



A comparison of adolescent smoking initiation measures on predicting future smoking behavior

Sunday Azagba*, Neill Bruce Baskerville, Leia Minaker

Propel Centre for Population Health Impact, University of Waterloo, Canada
School of Public Health and Health Systems, University of Waterloo, Canada

ARTICLE INFO

Available online 01 March 2015

Keywords:

Age at smoking initiation
Tobacco use
Adolescent cigarette smoking

ABSTRACT

Objectives. Evidence suggests that age at smoking initiation has implications for tobacco use, nicotine dependence, and resulting long-term health and chronic disease outcomes. The objective of the current study was to examine two different measures of smoking onset and to compare their validity in predicting future adolescent smoking survey.

Methods. Data from grades 9–12 students who participated in the 2012/2013 Youth Smoking Survey, a nationally-generalizable Canadian survey, and who had ever tried a cigarette, even a few puffs ($n = 8126$) were used in a multivariable logistic regression analysis to examine the association between age at smoking onset and current smoking behavior.

Results. Both “age at first puff” and “age at first whole cigarette” were significantly associated with current smoking status. Specifically, a delay of one year in the age at first puff was associated with lower odds of being a current smoker by 24% (AOR = 0.76, 95% CI = 0.73–0.79). Similarly, high school students who smoked their first whole cigarette at old age were less likely to report being a current smoker (AOR = 0.66, 95% CI = 0.62–0.71).

Conclusion. Efforts to prevent smoking uptake among youth, especially younger youth, are especially important in tobacco control efforts.

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Introduction

While the health risks of tobacco have been well-documented, cigarette smoking remains the leading cause of premature and preventable mortality worldwide (World Health Organization, 2014). In the last decade, Canada has witnessed considerable progress in efforts to reduce the smoking prevalence, especially among adolescents. For example, among youth aged 15 to 19, the smoking prevalence decreased from 28% in 1999 to 11% in 2012 (Canadian Tobacco Use Monitoring Survey, 2012). Evidence suggests that adolescence is a critical period for prevention targeting given that most adult smokers started smoking before the age of 18 years (Johnston et al., 2012; U.S. Department of Health and Human Services, 1994; Khuder et al., 1999; Wilkinson et al., 2007). At the same time, a number of studies have shown that starting to smoke at a young age strongly predicts future smoking patterns including daily smoking, smoking intensity, nicotine dependence, and difficulty quitting (Everett et al., 1999; Fernandez et al., 1999; Hu et al., 2006; Hwang and Park, 2014; Reidpath et al., 2013; Reidpath et al., 2014;

Wilkinson et al., 2007). Early age of smoking onset not only influences adult smoking behavior, but may also be a marker for other problem behaviors, including substance use, dropping out from school, sexual risk taking, and violent conduct (Ellickson et al., 1997, 2001).

In the extant literature, there is no standardized definition of the threshold for identifying when someone starts smoking. Prior research has commonly used aged at first tried smoking, even just a few puffs (e.g., Hwang and Park, 2014; Reidpath et al., 2013) and age at first smoking a whole cigarette (e.g., Everett et al., 1999; Hu et al., 2006; Reidpath et al., 2014). Other researchers have used a more restrictive threshold of “age at which regular smoking started”—(defined as smoking cigarettes every day) (Khuder et al., 1999). Findings using ‘age at first puff’ or ‘age at first whole cigarette’ are in part supported by sensitization-homeostasis theory (DiFranza and Wellman, 2005). Proponents of this theory argue that progression to tobacco dependence or addiction requires only a small exposure to tobacco, such as the first cigarette (DiFranza et al., 2007; DiFranza, 2010; Scragg et al., 2008; Sanouri, Ursprung and DiFranza, 2010); however, some researchers have questioned these findings (Hughes and Shiffman, 2008; Dar and Frenk, 2010).

While the debate on how to operationalize onset of smoking initiation is valid, not much is known about the comparison of these smoking initiation measures (age at first puff and age at first whole cigarette

* Corresponding author at: Propel Centre for Population Health Impact, Faculty of Applied Health Sciences, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada N2L 3G1.

E-mail address: sazagba@uwaterloo.ca (S. Azagba).

(Reidpath et al., 2014). The objective of the current study was to examine the two different measures of smoking onset and to compare their validity in predicting future adolescent smoking survey. From a tobacco use prevention perspective, it would be of benefit to know how these measures predict future smoking behavior given that most youth surveys do not collect information on both measures of smoking initiation.

Methods

Data

This study used a cross-sectional population sample from the 2012/2013 Youth Smoking Survey (YSS) to examine the association between adolescent smoking initiation and current smoking behavior. A detailed description of the design and procedure of the YSS has been documented elsewhere (Elton-Marshall et al., 2011). Briefly, the YSS is nationally representative, school-based sample of Canadian students in grades 6 to 12 that primarily collects information about adolescents' tobacco use as well as corresponding demographic variables. The survey excludes those living on First Nations reserves, Canada's three northern Territories (Yukon, Nunavut, and Northwest Territories), and those attending special schools or schools on military bases. The province of Manitoba did not participate in the 2012/2013 YSS cycle. The average school participation rate for 2012/2013 was 64%, with about 72% of students completing the paper-and-pencil questionnaires. All protocol and materials of the YSS received ethics approval from the University of Waterloo (the principal coordinator of the YSS), Health Canada, and institutions of consortium members where required. Analyses were restricted to high school students (grades 9–12). About 27,404 students in grades 9–12 participated in the 2012/2013 YSS.

Outcome variables

Smoking behavior was captured by two dichotomous variables reflecting regular smoking pattern: (1) current smokers were defined as students who smoked in the past 30 days and smoked at least 100 cigarettes in their lifetime, and (2) current daily smokers were defined as students who reported smoking every day in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

Independent variables

Among those who ever tried smoking a cigarette, smoking initiation age using age at first puff in continuous was derived from the question: "How old were you when you first tried smoking cigarettes, even just a few puffs?" "Response options were: "I do not know", "8 years or younger", "9 years", "10 years", "11 years" "12 years", "13 years", "14 years", "14 years", "16 years", "17 years", and "18 years or older".. Similarly, age at first whole cigarette was derived from those who reported ever smoking a whole cigarette. In keeping with previous studies (Everett et al., 1999; Reidpath et al., 2014; Reidpath et al., 2013), the analyses adjusted for a number of variables, including age in years, sex, home smoking restriction, parent or guardian smoking status, having at least a friend that smokes, and province of residence. Smoking status of friends was determined by response to the following question: "Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?" with response dichotomized to indicate either having at least one friend who smokes or no friends who smoke. Parent or guardian smoking status was obtained from a 'yes' response to whether a student's parents, step-parents, or guardians smoke cigarettes. Presence of a home smoking ban was dichotomized to indicate homes where smoking is not allowed inside the house, vs any other rules.

Statistical analysis

Multivariable logistic regressions were fitted separately to examine the association between current smoking behavior and 1) age at first puff and 2) age at first whole cigarette. The multivariable analyses were also stratified by gender. In a cross-model analysis, we examined whether there is significant difference between the estimated coefficients (age at first puff and age at first whole cigarette) using the nonlinear Wald test (Clogg et al., 1995). All regression results and the descriptive analysis are population weighted using the survey weights to produce population estimates and adjust for unequal probabilities of selection. All analyses were carried out using Stata version 13.

Results

The weighted demographic characteristics of the sample are shown in Table 1. Of the 8126 students who have ever tried cigarette smoking, even just a few puffs, the weighted results showed that about 20% are current smokers and 10% are current daily smokers. The mean age of smoking initiation (age at first puff) was 13.7 years (Table 1, column 1). Among those who ever smoked a whole cigarette (Table 1, column 2), about 34% are current smokers and 17% are current daily smokers. The mean age of smoking initiation (age at first whole cigarette) was 14 years.

The multivariable logistic regression results (Tables 2–4) show statistically significant associations between age at smoking onset (both age at first puff and age at first whole cigarette) and subsequent smoking behaviors. Table 2 reports the association between age at first puff and current smoking status. In column 1, the outcome variable is current smokers (students who smoked in the past 30 days and have smoked at least 100 cigarettes in their lifetime) and column 2 reports current daily smoker (smoked every day in the past 30 days and have smoked at least 100 cigarettes in their lifetime). The older the age at first puff, the less likely of being a current smoker (AOR = 0.76, 95% CI = 0.73–0.79). Specifically, a delay of one year in the age at first puff was associated with lower odds of being a current smoker by 24%. Likewise, having first puff at later age was negatively associated with being a current daily smoker (AOR = 0.76, 95% CI = 0.72–0.79). Analyses using age at first whole cigarette was equally associated with future

Table 1
Weighted sample characteristics (%) 2012–2013 YSS.

	Age at first puff sample (n = 8126)	Age at first whole cigarette sample (n = 5087)
<i>Smoking status</i>		
Current smoker	20.2	33.8
Non-smoker	79.8	66.2
Current daily smoker	9.9	16.6
Non daily smoker	90.1	83.4
<i>Gender</i>		
Male	53.2	54.1
Female	46.8	45.9
Current age	16.2	16.2
<i>Age of initiation</i>		
Age at first puff	13.7	
Age at first whole cigarette		14.0
<i>Smoking-related exposure</i>		
Presence of total home smoking ban	71.0	68.2
No total ban on smoking in home	29.0	31.8
At least one parent/guardian smokes	53.2	57.8
No parent/guardian smokes	45.6	41.0
Not stated	1.2	1.2
At least one close friend smokes	65.2	74.6
No close friends smoke	29.7	20.3
Not stated	5.1	5.1

Age is in years.

Table 2
Association between age at first puff and current smoking status.

	Current smoker	Current daily smoker
	AOR (95%CI)	AOR (95%CI)
Age at first puff	0.76 (0.73–0.79)	0.76 (0.72–0.79)
Male	1.27 (1.03–1.57)	1.25 (0.94–1.66)
Female	1	1
Current age	1.47 (1.34–1.61)	1.45 (1.30–1.62)

Current smokers was defined as students who smoked in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

Current daily smokers was defined as students who reported smoking every day in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

AOR is adjusted odds ratio (analysis adjusted for parents smoking status, friends smoking status, home smoking rules and province of residence).

smoking status (Table 3). High school students who smoked their first whole cigarette at old age were less likely to report being a current smoker (AOR = 0.66, 95% CI = 0.62–0.71) and a current daily smoker (AOR = 0.70, 95% CI = 0.66–0.74), respectively. The expected signs on the coefficients of included covariates were obtained. For example, being a male (AOR = 1.36, 95% CI = 1.08–1.71) and current age (AOR = 1.56, 95% CI = 1.39–1.74) were positively associated with being a current smoker.

Results from multivariable analyses stratified by gender are shown in Table 4. Similar results showing statistically significant association between age at smoking initiation and current smoking status were found for males and females. For example, a delay of one year in the age at first puff was associated with lower odds of being a current smoker by 21% (AOR = 0.79, 95% CI = 0.74–0.84) and 32% (AOR = 0.68, 95% CI = 0.63–0.73) for males and females respectively. Likewise, a delay of one year in the age at first puff was associated with lower odds of being a current smoker by 26% for males (AOR = 0.74, 95% CI = 0.68–0.79) and 38% for females (AOR = 0.62, 95% CI = 0.56–0.68). Results from the nonlinear Wald test comparing coefficients across models found significant differences between age at first puff and age at first whole cigarette: current smoker ($\chi^2 = 88.91, p < 0.001$) and daily smoker ($\chi^2 = 44.43, p < 0.001$), where age at first whole cigarette was a significantly more strongly associated with current smoking behavior relative to age at first puff.

Discussion

This study examined the relationship between smoking initiation measures and current smoking behavior using a representative sample of Canadian high school students. In particular, we assessed the association between two indicators of smoking initiation: age at first puff and age at first whole cigarette and subsequent smoking status. To the best of our knowledge, this study is among the first to examine both smoking initiation measures. This study showed that the two indicators of smoking initiation were significantly different in predicting subsequent

Table 3
Association between age at first whole cigarette and current smoking status.

	Current smoker	Current daily smoker
	AOR (95%CI)	AOR (95%CI)
Age at first whole cigarette	0.66 (0.62–0.71)	0.70 (0.66–0.74)
Male	1.36 (1.08–1.71)	1.29 (0.95–1.74)
Female	Ref	Ref
Current age	1.56 (1.39–1.74)	1.48 (1.30–1.69)

Current smokers was defined as students who smoked in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

Current daily smokers was defined as students who reported smoking every day in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

AOR is adjusted odds ratio (analysis adjusted for parents smoking status, friends smoking status, home smoking rules and province of residence).

smoking status; however, both indicators had statistically significant association with subsequent smoking status. Our finding that age at smoking onset was associated with current smoking status is in keeping with other studies (Everett et al., 1999; Fernandez et al., 1999; Hwang and Park, 2014; Reidpath et al., 2013; Reidpath et al., 2014; Wilkinson et al., 2007). For example, one U.S. study using data from the Youth Risk Behavior Survey found that age at first whole cigarette was independently associated with regular smoking after adjusting for race/ethnicity, sex and age (Reidpath et al., 2014). Although not directly comparable, another study examining the relationship between age at first puff and current smoking in three European countries found mixed results (Reidpath et al., 2013).

Despite the controversy in characterizing the trajectory from smoking onset to tobacco dependence among youth (DiFranza et al., 2007; DiFranza, 2010; Hughes and Shiffman, 2008; Dar and Frenk, 2010), research has shown that there is heightened vulnerability to problem behaviors including smoking during adolescence (Boyer, 2006; Cooper et al., 2003; Ellickson et al., 1997, 2001). It is less debatable that tobacco control interventions aimed at preventing adolescents from experimenting with cigarettes provide long-term health benefits. While policies on restricting adolescents' access to cigarettes have been implemented in many jurisdictions, a significant number of underage smokers still have easy access to tobacco (Darling et al., 2005; Leatherdale and Strath, 2007; Leatherdale, 2005; Robinson and Amos, 2010). Understandably, many underage smokers get their cigarettes from social sources (Leatherdale and Strath, 2007; Wolfson et al., 1997); however, effective enforcement of underage sales laws has significant impacts on youth smoking (DiFranza et al., 2009).

The results of the present study need to be considered along with its limitations. First, the study used self-reported data including age of smoking initiation, which may be subject to recall and reporting bias. Second, the current study makes no claim on the causal relationship between age at smoking initiation and subsequent smoking status. Finally, while the analysis adjusted for selected covariates, there may be other important characteristics or unobserved factors not adjusted for in the analysis (e.g., respondents smoking history). Despite the study limitations, our results showed that both age at first puff and age at first whole cigarette were significantly associated with current smoking status after adjusting for potential confounders including parents and friends smoking status.

Conclusions

This study found that reported age of smoking initiation (age at first puff and age at first whole cigarette) is associated with current smoking behavior in Canadian adolescents. We also examined whether these two measures were significantly different in predicting current smoking behavior. Age at first whole cigarette had a stronger association with current smoking behavior than 'age at first puff'. Given that survey research must inherently balance the need to reduce respondent burden with the need to obtain valuable information, findings of the current study indicate that if only one "age at initiation" question can be included in a youth tobacco survey, age at first whole cigarette provides more useful information. The findings further demonstrate that having information on age of initiation is valuable for both the planning and evaluation of future smoking prevention policy interventions for youth.

Funding

This work was supported by a research grant from the Canadian Cancer Society Research Institute (CCSRI) (grant number 2011-701019). CCSRI did not play any role in the study design, collection, analysis or interpretation of the data, or contribute in any way to the writing of the report or the decision to submit this publication.

Table 4

Association between age at smoking initiation and current smoking status stratified by gender.

	Males		Females	
	Current smoker	Current daily smoker	Current smoker	Current daily smoker
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
<i>Model 1</i>				
Age at first puff	0.81 (0.76–0.85)	0.79 (0.74–0.84)	0.67 (0.62–0.72)	0.68 (0.63–0.73)
Current age	1.47 (1.31–1.66)	1.39 (1.20–1.61)	1.51 (1.30–1.76)	1.61 (1.38–1.87)
<i>Model 2</i>				
Age at first whole cigarette	0.74 (0.68–0.80)	0.74 (0.68–0.79)	0.51 (0.46–0.58)	0.62 (0.56–0.68)
Current age	1.49 (1.29–1.73)	1.38 (1.15–1.65)	1.75 (1.50–2.04)	1.71 (1.44–2.04)

Current smokers was defined as students who smoked in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

Current daily smokers was defined as students who reported smoking every day in the past 30 days and have smoked at least 100 cigarettes in their lifetime.

AOR is adjusted odds ratio (analysis adjusted for parents smoking status, friends smoking status, home smoking rules and province of residence).

Conflict of interest

None.

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