC, both the use of smokeless tobacco (adjusted prevalence ratio [APR] = 2.43; 95% confidence interval [CI] = 1.58, 3.73) and cigar use (APR = 1.72; 95% CI = 1.33, 2.22) in the postpolicy period had positive statistically significant values. When participants were stratified by grade (a proxy for age groups), these values were nearly identical for high-school students. For those in middle school (whose tobacco use prevalence is considerably lower), the value of the coefficients designating policy impact were even higher, although the coefficient for any tobacco use was not statistically significant.

Table 3 also presents results from the difference-in-differences analyses of the YRBS surveys. In the postpolicy period, only the prevalence ratio for current cigarette use was statistically significant (APR = 1.40; 95% CI = 1.10, 1.80). When the sample was restricted to those younger than 18 years



Note. FDA = Food and Drug Administration; MLPA = minimum legal purchase age; NY = New York State; NYC = New York City.

FIGURE 1—Timeline of Major Tobacco-Related Legislation and Adolescent Tobacco Use in New York City and New York State, 2008–2016

TABLE 2—Time Trends in Percentage of Adolescent Cigarette Purchasing Behaviors Among Current Adolescent Smokers: New York City and New York State, 2008–2016

Measure	Youth Tobacco Survey ^a					Pre-Post Difference, Percentage Points (2016–2012)
	2008 (n = 4570)	2010 (n = 666)	2012 (n = 552)	2014 (n = 361)	2016 (n = 216)	
Buy cigarettes in store, weighted %						
NY	25.34	26.99	26.98	28.64	32.26	5.28
NYC	39.29***	33.61	38.5*	40.79*	32.48	-6.02
ID/age checked, weighted %						
NY	48.41	54.46	49.97	51.35	38.22	-11.75
NYC	45.78	42.23	39.62	42.3	38.49	-1.13
Buy loose cigarettes, weighted %						
NY	19.68	22.62	33.36	34.49	43.13	9.77
NYC	41.35***	51.45***	55.52**	54.67*	54.68	-0.84
Attempted to quit smoking, weighted %						
NY	54.63	61.38	56.13	57.04	48.29	-7.84
NYC	63.30***	57.01	59.79	65.70	60.28***	0.49
Mean age of cigarette initiation, y						
NY	12.84	12.12	13.23	12.97	12.98	-0.25
NYC	12.53	13.05	13.16	12.91	12.71	-0.45

Note. ID = identification; NY = New York State; NYC = New York City. Data from Youth Tobacco Survey, 2008–2016. Difference between NYC and control group (rest of New York State) from adjusted Wald test. Statistical significance of the pre–post difference from design-corrected F test. No pre–post differences were statistically significant.

^aSample size of current cigarette smokers.

* $P < .05$; ** $P < .01$; *** $P < .001$.

(thus legally prohibited from purchasing tobacco in either NYC or the Florida counties), current cigarette use was similarly positive and statistically significant. We observed no

significant impacts for combined tobacco use or for smokeless tobacco alone. These patterns remained the same when we analyzed by gender (Figure B, available as a supplement

to the online version of this article at <http://www.ajph.org>). By 2015, adolescent tobacco use in the 4 Florida counties was nearly equivalent to that reported in NYC.

TABLE 3—Difference-in-Differences Estimates of the Impact of New York City's Policy Change on Current Tobacco Use: New York City, New York State, and Selected Florida Counties, 2007–2016

	Cigarette, Smokeless Tobacco, or Cigar Use, APR (95% CI)	Cigarette Use, APR (95% CI)	Smokeless Tobacco Use, ^a APR (95% CI)	Cigar Use, ^b APR (95% CI)
NYC vs rest of NY state (YTS)				
Overall	1.42 (1.12, 1.79)	1.25 (0.88, 1.76)	2.43 (1.58, 3.73)	1.72 (1.33, 2.22)
High school only	1.42 (1.11, 1.82)	1.24 (0.85, 1.82)	2.41 (1.48, 3.93)	1.63 (1.19, 2.23)
Middle school only	1.50 (0.84, 2.69)	1.26 (0.65, 2.44)	2.48 (1.10, 5.55)	2.70 (1.64, 4.45)
NYC vs 4 FL counties (YRBS)				
Overall	1.18 (1.00, 1.39)	1.40 (1.10, 1.80)	0.87 (0.66, 1.15)	... ^c
Younger than 18 y only	1.13 (0.96, 1.32)	1.34 (1.04, 1.71)	0.84 (0.62, 1.13)	... ^c

Note. APR = adjusted prevalence ratio; CI = confidence interval; FL = Florida; NY = New York State; NYC = New York City; YRBS = Youth Risk Behavior Survey; YTS = Youth Tobacco Survey. Policy changes refer to when, in August 2014, NYC raised the tobacco minimum legal purchase age from 18 to 21 years, accompanied by Sensible Tobacco Enforcement legislation, which strengthened provisions and penalties for a variety of sales regulations, established minimum pricing, and set minimum pack sizes for tobacco products other than cigarettes (existing laws had already set minimum packaging requirements for cigarettes). Results are prevalence ratios and 95% confidence intervals from robust Poisson regression. Models additionally controlled for NYC fixed effect, year, self-reported weekly income (YTS only), grade (age for YRBS), gender, and race/ethnicity (results not shown).

^aIncludes chew, snuff, dip, snus, or dissolvable tobacco.

^bIncludes cigars, little cigars, bidi, kretek, or pipes.

^cThis outcome did not meet the parallel trends assumption in the YRBS, so difference-in-differences results are not presented.

DISCUSSION

This is the first study, to our knowledge, to assess the relationship between the passage of a broad set of regulations—the most significant of which included raising the MLPA to 21 years—on adolescent tobacco use in a major population center. In a straightforward pre–post test of the policy, our findings revealed a modest decrease in tobacco product use among NYC adolescents, largely driven by a decline in cigarette use. However, our difference-in-differences analysis revealed that this decrease was overshadowed by the steep decline in tobacco use in the rest of New York State after policy implementation, indicating a strong secular decline in current tobacco use. This decline was further confirmed when we compared NYC rates with those from a large urban and diverse sample from Florida. Moreover, we observed no changes pre–post policy change in youths' purchasing of loose cigarettes, suggesting that stiffer penalties included in the legislation may not have substantively altered this activity either by licensed retailers or street vendors. These findings suggest that either the broad set of regulations adopted by NYC were not robust enough to alter youth tobacco use in the city beyond those occurring in comparison communities or may have been rendered less effective because of poor retailer compliance and illicit tobacco supplies.

These analyses demonstrated that the comparison areas experienced considerable and sustained declines in most aspects of adolescent tobacco use. The CDC has reported declines in all forms of tobacco use among adolescents nationally from 1991 to 2015, with the exception of smokeless tobacco products and e-cigarettes.¹⁶ Passage of the 2009 FSPTCA provided new funding and a host of antitobacco measures, which likely contributed to the substantial secular declines throughout the United States. Many states have also increased taxes on tobacco products, though of varying magnitude. New York State passed a substantial increase in cigarette taxes in 2010, affecting both city and state residents. Florida's increase in tobacco taxes in 2009 was less than a quarter of that of New York State (Tables B and C, available as supplements to the online version of this article at <http://www.ajph.org>).

Our results may point to the difficulty of substantially lowering adolescent tobacco use

in NYC with these policies given its context. The Institute of Medicine report estimated a 12% reduction in cigarette use (over the long term) following a simulated increased national MLPA of 21 years, whereas NYC saw only a 3% decline in this behavior. One possible explanation is that many of the policies with the strongest evidence base (raising taxes, licensing tobacco retailers, and strong smoke-free laws) had already been established in NYC, including many provisions of the FSPTCA.^{17–21} Arguably, NYC may have already experienced the largest gains from these laws. Furthermore, NYC's tobacco retail market is different from that in many places throughout the country because of its size, its population density, the predominance of small independent retailers, and the proximity of neighboring states and counties whose policies were less restrictive. The diversity of this market presents challenges to the enforcement of laws governing retailers. For instance, evidence of bootlegging has been found in New York State following the 2002 and 2008 tax increases,^{22–25} and in NYC, recent studies found limited compliance with ID check laws immediately following the increase in the MLPA²⁶ and a high proportion (15%) of in-store purchases yielded bootlegged cigarettes.²⁷ Our results regarding the frequency of purchases of loose cigarettes support the hypothesis that such illicit activities continue to flourish in both NYC and New York State.

The results presented here differ somewhat from the only previous empirical study of raising the MPLA to 21 years, in Needham, Massachusetts (population 36 000). Their postpolicy assessment attributed a reduction (compared with control communities) in youth cigarette smoking to the passage of the nation's first MLPA 21 law in 2005, and noted Needham's aggressive enforcement of the law in advance of the Synar amendment's requirements.⁷ Still, although cigarette smoking declined in Needham much faster than it did in comparison communities from 2005 to 2010, declines in comparison communities outpaced declines in Needham after 2010.

Limitations

This study had several important limitations. It relied on a series of cross-sectional surveys, so we cannot follow the same

students over time. Students surveyed are all in-school youths, so we cannot generalize to those who are out of school. For outcomes that included e-cigarettes, we were not able to conduct a difference-in-differences analysis, so, although we could not assess the policy's immediate impact on the use of these devices, we note that such devices are covered by NYC's MLPA laws and their use increased in absolute terms after these laws became effective. The results reported here are possible underestimates of overall tobacco use as “roll-your-own” tobacco was not included as a response option. In addition, we did not explicitly assess dual use or product substitutions over time.

Questions asked of current cigarette users were limited by small sample sizes that declined over time thus raising the possibility of type-2 error. These analyses could have underestimated MLPA 21 effects if it also had an impact on ID checks and sales refusals of tobacco products other than cigarettes.

Difference-in-differences analyses depend on the parallel trends assumption. We explicitly tested this assumption and found that it held for all outcomes except for cigar use in the YRBS. We note additionally that any policy changes that occurred in New York State should also affect NYC. However, estimates for the rest of New York State did include a few municipalities that had a slightly higher MLPA (19 vs 18 years) and in 2016, counties representing about 20% of the rest of New York State population (not just adolescents) increased their MLPA to 21 years. This suggests that we may have underestimated the impact of the policy in NYC as compared with the rest of New York State in the second postpolicy period (2016). However, none of the 4 large population centers in Florida experienced policy changes in any major aspect of tobacco control (Tables B and C, available as supplements to the online version of this article at <http://www.ajph.org>) and results found were similar to those with the New York YTS data. Finally, we note that we were unable to measure retailers' compliance with the law, nor measure enforcement efforts. Future studies should focus on assessing the law's implementation and impact in different jurisdictions, over longer time periods, within different tobacco regulatory environments, and with a cohort of adolescents to assess within-person changes over time.

Conclusions

This study suggests that Institute of Medicine estimates of significant declines in adolescent tobacco use resulting from raising the MLPA for tobacco to 21 years may need to be placed into context. It could be the case that MLPA 21 laws implemented in sites with high tobacco use and low tobacco excise taxes, for example, would have larger effects, or that impacts in NYC will only be realized over a longer time period. Still, the results presented here should not be taken to mean that raising the MLPA is ineffective; they simply reveal that the law did not reduce tobacco use in NYC at a faster rate than that observed in comparison sites. Further empirical evidence is needed to determine in which contexts MLPA 21 policies can be expected to make a significant impact on reducing youth tobacco use. **AJPH**

CONTRIBUTORS

Both authors each equally contributed to the design and implementation of the research, to the analysis of the results, and to the writing of the article.

HUMAN PARTICIPANT PROTECTION

All analyses used publicly available secondary data and were considered exempt from human participants review.

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