



Published in final edited form as:

J Child Adolesc Subst Abuse. 2014 January 1; 23(2): 137–143. doi:10.1080/1067828X.2012.750972.

Do Sources of Cigarettes Among Adolescents Vary by Age Over Time?

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Abstract

Trends in sources of cigarettes among adolescents were assessed using data from a teen cohort (2000-2006). Five sources—bought from store, got from other teen, stole from others, bought from others, and got from an adult—were measured over time by age. The most common source among all ages was other teens. Fewer teens bought cigarettes from stores, with a downward trend for all ages. Among all ages there was an upward trend in stealing with younger teens more likely to steal cigarettes. In addition to targeting cigarette sales, interventions are needed to target other youth cigarette sources.

Keywords

cigarettes; smoking; source; access; adolescents

INTRODUCTION

Although youth smoking rates in the U.S. have generally declined in recent years, prevalence rates for past 30-day smoking for 8th and 10th graders have risen slightly in 2009 and 2010 (Johnston et al. 2011), demonstrating a strong need for continued emphasis on reducing youth smoking. A key component in a comprehensive strategy to prevent and reduce youth smoking is restricting the supply of cigarettes to minors. The Centers for Disease Control and Prevention includes youth access control in its Best Practices for Comprehensive Tobacco Control Programs (Centers for Disease Control and Prevention 2007) as well as *Healthy People 2010 & 2020* which specify youth-access policy goals (US Dept of Health and Human Services 2000). Youth can obtain cigarettes via two general avenues: commercially (buying from a store or vending machine) and socially (borrowing, buying, or stealing from other youth or adults). Both types of sources need to be considered in a comprehensive approach to further reduce youth smoking.

Previous research has shown that due to increased efforts to reduce commercial sales of cigarettes to minors in many communities throughout the 1990s, it became less likely for youth to buy their cigarettes from stores and more likely for youth to obtain cigarettes from social sources (Altman et al. 1999; Cummings et al. 2003; DiFranza and Coleman 2001; Forster et al. 1998; Altman et al. 1999; J. L. Forster et al. 1998; Levy and Friend 2002). More recent research confirms that social sources, such as friends and parents, are the most common sources of cigarettes among youth (Castrucci et al. 2002; Gratias et al. 1999;

Kaestle 2009; Pokorny et al. 2006); however, most of these studies employed cross-sectional designs, limiting clear conclusions about how sources have changed over time. In addition, most of these studies relied on school-based samples and hence did not include school drop-outs and other youth not attending school.

Several cross-sectional studies have examined factors associated with various types of cigarette sources among youth. For example, younger youth are more likely than older youth to use social sources (Castrucci et al. 2002; Gratiyas et al. 1999; Pokorny et al. 2006), as are females compared to males (Castrucci et al. 2002; Kaestle 2009). Also, heavier smokers are less likely to use social sources as their only source of cigarettes and they are more likely to be a social source of cigarettes to other teens (Forster et al. 2003; Harrison et al. 2000; Pokorny et al. 2006; Widome et al. 2007).

We identified one study that used a longitudinal design to examine how sources of cigarettes among youth vary over time (Robinson et al. 2006), using data from 1994-1996. The study included a school-based cohort of seventh graders in one metropolitan area who were followed annually through ninth grade. They found that social sources were the primary methods to obtain cigarettes across the three grades. Over the study period, smokers came to rely more on stores for their cigarettes, but peers as a source of cigarettes also increased.

In this study we assess how sources of cigarettes among adolescents vary over time by age cohort, from 2000 to 2006 among a community-based cohort of youth ages 14-17. We expand on previous studies by including four separate community-based age cohorts; we also provide more recent data. Assessing sources of cigarettes across time and for separate age cohorts can help us determine whether changes in sources varies by cohort and can help inform how interventions can be tailored for different age groups. We assessed: (1) changes in sources of cigarettes within age groups over time and (2) differences in sources of cigarettes across age groups. We hypothesize that social sources will be less common among older age groups compared to younger groups, but more common within age group over time for all age groups.

METHODS

Study Design

Data for this study are from the Minnesota Adolescent Community Cohort (MACC). A detailed description of the study design can be found elsewhere (Forster et al. 2011). Minnesota was divided into geopolitical units (GPUs), half of which were selected at random for the study. Clearwater Research, Inc. conducted the recruitment of adolescents using a combination of probability and quota sampling methods via modified random digit dialing. Households within the selected GPUs were called to identify those with at least one teen between 12 and 16 years old; the final sample included 3,636 youth in Minnesota. An additional cohort of 12-year olds were added in Round 3 of data collection (n = 584) for a total sample of 4,220.

Participants were interviewed via telephone in six-month intervals, from early adolescence into young adulthood (beginning in 2000-2001). Each interview lasted 10 to 20 minutes and was structured so that verbal responses would not be revealing to anyone overhearing the respondent. Study participants received \$10-15 for each completed interview. Parents provided active informed consent for their children (under age 18) to participate in the study. Once study participants reached the age of consent (age 18), we obtained active informed consent from each participant for each survey completed. The University of Minnesota Institutional Review Board approved this study.

Study Sample

Data for this study were drawn from both the original baseline cohort and the sample of 12-year-olds who were recruited one year after baseline (Round 3). We used data from the first 11 surveys of the MACC project (October 2000 to September 2006); the overall retention rate after the 11 rounds of data collection was 86% among eligible participants. We restricted our sample to youth who were between 14 and 17 years old at the time of survey and who reported smoking on at least one day in the past 30 days (i.e., for each round, all respondents ages 14-17 who reported being a past-30 smoker for *that* round were included; the number of participants per round varied and the total number of participants was 1,259 across the 11 rounds). The number of participants for each survey round by age can be found in Table 1 (Rounds 1-12; no round 7 due to gap in funding).

Study Variables

Our outcome variables pertained to possible methods participants used to obtain their last cigarette. The variables were constructed based on a series of survey questions which were asked of all study participants (past 30-day smokers). Questions were adapted from similar items used by the Centers for Disease Control and Prevention (Youth Risk Behavior Survey; www.cdc.gov/yrbs) and other similar local and national surveys. The questions were (response options for each were yes/no):

How did you get the last cigarette you smoked?

Did you get it from... (a) another teenager? (b) an adult who let you have it?

Did you buy it... (a) from a store? (b) from a vending machine? (c) from another person?

Did you take it...(a) from another person? (b) from a business?

From these questions, we created variables pertaining to five possible methods: bought from a store, got from another teenager, stole from others, bought by paying others, and got from an adult. We did not include other sources (e.g., stole from a store) because of very low frequencies. Each of the retained outcome variables was treated as a dichotomous variable (Yes/No). We measured two independent variables: age in years (14 to 17), measured as a categorical variable based on birth date at baseline, and survey round (1 to 12), measured as a continuous variable. We also included four covariates: (1) gender; (2) number of four closest friends who smoke cigarettes (0-4); (3) number of other smokers in household (0 vs. 1 or more); and (4) number of days smoked in past 30 days smoke (continuous variable collapsed based on distribution to: 1 day, 2 to 7 days, 8 to 29 days, 30 days).

Statistical Analyses

We first computed descriptive statistics for all variables. To investigate how cigarette sources changed over time by age cohort, we used generalized linear mixed-effects models with a binary distribution and logit link function. From the model fitting results, for each outcome variable we computed odds ratios and p-values for age, survey round, the age by survey interaction, and each covariate. To look at the trend of cigarette sources over time for each age cohort, we drew adjusted mean lines smoothed by a local polynomial fit (LOESS). Due to repeated measurements across surveys and individuals nested within GPUs, correlations across surveys and GPU were accounted for in the models using random effects. We first fitted models with the full sample and then stratified by gender. We conducted all analyses in SAS (Version 9.1) using PROC GLIMMIX for generalized mixed models that uses a Maximum Likelihood Estimate method with the assumption that data are missing at random (Enders, 2010).

RESULTS

At baseline, 28% of our participants were daily smokers, 22% lived with a smoker, and 39% reported that all of their four closest friends smoke. Baseline frequencies for all outcome variables for each age cohort are in Table 2. The most common source for the last cigarette among all age cohorts was other teens (40 to 70%) but a greater percentage of younger teens versus older teens used this source. The frequency of the other types of cigarettes sources varied by age but a greater proportion of older teens than younger teens bought their last cigarette from a store and a greater proportion of younger teens stole their last cigarette.

Longitudinal Results

Bought last cigarette from store—We found that youth were less likely to buy their last cigarette from a store over time ($p=0.0008$) and the time by age interaction effect was significant, with the age 15 cohort having a particularly steep and steady drop over time (age x survey: $p=0.023$; Table 3; Figure 1). Table 3 also shows males ($p=0.001$; OR = 1.67, 95% CI=1.22, 2.28) and youth who have more friends who smoke ($p=0.022$; OR 1.20, 95% CI=1.03, 1.40) were more likely to buy their last cigarette from a store. Youth who smoked on fewer days in the past 30 were less likely to buy their last cigarette from a store ($p<0.0001$), with an increasing trend in likelihood as smokers approached daily use.

Got last cigarette from another teenager—Younger teens were more likely to get their last cigarette from another teenager ($p=0.04$) with a decreasing likelihood with increasing age; we found no significant difference over time or between age cohorts over time (Table 3). Teens who live with other smokers were less likely than those who did not live with smokers to get their last cigarettes for another teenager ($p=0.04$; OR = 0.81, 95% CI=0.66, 1.00). Teens who smoked less than daily were more likely than daily smokers to get their last cigarette from another teenager ($p<0.0001$) with an decreasing trend in likelihood as smokers approached daily use.

Stole last cigarette from others—Youth were more likely to steal their last cigarettes from others over time ($p=0.018$; Table 3; Figure 2); this trend did not differ by age cohort ($p=0.67$; Table 3). Youth who live with other smokers were more likely than those who did not live with smokers to steal their last cigarettes from others ($p<0.0001$; OR = 3.33, 95% CI=1.91, 5.82).

Bought last cigarette from others—There were no significant age or time effects for youth who bought their last cigarette from others, but we found that youth who smoked less than daily were less likely than daily smokers to buy their last cigarette by paying others ($p<0.0001$), with an increasing trend in likelihood as smokers approached daily use (Table 3).

Got last cigarette from an adult—The proportion of youth getting their last cigarette from an adult did not differ by age or time (Table 3), but we found males were less likely to get their last cigarette from an adult ($p=0.013$; OR=0.67, 95% CI=0.48, 0.92) and those who lived with other smokers were more likely to get their last cigarette from an adults ($p=.031$; OR=1.42, 95% CI 1.03, 1.95). Youth who smoked less than daily were less likely than daily smokers to get their last cigarette from adult ($p<0.0001$), with an increasing trend in likelihood as smokers approached daily use.

Stratified analyses—Stratified analyses by gender showed several significant differences (results not shown). Females, but not males, were less likely to buy their last cigarette from a store over time ($p=0.004$); younger females were less likely than older females to buy their

last cigarette from a store ($p=0.012$) but there were no such age effect for males. Females who smoke less than daily were less likely than daily smokers to get their last cigarette from an adult ($p<0.0001$), but this was not seen among males. Younger males were more likely than older males to steal their last cigarettes from others ($p=0.016$) but there were no such age effect for females.

DISCUSSION

Similar to other studies, we found that by far the most common source of cigarettes among teenagers was social sources (Castrucci et al. 2002; Gratias et al. 1999; Kaestle 2009), specifically other teens (Castrucci et al. 2002; Robinson et al. 2006). This was true for all age cohorts and at each survey round. Although we saw no changes over time across age cohorts in likelihood of getting last cigarette from another teen, overall, younger youth were more likely than older youth to get their last cigarette from a peer, which is consistent with previous cross-sectional studies (Castrucci et al. 2002; Gratias et al. 1999; Kaestle 2009; Pokorny et al. 2006). Interventions aimed at preventing cigarettes sales to minors are still needed, as those teens who buy cigarettes are more likely to be providers to other teens (Pokorny et al. 2006; Forster et al. 2003).

As found in earlier studies (Levy and Friend 2002; Castrucci et al. 2002; Gratias et al. 1999; Kaestle 2009), our results show that a fairly small proportion of teens buy cigarettes from stores, and older youth are more likely than younger youth to buy their last cigarette from a store. We extend previous research, however, by identifying a general downward trend from 2000-2006 for all age cohorts in the likelihood of buying cigarettes from stores, with the age 15 cohort having a particularly steep and steady drop over time (Figure 1). This overall downward trend could be explained by many communities' continued emphasis on reducing illegal cigarette sales to teens. Perhaps 15 year-olds have been particularly targeted or responsive to these interventions. It is important to note that this study was conducted in Minnesota where there have been particularly strong efforts to reduce cigarettes sales to minors (Forster et al. 1998); the downward trend we found may be due to those increased efforts although we did not test any specific intervention effects.

Another interesting finding was an overall upward trend in likelihood of stealing cigarettes from others. The percentage of youth stealing cigarettes is small compared to other sources but it is the only source where we saw a significant upward trend. There were no significant difference in the trend over time by age cohort, but younger male teens were more likely than older male teens to report stealing cigarettes from others. Perhaps as it has been more difficult for teens, particularly younger teens, to buy cigarettes from stores, they have begun to steal more often. Although we did not ask specifically who they stole from, we did find that teens who lived with smokers were more likely to steal their last cigarette, so perhaps parents or older siblings are sources. It should be noted that we did also inquire about stealing cigarettes directly from stores, as we mentioned in the Methods section, but the prevalence of this behavior was near zero for each age cohort.

For all methods of obtaining the last cigarette with the exception of stealing, the number of days smoked in past 30 days was significantly associated with the likelihood of using each method although the directions of the associations varied. Daily smokers were less likely than less frequent smokers to get their last cigarette from another teen and *more* likely to buy it from a store or from others; female daily smokers were more likely than females who smoke less often to get their last cigarette from an adult. As found in other studies, methods of accessing cigarettes vary by level of smoking (Pokorny et al., 2006; Harrison et al., 2000; Widome et al., 2007) and interventions need to take these differences into consideration.

Several limitations of this study should be noted. First, our data are from self-reported surveys and hence may be affected by social desirability, but self-report surveys are standard in research on adolescent health behaviors and our results can readily be compared to similar previous studies as well as future studies. Second, our participants reside in one state in the U.S. limiting generalizability to other geographic regions and countries. However, unlike most studies examining sources of cigarettes among youth, we use a community-based sample rather than a school-based sample that commonly requires a student to be present on the day of survey. Similarly, our sample includes both rural and urban youth from across the state rather than samples limited to one particular municipality or region. Third, we did not have all ages participating at every survey round (e.g., no 17-year-olds in Survey 1; no 14-year-olds in Surveys 9-12); however we did have sufficient numbers across several rounds to test a temporal relationship.

Our study extends the current literature by examining the sources of cigarettes among youth over time and with four separate age cohorts. We find that other teens continue to be the most prominent source of cigarettes particularly among younger teens. We also see a downward trend in teens buying cigarettes from stores and an upward trend in teens stealing cigarettes from others. Although interventions to decrease commercial access appear to have been effective, particularly for younger teens, these strategies need to be continued as they in turn can limit social access by reducing the total amount of cigarettes accessible to youth. More interventions are also needed to specifically target social access, particularly among teens who get cigarettes from other teens and by stealing from others.

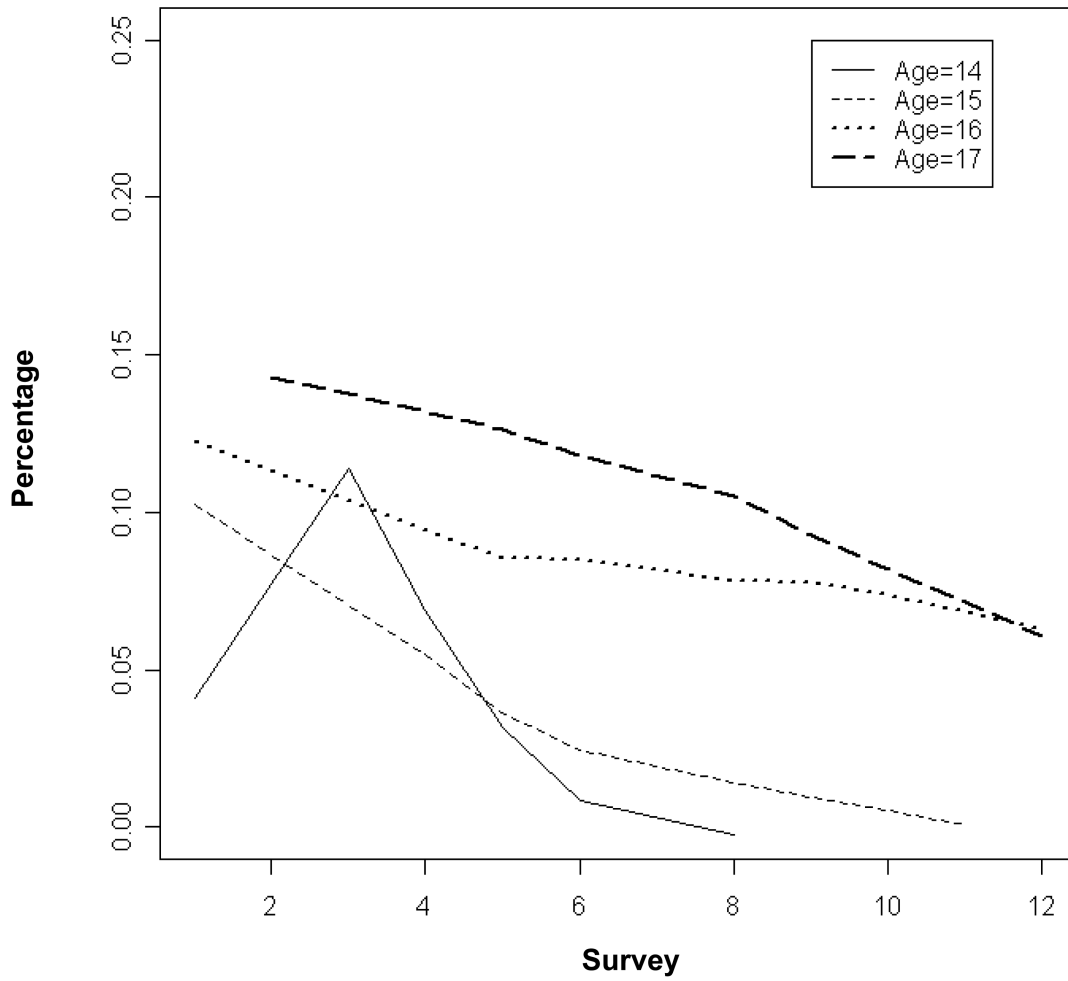
Acknowledgments

This research was funded by the National Cancer Institute, National Institutes of Health R01-CA086191, Jean Forster, Principal Investigator. The authors thank Rose Hilk for her assistance with data management, Clearwater Research, Inc. for its careful implementation of the telephone survey procedures, and the Health Survey Research Center for its assistance with tracking participants.

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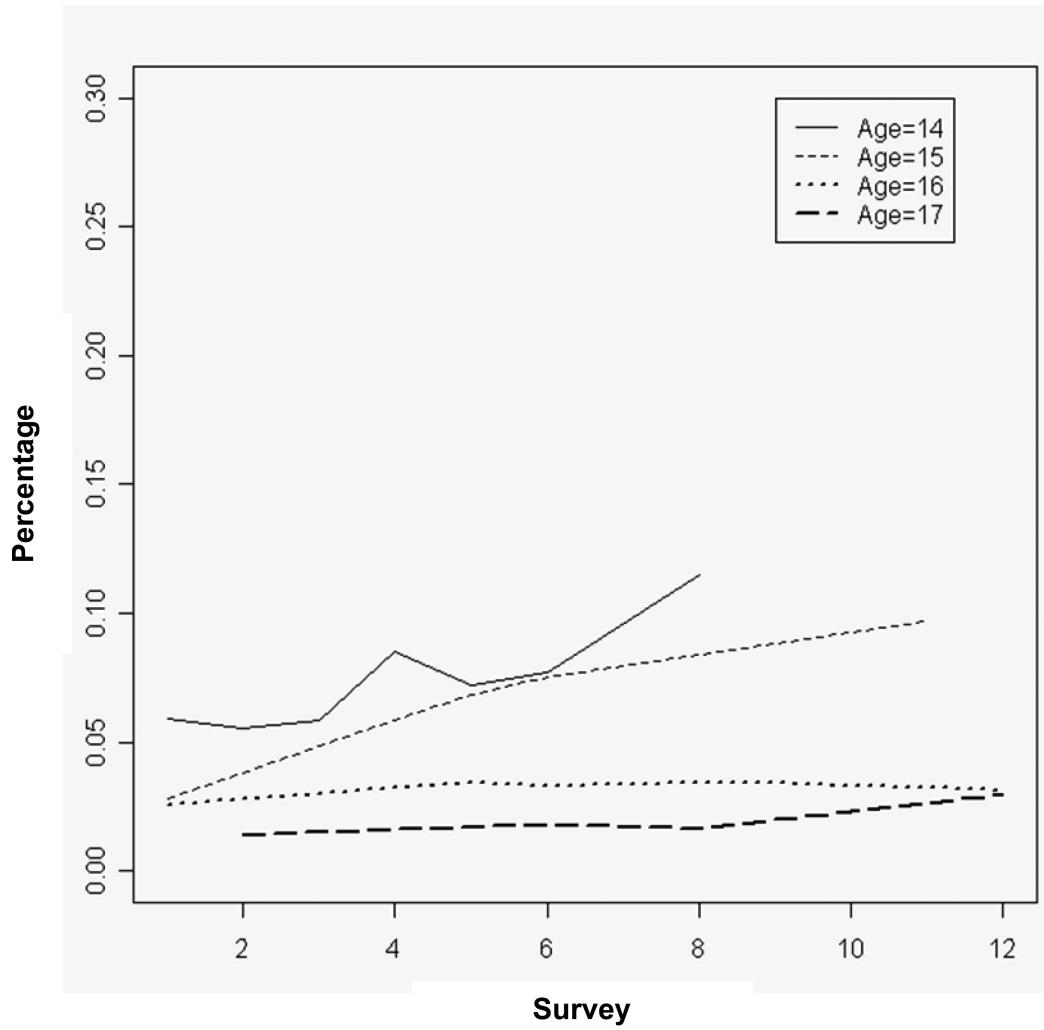
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Note: Interaction term (age x survey round) significant ($p=0.023$); time trend (survey round) significant ($p=0.0008$).

Figure 1.
Percentage of youth buying last cigarette from store, by survey round and age



Note: Time trend (survey round) significant ($p= 0.018$).

Figure 2.
Percentage of youth stealing last cigarette from others, by survey and age

Table 1

Percentage (n) of participants (past month smokers) in each age cohort at each survey round (2000-2006) among Minnesota adolescents

Age	Survey Round											
	1	2	3	4	5	6	8	9	10	11	12	
14	19.7% (65)	14.8% (61)	10.7% (43)	8.1% (31)	9.4% (33)	10.1% (34)	6.9% (18)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	
15	30.9% (102)	23.3% (96)	20.3% (82)	19.7% (75)	20.2% (71)	19.0% (64)	17.6% (46)	21.0% (48)	11.9% (24)	0.6% (1)	0.0% (0)	
16	49.4% (163)	39.8% (164)	27.0% (109)	30.4% (116)	31.0% (109)	32.4% (109)	29.0% (76)	32.8% (75)	36.6% (74)	39.2% (65)	24.8% (33)	
17	0.0% (0)	22.1% (91)	41.9% (169)	41.7% (159)	39.5% (139)	38.4% (129)	46.6% (122)	46.2% (106)	51.5% (104)	60.2% (101)	75.2% (100)	
Total	330	412	403	381	352	336	262	229	202	166	133	

Table 2

Prevalence of source of last cigarette among Minnesota adolescents for each age cohort at baseline (2000)

	Age			
	14	15	16	17 ^a
Got from another teen	62% (40)	68% (69)	47% (77)	40% (36)
Got from adult	6% (4)	7% (7)	17% (27)	16% (15)
Bought from store	8% (5)	11% (11)	21% (34)	22% (20)
Bought from person	12% (8)	11% (11)	11% (18)	19% (17)
Stole from others	11% (7)	4% (4)	4% (7)	1% (1)

^aRound 2 data due to no 17-year-olds in first survey round

Table 3

Source of last cigarette for Minnesota adolescents by survey round, age cohort, age cohort \times survey round, and covariates (2000-2006)

	Source of Last Cigarette (odds ratio (95% CI))				
	Bought from a store	Got from another teen	Stole from others	Bought by paying others	Got from an adult
Survey round	<i>p</i> =0.0008	<i>p</i> =0.76	<i>p</i> =0.018	<i>p</i> =0.57	<i>p</i> =0.40
Age	<i>p</i> =0.064	<i>p</i> =0.004	<i>p</i> =0.30	<i>p</i> =0.75	<i>p</i> =0.28
14	0.23(0.10, 0.51)	1.69(1.02, 2.81)	4.33(2.03, 9.23)	0.90(0.51,1.61)	0.69(0.36,1.34)
15	0.23(0.13, 0.39)	1.55(1.21, 1.98)	2.99(1.65, 5.39)	1.17(0.83,1.64)	0.72(0.47,1.12)
16	0.69(0.56, 0.85)	1.26(1.05, 1.52)	1.78(1.03, 3.08)	1.11(0.83,1.49)	0.89(0.69,1.15)
17	Ref.	Ref.	Ref.	Ref.	Ref.
Age \times Survey round^a	<i>p</i> =0.023	<i>p</i> =0.09	<i>p</i> =0.67	<i>p</i> =0.58	<i>p</i> =0.81
Age 14	0.91(0.74,1.11)	1.01(0.89,1.15)	1.10(0.91,1.33)	0.94(0.77,1.15)	1.06(0.86,1.30)
Age 15	0.76(0.66,0.87)	0.95(0.88,1.03)	1.15(1.01,1.30)	1.08(0.97,1.20)	1.05(0.94,1.18)
Age 16	0.95(0.88,1.02)	0.98(0.93,1.02)	1.05(0.97,1.15)	1.04(0.98,1.10)	1.03(0.97,1.09)
Age 17	0.93(0.88,0.98)	1.04(0.99,1.08)	1.05(0.94,1.19)	1.03(0.96,1.09)	1.00(0.94,1.06)
Gender	<i>p</i> =0.001	<i>p</i> =0.11	<i>p</i> =0.96	<i>p</i> =0.71	<i>p</i> =0.013
Male	1.67(1.22,2.28)	0.86(0.71,1.04)	1.01(0.67,1.54)	1.06(0.78,1.45)	0.67(0.48,0.92)
Female	Ref.	Ref.	Ref.	Ref.	Ref.
Number of 4 closest friends who smoke (0-4)	<i>p</i> =0.022	<i>p</i> =0.09	<i>p</i> =0.39	<i>p</i> =0.27	<i>p</i> =0.48
	1.20(1.03,1.40)	0.92(0.83,1.01)	0.92(0.75,1.12)	1.07(0.95,1.19)	0.95(0.83,1.09)
Number of other smokers in household	<i>p</i> =0.081	<i>p</i> =0.04	<i>p</i> <0.0001	<i>p</i> =0.89	<i>p</i> =0.031
1 or more	0.79(0.61, 1.03)	0.81(0.66, 1.00)	3.33(1.91,5.82)	0.98(0.75,1.28)	1.42(1.03,1.95)
0	Ref.	Ref.	Ref.	Ref.	Ref.
Number of days smoked in past 30	<i>p</i> <0.0001	<i>p</i> <0.0001	<i>p</i> =0.31	<i>p</i> <0.0001	<i>p</i> <0.0001
1	0.07(0.03,0.16)	14.05(9.33,21.4)	1.29(0.67,2.50)	0.04(0.02,0.11)	0.29(0.16,0.55)
2 to 7	0.17(0.12,0.26)	9.02(6.87,11.84)	0.74(0.44,1.22)	0.17(0.11,0.26)	0.52(0.37,0.73)
8 to 29	0.47(0.37,0.61)	3.30(2.70,4.03)	0.86(0.53,1.41)	0.60(0.42,0.86)	0.58(0.43,0.78)
30 days	Ref.	Ref.	Ref.	Ref.	Ref.

Bold entries are significant at $p < .05$

Ref. = referent group

^aThe odds ratio is the odds of at one survey round compared to the odds of the previous survey round for each age group 14 to 17.