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## Original Investigation

# Youth Knowledge of Tobacco 21 and its Association With Intention to Use Tobacco

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### Abstract

**Background:** Raising the minimum legal age (MLA) of tobacco sales from 18 to 21 (Tobacco 21 [T21]) has recently been implemented nationwide as a method to reduce tobacco use, but empirical data on youth knowledge of T21 policies and related pathways to tobacco use are limited.

**Methods:** Data were collected from the 2018 Kansas Communities That Care Student Survey. Knowledge of the MLA was compared between T21 and non-T21 regions using a quasi-experimental design. Logistic regression and mediation analysis were conducted to assess the association between knowledge of the MLA, influencing factors, and intention to use tobacco.

**Results:** Of 16 949 students (aged between 11 and 18) completing the T21 survey, fewer students responded correctly about the MLA in T21 than in non-T21 regions (37.4% vs. 46.3% responded correctly, 27.6% vs. 24.2% responded incorrectly, respectively). In T21 regions, Hispanics and students who support T21 were more likely to respond correctly about the MLA. Among current non-tobacco users in T21 regions, students who responded correctly about the MLA were less likely to report intention to use tobacco (adjusted odds ratio [AOR] = 0.7, 95% confidence interval [CI]: [0.6–0.8]) than those who responded incorrectly. The pathway from knowledge of the MLA to intention to use tobacco was significantly mediated by increased support for T21 ( $p = .002$ ), perceived difficulty in accessing cigarettes ( $p = .042$ ), and reduced susceptibility to peer influence ( $p = .027$ ).

**Conclusions:** Knowledge of the MLA was inversely associated with intention to use tobacco among youth. Educational campaigns to raise awareness and support for T21 among youth may improve the impact of T21 policies.

**Implications:** This study examined youth knowledge of the MLA to purchase tobacco products, and whether knowledge of the MLA was associated with reduced intention to use tobacco. It also examined other influencing factors (eg, perceived support for T21) and potential mediation pathways linking knowledge of the MLA with intention to use tobacco. Given the nationwide adoption of T21, educational campaigns to promote knowledge of the policy may improve its impact.

### Introduction

Tobacco use is the leading cause of preventable death with the vast majority of tobacco use beginning in adolescence.<sup>1</sup> Tobacco use at

an early age is associated with lower rates of smoking cessation and increased risk of addiction and use of other substances.<sup>1–3</sup> Raising the minimum legal age (MLA) of tobacco sales from 18 to 21 has

recently been advocated as a method to reduce tobacco use prevalence.<sup>4</sup> By November 2019, over half of the US population and 530 jurisdictions across 26 different states were covered by Tobacco 21 (T21).<sup>5</sup> In December 2019, Congress passed a federal law raising the minimum age to purchase all tobacco products from 18 to 21 nationwide.<sup>6</sup> The National Academy of Medicine (formerly known as the Institute of Medicine (IOM)) performed simulation studies that predicted the implementation of T21 nationwide would result in a 12% reduction in smoking prevalence over time.<sup>4</sup> However, the IOM also pointed out the lack of empirical evidence for the impact of raising the MLA,<sup>4</sup> and called for more research to establish the effectiveness of T21 policies.

Several states and municipalities that have implemented T21 have developed T21 logic models to guide their efforts (eg, California, Hawaii, and St. Louis County).<sup>7</sup> These models include short-term outcomes such as increased awareness and support for T21. A recent study<sup>8</sup> reported that nearly two-thirds (63.6%) of young adults aged 18–24 in California were aware of the T21 law 7 months after it was implemented in June 2016. The awareness of the T21 law was high across sociodemographic groups, with current tobacco users having the highest awareness of T21. However, this study did not explore knowledge about the MLA among youth under 18 and did not compare the knowledge of the MLA across T21 regions and non-T21 regions.

Youth are at a transition stage<sup>9</sup> and studies have shown that lack of knowledge of tobacco control policies is associated with susceptibility and future smoking behaviors among adolescents.<sup>2</sup> Increased knowledge of tobacco control policies may help strengthen public support, change social norms, and accelerate compliance and diffusion of policy across populations.<sup>10,11</sup> Nonsmokers lacking knowledge of the MLA might perceive that tobacco products are easier to get and may, therefore, be more susceptible to using tobacco products than those with knowledge of the MLA. Previous studies have also found that peer influence and other attitudinal factors predict youth support of T21<sup>12</sup> and T21 support is associated with reduced susceptibility to youth tobacco use.<sup>13</sup> However, to the best of our knowledge, no studies have assessed the pathways through which T21 policy impacts youth. We seek to address this gap and conjecture that influencing factors (T21 support, perceived difficulty in accessing cigarettes, and peer influence) may have mediation effects in the pathway between knowledge of the MLA and intention to use tobacco among youth non-tobacco users.

Between November 2015 and August 2018, 20 cities or localities in Kansas passed T21 laws while other regions in Kansas retained the MLA of 18. This provides an opportunity to explore youth knowledge of MLA where T21 was implemented in local communities as opposed to statewide and in a state with a higher prevalence of tobacco use and weaker tobacco control laws than many other states.<sup>14</sup> This study used data from the 2018 Kansas Communities That Care (KCTC) Student Survey to test the following hypotheses: (1) Does youth awareness of MLA differ between T21 and non-T21 regions? (2) Is knowledge of the MLA associated with reduced intention to use tobacco in the next 12 months among current non-tobacco users? (3) To what extent is the relationship between knowledge of the MLA and intention to use tobacco mediated by T21 support, perceived difficulty in accessing cigarettes, and peer influence of tobacco use?

## Methods

### KCTC Survey

This study utilized a subset of data from the KCTC Student Survey, a cross-sectional, school-based, annual survey that has been tracking

teen use of harmful substances such as alcohol, tobacco, and other drugs since 1994. The KCTC surveys are offered annually to public and private schools in Kansas for students in 6th, 8th, 10th, and 12th grades. Between December 1, 2017 and January 31, 2018, 220 school districts and 63 519 students participated in the KCTC survey with a combined school and student response rate of 42.5%. Participation in the 2018 KCTC survey was anonymous, voluntary, and required written parental consent for student participation (see [Supplementary Appendix 2](#) for details of the survey instrument). Tobacco-21-related questions (described below) were added to the main survey for schools selected for inclusion in this study based on a quasi-experimental design that compared students in schools in T21 and non-T21 areas.

### Quasi-Experimental Design

To reduce the potential sampling biases due to geographic locations, school characteristics, and smoking prevalence, middle and high schools in T21 and non-T21 areas were selected through a quasi-experimental design, which matched schools in T21 and non-T21 areas based on grade composition, enrollment size, past 30-day cigarette use, and socioeconomic status. Schools were assigned to T21 versus non-T21 areas based on the status of T21 legislation in the school's location as of November 2017. Both T21 schools and comparison schools were considered for inclusion if they had a 50% or greater participation rate on the 2014 KCTC Student Survey, the latest survey with a high response rate among schools across the state. After meeting the inclusion criteria, non-T21 comparison schools were chosen as the control and matched 1-1 to a T21 school based on the following criteria: (1) the same grade composition as the T21 school (ie, grade 6–12 vs. 9–12); (2) an enrollment size within 100 students if <500 total enrolled or within 200 students if >500 total enrolled; (3) difference of past 30-day cigarette use within 1%; (4) difference of percent free/reduced lunch within 10%; (5) difference of percent white within 10%. If more than one non-T21 school met the initial matching criterion, a secondary criterion was used to make the best match: (1) the prevalence of smokeless tobacco use; (2) the percent of Hispanic students; (3) the percent of black students. After the selection, 25 T21 schools (11 high schools and 14 middle schools) were matched with appropriate comparison schools. Since this study used only secondary and de-identified data, it was deemed as exempt by the Children's Mercy Hospital Institutional Review Board.

## Measures

### Knowledge of the MLA

Participants from the selected schools were asked the question "What is the legal age to purchase tobacco products (ie, cigarettes, e-cigarettes, cigars, smokeless tobacco, etc.) in your city?" with response options "16," "17," "18," "19," "20," "21," and "I don't know." Students ( $n = 16\ 949$ ) who answered the MLA question were included in the final analytical sample. Knowledge of the MLA was further grouped into "<21 years (incorrect)," "21 years (correct)," and "I don't know" for schools located in the T21 regions and "<18 years (incorrect)," "18 years (correct)," "19–21 (incorrect)," and "I don't know" for schools located in non-T21 regions.

### Tobacco Use Status

Tobacco use was assessed by four separate questions, "During the past 30 days, on how many occasions (or how frequently) have you smoked cigarettes?"; "... used smokeless tobacco?" "...smoked

**Table 1.** Sample Characteristics by Knowledge of the Minimum Legal Age (MLA) in T21 and Non-T21 Regions (n = 16 949), 2018 Kansas Communities That Care (KCTC) Student Survey

Knowledge of MLA (y) <sup>a</sup>	T21 areas (%)						Non-T21 areas (%)						p <sup>d</sup>
	N (%)	<18	18	19–20	21 (correct)	Unknown	N (%)	<18	18 (correct)	19–20	21	Unknown	
Overall	7964	2.1	24.1	1.4	37.4	35.0	8985	2.2	46.3	1.8	20.2	29.5	<.001
Age													
11–12 y	2167 (27.2%)	1.7	13.8	2.2	38.4	44.0	2147 (23.9%)	2.2	23.6	3.2	29.0	42.0	<.001
13–15 y	3560 (44.8%)	2.2	27.8	1.3	31.8	36.9	3988 (44.5%)	2.1	44.0	1.6	21.4	30.9	
≥15 y	2228 (28.0%)	2.3	28.3	0.8	45.2	23.3	2832 (31.6%)	2.4	66.9	1.1	11.8	17.8	<.001
Sex													
Female	4207 (53.0%)	1.4	23.4	1.3	36.5	37.4	4635 (52.0%)	1.6	45.5	2.0	19.5	31.4	<.001
Male	3735 (47.0%)	2.8	25.0	1.5	38.2	32.4	4286 (48.0%)	2.8	47.4	1.7	21.0	27.1	<.001
Race/ethnicity													
NH <sup>b</sup> -white	4884 (61.4%)	1.6	27.3	1.0	36.4	33.8	5362 (59.9%)	2.0	50.3	1.5	18.5	27.7	<.001
NH-black	632 (7.9%)	4.3	18.2	3.2	37.2	37.2	753 (8.4%)	3.1	35.1	3.1	25.8	33.1	<.001
Hispanics	852 (10.7%)	2.0	17.5	2.0	43.8	34.7	1044 (11.7%)	2.7	40.9	1.9	23.0	31.5	<.001
NH-Others	1584 (19.9%)	2.5	20.5	1.8	37.1	38.1	1794 (20.0%)	2.2	42.8	2.3	21.2	31.5	<.001
Current any tobacco use													
No	6820 (90.4%)	1.8	23.2	1.5	35.8	37.9	7667 (91.9%)	1.8	44.5	1.8	20.9	30.9	<.001
Yes	726 (9.6%)	4.0	35.5	1.1	49.2	10.2	676 (8.1%)	5.9	74.4	0.7	8.9	10.1	<.001
Cigarette	163 (2.1%)	11.0	23.3	2.5	55.2	8.0	253 (3.0%)	10.3	72.7	1.2	6.3	9.5	<.001
E-cigarette	612 (7.9%)	3.3	36.9	1.0	49.3	9.5	455 (5.3%)	6.4	74.9	0.7	7.7	10.3	<.001
Cigar	156 (2.0%)	9.6	29.5	0.6	53.2	7.1	227 (2.7%)	9.7	69.6	1.8	8.8	10.1	<.001
Smokeless tobacco	138 (1.8%)	11.6	29.7	1.4	52.2	5.1	208 (2.4%)	11.1	67.8	1.0	11.1	9.1	<.001
Support T21													
No	2526 (32.4%)	1.6	28.3	0.8	35.7	33.6	3105 (35.4%)	2.0	60.1	0.8	12.2	24.8	<.001
Yes	5262 (67.6%)	2.2	22.2	1.7	38.2	35.8	5672 (64.6%)	2.2	39.5	2.3	24.5	31.4	<.001
Difficulty getting cigarettes													
No	1850 (24.0%)	1.7	31.6	1.3	42.4	23.0	2576 (30.8%)	1.4	66.7	0.9	13.2	17.8	<.001
Yes	5849 (76.0%)	2.3	21.7	1.4	35.4	39.2	5794 (69.2%)	2.5	38.3	2.1	23.1	34.1	<.001
Peer influence													
No	5894 (74.0%)	1.8	21.2	1.4	35.5	40.1	6850 (76.2%)	2.0	40.9	2.0	22.1	33.1	<.001
Yes	2070 (26.0%)	2.8	32.7	1.4	42.7	20.4	2135 (23.8%)	3.0	63.9	1.4	14.1	17.6	<.001
Susceptibility to tobacco use	7964	59.1	34.6	24.3	27.6	14.3	8985	50.0	32.7	20.6	16.3	12.9	<.001

<sup>a</sup>Participants were asked the question “What is the legal age to purchase tobacco products (ie, cigarettes, e-cigarettes, cigars, smokeless tobacco, etc.) in your city?” with response options “16,” “17,” “18,” “19,” “20,” “21,” and “I don’t know.”

<sup>b</sup>Chi-square test was performed to compare the distribution of knowledge of the MLA by sample characteristics.

<sup>c</sup>NH: non-Hispanic.

**Table 2.** Factors Associated With Knowledge of the Minimum Age to Purchase Tobacco Products in T21 Regions, 2018 Kansas Communities That Care (KCTC) (*n* = 7964)

Knowledge of the MLA <sup>a</sup>	21 y <sup>b</sup>		Unknown <sup>b</sup>	
	AOR	<i>p</i>	AOR	<i>p</i>
Age				
11–12 y	REF <sup>c</sup>	REF	REF	REF
13–15 y	0.5 (0.4–0.6)	<.001	0.6 (0.5–0.7)	.039
≥15 y	0.7 (0.5–1.1)	.716	0.5 (0.4–0.6)	<.001
Sex				
Female	REF	REF	REF	REF
Male	0.9 (0.8–1.0)	.189	0.7 (0.7–0.8)	<.001
Race/ethnicity				
NH <sup>d</sup> -white	REF	REF	REF	REF
NH-black	1.2 (1.0–1.5)	.602	1.1 (0.9–1.4)	.880
Hispanics	1.7 (1.3–2.1)	<.001	1.2 (0.8–1.7)	.624
NH-Others	1.3 (1.1–1.4)	.971	1.2 (1.1–1.4)	.156
Current any tobacco use				
No	REF	REF	REF	REF
Yes	1.2 (0.8–1.8)	.419	0.3 (0.3–0.5)	<.001
Support T21				
No	REF	REF	REF	REF
Yes	1.3 (1.1–1.5)	.008	0.9 (0.7–1.1)	.430
Difficulty to get cigarettes				
No	REF	REF	REF	REF
Yes	1 (0.9–1.2)	.556	1.5 (1.2–1.8)	<.001
Peer influence				
No	REF	REF	REF	REF
Yes	0.9 (0.8–1.0)	.044	0.6 (0.5–0.6)	<.001

AOR = adjusted odds ratio; MLA = minimum legal age.

<sup>a</sup>For students in T21 areas, multinomial logistic regression was performed where knowledge of the MLA was treated as the dependent variable and all listed factors were included as explanatory variables.

<sup>b</sup>Participants who answered MLA incorrectly as “<21 years” served as the reference.

<sup>c</sup>Ref: Reference.

<sup>d</sup>NH: non-Hispanic.

cigars, cigarillos, or little cigars?”; and “... used electronic cigarettes (e-cigarettes)?” Students who reported greater than 0 occasions to any of these questions were classified as current tobacco users.<sup>15</sup>

### Influencing Factors

Youth support for T21, access to tobacco, and peer influence were included as these variables have been associated with tobacco use behaviors.<sup>2,13,16</sup> Youth support for T21 was assessed with the item “Do you think the minimum age to buy tobacco products should be 21?” Students who responded “Definitely yes,” and “Probably yes” were classified as being “supportive of T21,” while those who responded “Probably not,” and “Definitely not” were classified as being “not supportive of T21.”<sup>13</sup> Access to tobacco was assessed by the question “If you wanted to get some cigarettes, how easy would it be for you to get some?” Students who responded “Very hard” and “Sort of hard” were classified as perceiving it “difficult to access cigarettes,” and students who responded “Very easy” and “Sort of easy” were classified as finding it “not difficult to access cigarettes.” Peer influence on use of e-cigarettes and cigarettes, the two most commonly used tobacco products by youth,<sup>15</sup> were also assessed. Peer influence was assessed with two items “Think of your four best friends (the friends you feel closest to). In the past year (12 months) how many of your best friends have used electronic cigarettes (e-cigarettes)?” and “Think of your four best friends (the friends you feel closest to). In the past year (12 months), how many of your best friends have smoked cigarettes?” Students who responded 0 to both questions

were classified as having “no peer influence of tobacco use” and students who responded ≥1 to either question were classified as having “peer influence of tobacco use.”

### Intention to Use Tobacco

Intention to use tobacco was measured by three items: (1) “Do you think you will try a cigarette in the next 12 months?”; (2) “Do you think you will try a cigar, cigarillo, or little cigar in the next 12 months?”; and (3) “Do you think you will try an electronic cigarette (e-cigarette) in the next 12 months?” Responses for these questions included “Definitely yes,” “Probably yes,” “Probably not,” and “Definitely not.” Intention to use cigarettes, cigars, and e-cigarettes was coded as “no” if respondents answered “Definitely not” to the corresponding question. Responders who answered “Definitely not” to all three questions were classified into the group “no intention to use tobacco.” The respondents who answered “Definitely yes,” “Probably yes,” or “Probably not” to either of these three questions were classified into the group “intention to use tobacco.”<sup>17,18</sup>

### Covariates

Demographic covariates included sex (male or female), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic others), and age (11–12, 13–14, ≥15 years). Analysis by grade (6th, 8th, 10th, and 12th) yielded similar results as analysis by age group, thus the results by grade were omitted.

**Table 3.** Factors Associated With Intention to Use Tobacco Products Among Current Non-tobacco Users in T21 Regions, 2018 Kansas Communities That Care (KCTC) (*n* = 6820)

Factor	Intention <sup>a</sup> to use tobacco <sup>b</sup>		
	Prevalence (%)	AOR <sup>c</sup>	<i>p</i>
Knowledge of the MLA			
<21 y	26.5 (24.5–28.6)	REF <sup>d</sup>	REF
21 y	18.0 (16.5–19.6)	0.7 (0.6–0.8)	<.001
Unknown	12.1 (10.8–13.4)	0.5 (0.4–0.6)	<.001
Age			
11–12 y	8.5 (7.3–9.7)	REF	REF
13–15 y	19.4 (18.0–20.8)	2.0 (1.6–2.4)	<.001
≥15 y	27.0 (24.9–29.2)	2.1 (1.6–2.6)	<.001
Sex			
Female	16.8 (15.6–18.1)	REF	REF
Male	19.3 (18.0–20.7)	1.2 (1.1–1.4)	.002
Race/ethnicity			
NH <sup>e</sup> -white	19.0 (17.8–20.2)	REF	REF
NH-black	17.9 (14.7–21.2)	1.0 (0.7–1.3)	.952
Hispanics	19.0 (16.2–21.8)	1.0 (0.8–1.3)	.730
NH-Others	14.8 (13.0–16.7)	0.8 (0.6–1.0)	.099
Support T21			
No	27.0 (25.0–29.0)	REF	REF
Yes	14.1 (13.1–15.1)	0.5 (0.5–0.6)	<.001
Difficulty to get cigarettes			
No	32.5 (30.0–35.0)	REF	REF
Yes	14.4 (13.4–15.3)	0.6 (0.5–0.7)	<.001
Peer influence			
No	12.6 (11.8–13.5)	REF	REF
Yes	41.0 (38.3–43.7)	3.4 (2.9–4.0)	<.001

AOR = adjusted odds ratio; MLA = minimum legal age.

<sup>a</sup>Intention to use tobacco was measured by three items: (1) “Do you think you will try a cigarette in the next 12 months?” (2) “Do you think you will try a cigar, cigarillo, or little cigar in the next 12 months?” and “Do you think you will try an electronic cigarette (e-cigarette) in the next 12 months?” The respondents who answered “Definitely yes,” “Probably yes,” or “Probably not” to either of these 3 questions were classified into the group “intention to use tobacco.”

<sup>b</sup>Sensitivity analysis was performed to assess the intention to use cigarettes, e-cigarettes, and cigars in next 12 months, respectively. See [Supplementary Appendix Table 1](#).

<sup>c</sup>For participants in T21 areas, binary logistic regression was performed where intention to use tobacco was treated as the dependent variable and all listed factors were included as explanatory variables.

<sup>d</sup>Ref: Reference.

<sup>e</sup>NH: non-Hispanic.

### Statistical Methods

The distribution (%) of knowledge of the MLA along with the 95% confidence interval (CI) was calculated in T21 and non-T21 regions, overall and by demographic factors, by current tobacco use status, and by attitudinal and interpersonal factors. A chi-square test was used to detect group differences. Among students in T21 regions, multinomial logistic regression was performed to assess factors associated with knowledge of the MLA and binary logistical regression was conducted to assess the association between knowledge of the MLA and intention to use tobacco in the next 12 months among current non-tobacco users. The clustering of students at the school level was accounted for by using SAS survey procedures.<sup>19</sup> Adjusted odds ratios (AOR) and 95% CIs were calculated in the multivariable logistic regression analysis. The mediation analysis was conducted

using SAS Causalmed Procedure to assess the direct and indirect effects of knowledge of the MLA on intention to use tobacco through three influencing variables: T21 support, perceived difficulty to access cigarettes, and peer influence on tobacco use. The indirect effect refers to knowledge of the MLA effect that has an influence on a mediator variable, which then has a direct effect on the outcome variable (intention to use tobacco). A significant indirect effect in the presence of a significant total effect was reported as a mediated effect and the mediation analysis was conducted using the general linear model.<sup>20</sup> Statistical analyses were performed using SAS 9.4 (Cary, NC) and *p* values < .05 were considered statistically significant.

### Results

Of 16 949 students who responded to the question about the MLA, 7964 (47.0%) and 8985 (53.0%) were from schools located in T21 and non-T21 areas, respectively. Overall, fewer students responded correctly about the MLA in T21 regions than in non-T21 regions (37.4% vs. 46.3%; *p* < .001), and more students in T21 regions responded “I don’t know” (35.0% vs. 29.5%; *p* < .001) ([Table 1](#)).

The comparison of sample characteristics by knowledge of the MLA is presented in [Table 1](#). Among students in T21 regions, those who responded correctly (vs. not) were more likely to be 15 years of age or older, be Hispanic, be current tobacco users, support T21, and have peer influence of tobacco use, but they were less likely to perceive difficulty in getting cigarettes. For instance, of current tobacco users, 49.2% responded correctly to the MLA question compared to 35.8% of current non-tobacco users.

Among students in non-T21 regions, students who responded correctly (ie, 18 years) were more likely to be older, be non-Hispanic whites, be current tobacco users, and have peer influence of tobacco use, but they were less likely to support T21 and perceive difficulty in getting cigarettes.

[Table 2](#) presents factors associated with knowledge of the MLA in T21 regions. As compared to those who responded incorrectly, Hispanics (vs. non-Hispanic whites) (AOR = 1.7, 95% CI [1.3–2.1]) and students supporting T21 (vs. not supporting) (AOR = 1.3, 95% CI [1.1–1.5]) had higher odds of reporting the correct MLA; students aged 13–15 years old (vs. those aged 11–12 years old) (AOR = 0.5, 95% CI [0.4–0.6]) and those reporting peer influence of tobacco use (vs. no) (AOR = 0.9, 95% CI [0.8–1.0]) had lower odds of reporting the correct MLA.

[Table 3](#) presents the multivariable analyses that describe the association between knowledge of the MLA and intention to use tobacco products among current non-tobacco users in T21 regions (*n* = 6820). As compared to those who incorrectly responded “<21 years” as the MLA, students who correctly responded “21 years” had lower odds of reporting intention to use tobacco in the next 12 months (AOR = 0.7, 95% CI [0.6–0.8]). Older students (vs. 11–12 years old), males (vs. females), and students having peer influence of tobacco use (yes vs. no) had higher odds of reporting intention to use tobacco. Supporting T21 and perceived difficulty of getting cigarettes was associated with a lower odds of intention to use tobacco. A sensitivity analysis was also performed to assess the association between the perceived MLA and intention to use tobacco by type of tobacco product (ie, cigarettes, e-cigarettes, and cigars). The results, presented in [Supplementary Appendix Table 1](#), are largely consistent with the findings for intention to use any tobacco product ([Table 3](#)).

The mediation analyses are presented in [Figure 1](#). All three influencing variables had significant mediation effects on the



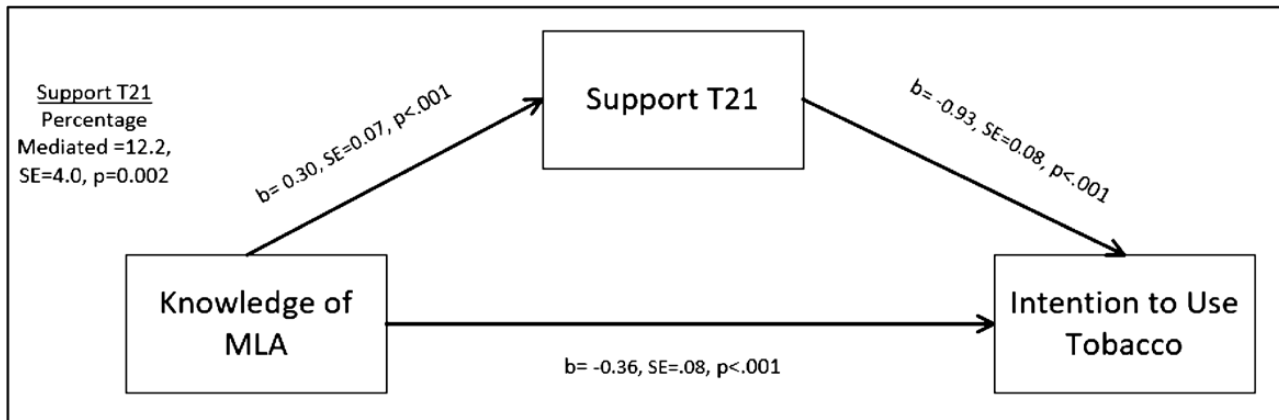


Figure 1.a Mediation effect of support T21

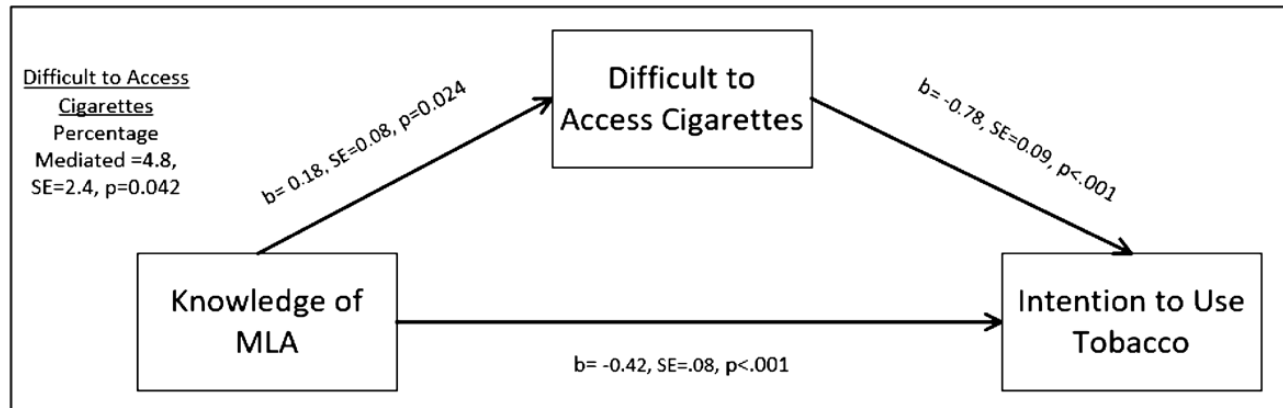
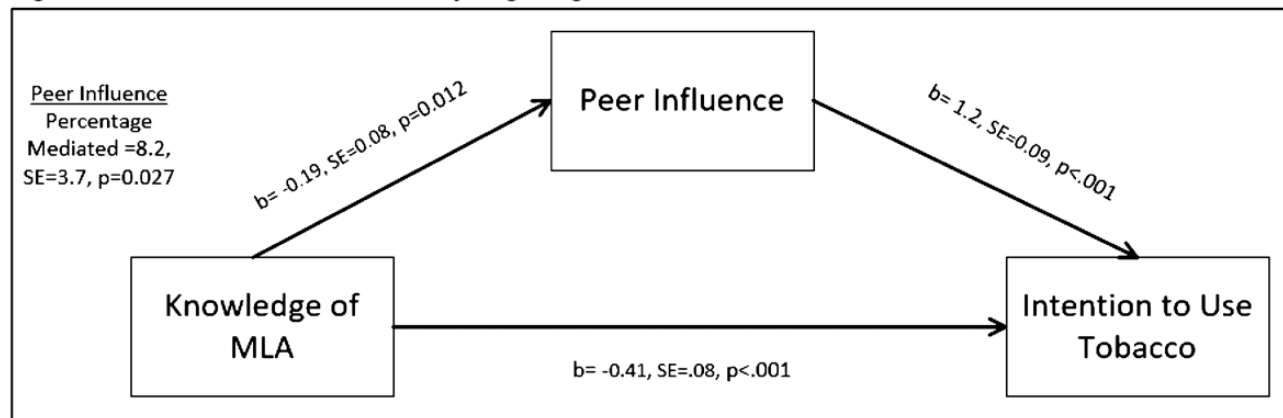


Figure 1.b Mediation effect of difficulty to get cigarettes



**Figure 1.** Mediation analyses<sup>a</sup> of knowledge of the minimum legal age (MLA) on intention to use tobacco among current non-tobacco users, 2018 Kansas Communities That Care (KCTC) ( $n = 14\,487$ ). (a) Mediation effect of support T21. (b) Mediation effect of difficulty to get cigarettes. (c) Mediation effect of peer influence. <sup>a</sup>Mediation analysis was performed using the general linear models among students in T21 regions. The dependent variable was intention to use tobacco (yes vs. no), and the predictive variable was knowledge of the MLA (21 y vs. <21 y). All analyses were adjusted by age, gender, and race/ethnicity. Mean and standard error (SE) of direct effects, indirect effect, and mediation effects were reported for each influencing (mediator) variable.

association between knowledge of the MLA and intention to use tobacco. The percentages mediated were 12.2% by T21 support (Figure 1a), 4.8% by perceived difficulty of accessing cigarettes (Figure 1b), and 8.2% by peer influence (Figure 1c). The indirect paths show that knowledge (vs. lack of knowledge) of the MLA was associated with greater support of T21 ( $b = 0.30, p < .001$ ), greater perceived difficulty to access cigarettes ( $b = .18, p = .024$ ), and lower peer influence on tobacco use ( $b = -.19, p = .012$ ), all of

which were associated with lower intention to use tobacco in the next 12 months.

## Summary and Discussion

T21 is among a small number of low-cost, population-level interventions that have been promoted to delay youth tobacco initiation and reduce smoking prevalence.<sup>4,21</sup> A case study of policy adoption in

Missouri demonstrated the relative advantage and ease of adoption of T21 compared to smoke-free policies using the social construction of target population theory.<sup>21</sup> With the nationwide adoption of T21, it is critical to understand the pathways through which T21 might impact youth tobacco use. This study conducted prior to the adoption of the nationwide T21 policy, assessed students' knowledge of local T21 policies and the association between that knowledge and intent to use tobacco products.

Although T21 logic models have delineated increased awareness and understanding of T21 policy as short-term outcomes,<sup>7,8</sup> this study found that many adolescents were not aware of the MLA to purchase tobacco products and that efforts are needed to increase youth knowledge. Our findings suggest two implications in policy adoption and implementation. First, a patchwork of different MLAs across states and localities could be one possible reason for the lack of knowledge of the MLA among youth, especially in states that partially passed T21 laws. Thus, the adoption of T21 at the national level may help increase knowledge of T21. Second, knowledge of the MLA in T21 regions could strengthen the effects of the policy and promote the impact of T21 policies. Because adolescents will be direct beneficiaries of T21, raising the awareness and knowledge of newly enacted Tobacco 21 ordinances among youth becomes critical to ensure successful policy implementation.<sup>10,11</sup>

This study further assessed factors associated with incorrect knowledge of the MLA to purchase tobacco products in T21 regions. As compared to those who responded correctly, students who were aged 13–15 years old or were non-Hispanic whites were more likely to respond incorrectly about MLA. We also found that support for T21 was associated with a decreased odds of lack of knowledge of the MLA. Customized messages tailored to the subpopulations at risk (eg, adding T21 educational campaign messages to different age groups) might resonate more with students and effectively raise knowledge and support for T21 policy among youth.

This study found a positive correlation between knowledge of the MLA to purchase tobacco products and lower intention to use tobacco in the next 12 months among current non-tobacco users. Furthermore, mediation analyses identified plausible pathways through which knowledge of MLA relates to reduced intention to use tobacco. For instance, knowledge of MLA was associated with an increase in support for T21, which is correlated with youth smoking behaviors.<sup>13</sup> Furthermore, peer influence and perceived ease of access to tobacco were associated with intention to use tobacco among youth.<sup>2</sup> Our results also demonstrated significant indirect effects between knowledge and reduced intention to use tobacco through these two influencing variables. Since the presence of intention to use is a precursor to identifying adolescents who may progress from nonuse to experimentation or established tobacco use,<sup>17</sup> longitudinal studies are needed to assess the relationship between youth knowledge of T21 and subsequent youth tobacco use behaviors.

The tobacco use landscape of youth has changed substantially in recent years with more adolescents using e-cigarettes and other emerging tobacco products.<sup>15</sup> The current use of electronic cigarettes (e-cigarettes) has outpaced the use of traditional cigarettes since 2014<sup>15</sup> and increased significantly from 2017 to 2019.<sup>22</sup> In 2019, more than 1 in 4 students in the 12th grade and more than 1 in 5 in the 10th grade reported using e-cigarettes in the past 30 days.<sup>22</sup> With the passage of a nationwide T21 law, it is critical to understand the impact of T21 policy across all tobacco products. In the sensitivity

analysis, this study found that knowledge of T21 was associated with reduced intention to use all tobacco products including cigarettes, e-cigarettes, and smokeless tobacco. The consistency in our results suggests that the benefits of raising knowledge of T21 may extend to e-cigarettes and other emerging tobacco products.

This study has several limitations. First, the 2018 KCTC Student Survey data are cross-sectional, thus causal inference cannot be established. Second, the data are based on one state (Kansas), and our findings might not be generalizable to other states. However, youth smoking rates in Kansas are close to the national average,<sup>23</sup> and Kansas has a mix of urban and rural areas and sufficient demographic diversity<sup>24,25</sup> to explore social-demographic impacts. Third, the students were classified as being in or out of a T21 area using their school location which may not have always corresponded with where they lived. Some youth responses may, therefore, have been misclassified. Fourth, the 2018 KCTC Student Survey is a school-based survey collected from students who attended either public or private schools. The results might not be generalizable to all school-aged youth. Lastly, our study was unable to examine how variations in T21 and its enforcement might influence its impact. There will be a critical need for further studies to assess how state-level variation in the implementation of federal legislation influences the ultimate success of this policy.

Despite these limitations, this is the first study to assess youth knowledge of T21 and its pathways to precursors of tobacco use behaviors. Enactment of a nationwide Tobacco 21 ordinance can be seen as a milestone in the tobacco control movement, but further implementation and enforcement efforts are likely needed. The eventual success of the nationwide T21 ordinance will depend to a great deal on how it is implemented at the state and local level, including issues related to licensing, inspection frequency, and penalty structures for violations.<sup>26,27</sup> Our study suggests that concerted efforts to monitor and improve knowledge of T21 will be one of those factors that may influence the ultimate success of this policy.

## Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

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## Declaration of Interests

*None declared.*

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