

The Natural Course of Cigarette Smoking among Adolescent Daily Smokers in France and Quebec

Laetitia Minary¹, Nelly Agrinier^{1,2}, Erika N Dugas³, Marie-Pierre Sylvestre^{3,4} and Jennifer O'Loughlin^{3,4} 

¹Université de Lorraine, APEMAC, Nancy, France. ²CHRU-Nancy, INSERM, Université de Lorraine, CIC, Epidémiologie Clinique, Nancy, France. ³Centre de recherche du Centre Hospitalier de l'Université de Montréal, Montréal, QC, Canada. ⁴Department of Social and Preventive Medicine, School of Public Health, University of Montréal, Montréal, Quebec, Canada.

Tobacco Use Insights
Volume 13: 1–10
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1179173X20943549



ABSTRACT

OBJECTIVE: To describe the natural course of cigarette smoking and nicotine dependence (ND) over 1-year in daily smokers ages 15 to 17 living in different social contexts.

METHOD: Cigarette smoking and ND indicators were measured at baseline and 3- and 12-months thereafter among 95 daily smokers with a total of 123 observations from the Nicotine Dependence in Teens (NDIT) Study in Quebec, Canada, and in 111 daily smokers from the TABagisme chez les ADOlescents (TABADO) Study in Lorraine, France.

RESULTS: NDIT and TABADO participants initiated smoking a mean (SD) of 3.9 (1.6) and 3.7 (2.0) years prior to baseline, respectively. Despite baseline differences in age, sex, age at initiation, number of cigarettes smoked per day and social context, 85% of participants in both samples reported cravings and responded “yes” to “felt like you really need a cigarette”. Mean (SD) number of cigarettes smoked per day increased from 9.4 (8.1) to 11.8 (8.0) over 1 year in NDIT (adjusted mean difference (95% CI)=2.4 (0.8, 3.0)), and from 11.5 (6.5) to 13.5 (6.7) in TABADO (adjusted mean difference (95% CI)=2.0 (0.8, 3.1)). However, most ND indicators in both samples were stable over time and cessation was infrequent.

CONCLUSION: Despite notable differences across samples, the natural course of cigarettes smoked per day, ND symptoms and cessation was similar, suggestive of an underlying biologic rather than social process. To quit, adolescents who smoke daily will likely need (pharmacologic) intervention to counter the biological mechanisms underpinning ND, as well as complementary strategies targeting the social context such as creating social environments favoring cessation success.

KEYWORDS: Adolescent, tobacco use, smoking cessation, social context

RECEIVED: December 16, 2019. **ACCEPTED:** June 25, 2020.

TYPE: Original Research

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work is part of the COMET study that is supported by the French National Cancer Institute and the League Against Cancer (grant number 2017-045). The NDIT Study is supported by the Canadian Cancer Society (grant numbers 010271, 017435, 704031). The funders were not involved in the design or conduct of the study; collection, management, analysis or interpretation of the data; or preparation, review or approval of the manuscript. Dr. Sylvestre is supported by

a Chercheur-Boursier career award from the Fonds de Recherche du Québec-Santé (FRQ-S). Dr. O'Loughlin holds a Canada Research Chair in the Early Determinants of Adult Chronic Disease.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Jennifer O'Loughlin, Centre de recherche du centre hospitalier de l'Université de Montréal, 850 Saint-Denis (S03.468), Montreal, Quebec H2X 0A9, Canada. Email: jennifer.oloughlin@umontreal.ca

Introduction

Adolescence is a pivotal period in the natural course of cigarette smoking onset when initiation of smoking and first nicotine dependence (ND) symptoms often manifest.¹ Early intervention to prevent initiation and sustained smoking is critical. However, although ND symptoms can appear early in the natural course of smoking onset, evidence on effective strategies that support early cessation in adolescent smokers is limited.^{1,2} In a systematic review published in 2007 (corresponding to the decade in which both studies reported herein (ie, NDIT and TABADO) were undertaken), 71% (range: 28–84%) of adolescent smokers age 10 to 19 years had tried to quit, but 92% (range: 88–95%) of those who tried to quit relapsed within a year.³ More recent data in 2017 suggest that the problem persists—51% of smokers age 15 to 24 in Canada had made a quit attempt, but only 8% remained smoke-free for at least 24 hours.⁴ Thus, there is a compelling need

for research that clarifies how we can help novice smokers, and especially those with ND symptoms, quit before entrenchment of full-blown, long-term ND.

Social context has been broadly defined as the sociocultural forces including historical and political influences, legal structures and processes, organizations and institutions, and individual and personal trajectories, that shape day-to-day experiences and that affect health and behavior directly and indirectly.^{5,6} In addition to the biologic underpinnings of ND and the sociodemographic and psychosocial characteristics of individuals, social context may be highly influential in the natural course of cigarette smoking onset and ND, as well as the success of cessation interventions. As suggested by Logan and Spencer, “*smoking must be seen within a social and historical context [. . .] Individuals are not free choosing actors and their behavior is determined, at least in part, by their social and environmental circumstances*”.⁷



To explore whether the early natural course of cigarette smoking including the development of ND symptoms and cessation, differs in different social contexts, we compared adolescent daily smokers participating in 2 longitudinal studies (TABADO (TABagisme chez les ADOlescents) in Lorraine, France; NDI (Nicotine Dependence in Teens) in Quebec, Canada) over 1 year. France and Quebec are both actively engaged in tobacco control—both jurisdictions ratified the WHO Framework Convention on Tobacco Control⁸ in 2004 and both have banned tobacco sales to minors, tobacco smoking in public places and tobacco advertising (see Supplementary Table 1). However, in 2004, Quebec had already (ie, since 1998) banned tobacco sales to minors. France banned tobacco sales to minors less than age 16 in 2003 and then extended the ban to all minors in 2009. Since no penalty system was deployed, the ban was less strict in France reflecting less entrenched anti-smoking social norms, which might have contributed to greater access to cigarettes and higher levels of smoking acceptability among French adolescents. This lagged and lax application of the cigarette sales ban to minors in France versus Quebec may partly explain differences in smoking prevalence. Among adolescents age 15 to 19 years, the prevalence of daily smoking in Quebec was 18% in 2000 and 7% in 2010⁹ versus 33% and 24% in France in the same years.^{10,11} More recently in 2016, 5% of adolescents age 12 to 17 in Quebec smoked,¹² compared to 11% in France.¹³ Another factor possibly underpinning differences in prevalence is socioeconomic context (eg, 6% of Quebec adults were unemployed in 2017,¹⁴ compared to 9% in France¹⁵). Lower socioeconomic status (SES) is associated not only with a higher prevalence of smoking, but also with greater acceptance and deeper entrenchment of smoking in social structures and places, resulting in higher levels of “pro-smoking social norms”, especially in disadvantaged populations.¹⁶

The objective of this article was to compare the early natural course of cigarette smoking, ND symptoms and cessation over 1-year among daily smokers age 15 to 17 living in Lorraine, France and Quebec, Canada. We hypothesized that despite differences in social context and more specifically, in the timing and content of tobacco control policies, school curricula, geographic setting, family SES, single-parent versus nuclear family, smoking status of family members, friends and coworkers, and in smoking-related social norms, there are few differences across adolescent daily smokers living in different jurisdictions in the natural course of cigarette smoking, ND or cessation.

Methods

TABADO was a quasi-experimental study with an intervention and a comparison group, that aimed to evaluate a smoking cessation program among vocational apprentices. It included first-year students age 15 to 20 years enrolled in vocational training centers in Lorraine, France in 2007 to 2009.¹⁷ All participants completed questionnaires at baseline in 2008 to 2009, and then again 3- and 12-months thereafter. Ethics approval was

obtained from several French national scientific and ethical bodies (INSERM, CCTIRS, CNIL). Reuse of TABADO data is registered under the French Reference Methodology MR004 (n°2019-072).

Only the 538 participants in the comparison group in TABADO were considered for inclusion in the current study (2008–2009). Daily smokers were identified by: “How many cigarettes do you currently smoke per day on average?”. Among the 538 participants in the comparison group, 218 smokers age 15 to 17 years who reported smoking one or more cigarettes per day at baseline were identified. Among these 218 daily smokers, 57 and 50 who did not provide data at 3- and/or 12-months respectively were excluded. Therefore, the analytic sample with complete 3- and 12-month follow-up data retained for this current study included 111 participants.

ND symptoms measured in TABADO comprised indicators of cravings, withdrawal symptoms and the Hooked on Nicotine Checklist (HONC).¹⁸ Quitting at the 3- or 12-month follow-up was defined as responding “non-smoker or former smoker” to: “Are you a smoker, non-smoker or a former smoker?”.

NDIT is an ongoing investigation of 1294 participants recruited in grade 7 (ie, at age 12–13) in 10 high schools in or near Montreal, Canada in 1999 to 2000.¹⁹ Self-report questionnaires were administered at school every 3 months from grade 7 to 11, for a total of 20 cycles during the 5 years of high school. All participants provided assent and their parents provided informed consent. NDI received approval from the ethics review board of the Centre de Recherche du Centre Hospitalier de l’Université de Montréal.

To attain a sample comparable to the TABADO sample, we considered data from cycles completed in 2001 to 2005 when participants were age 15 to 17 years. We identified the first cycle at each of age 15, 16, and 17 in which the participant reported daily smoking (ie, the cycle considered to be baseline in this current analysis). We used 2 indicators measured in each cycle to identify daily smokers: (i) “Check the one box that describes you best. . . I smoke cigarettes every day;” and among the daily smokers identified, we verified frequency of smoking in a past-month recall: (ii) “During the last month, on how many days did you smoke cigarettes, even just a puff?” (none; 1 day; 2–3 days; 4–5 days; 6–10 days; 11–15 days; 16–20 days; 21–30 days; every day; I don’t know). Among 169 eligible daily smokers age 15, 16, or 17, 95 with a total of 123 observations, had complete data at the 3- and 12-month follow-up (ie, baseline data at age 15, 16, or 17 with complete follow-up data 3- and 12-months thereafter) and were therefore retained for analysis in a pooled database in which each participant could be included up to 3 times.

ND symptoms comprised indicators of cravings, withdrawal symptoms and the HONC.¹⁸ Quit status at the 3- and 12-month follow-up was measured in 2 indicators: (i) reporting that current smoking status was non-smoking; and (ii) not smoking cigarettes on any day in a past-month recall.

Figure 1 details the derivation of the NDIT and TABADO samples. Supplementary Tables 2 and 3 detail the questionnaire items that comprise each NDIT and TABADO indicator used in this analysis including response options and if applicable, re-coding for analysis

Data analysis

We compared baseline characteristics of daily smokers retained for analysis with those of daily smokers not retained in both samples, using chi square tests for categorical variables and Student t-tests or Wilcoxon tests for continuous variables. Because a single NDIT participant could be included up to 3 times in the pooled database, we corrected the standard errors for multiple observations on the same individuals. Baseline characteristics were then compared across samples, again using chi square tests for categorical variables and Student t-tests or Wilcoxon tests for continuous variables. We then computed the mean difference and 95% confidence intervals (CIs) adjusted for sex, age and parental smoking between baseline and 12-month follow-up values of each smoking and ND indicator across samples. Given the small sample sizes, we chose to adjust for variables highly related to smoking and with the largest imbalances across the 2 samples. In NDIT analyses, we corrected the standard errors for multiple observations on the same individuals. Analyses were undertaken using SAS 9.4 (SAS Institute, Inc., Cary, NC) and SPSS, Version 25.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

Results

Table 1 compares baseline characteristics of NDIT and TABADO daily smokers retained and not retained in the analytic samples. In NDIT, daily smokers retained were approximately 1 year younger on average than those not retained. In TABADO, relatively fewer males were retained.

At baseline, demographic characteristics differed markedly across the samples (Table 2). Three-quarters of TABADO participants were male, compared to 28% of NDIT participants. TABADO participants were older by almost 1 year on average than NDIT participants (16.1 vs 15.3 years). Although the proportion of participants living in single-parent families was similar across samples (ie, 17% in NDIT vs 21% in TABADO), several other indicators of social context differed. Only 5% of TABADO participants attended schools located in rural settings compared to 21% of NDIT participants. All TABADO participants were French speaking compared to 46% of NDIT participants. Because the indicators used to measure SES differed, we could not compare SES directly in NDIT and TABADO. Nevertheless, 41% of NDIT participants had a university-educated mother and 35% of TABADO participants had parents with an advantaged or very advantaged socio-professional status. Importantly, tobacco influences in the social environment differed across the samples. TABADO participants had a higher proportion of parents who smoked

(69% vs 50%), but a higher proportion of NDIT participants reported that their friends smoked (100% vs 82%). Approximately 44% of participants in both samples had siblings who smoked.

With reference to cigarette smoking-related characteristics and ND symptoms, daily smokers in NDIT smoked their first whole cigarette earlier than TABADO smokers (age 11.4 vs 12.4). Although TABADO participants smoked more cigarettes per day at baseline (11.5 vs 9.4), NDIT and TABADO participants initiated smoking a mean of 3.9 and 3.7 years prior to baseline, respectively. Most participants in both samples (96% to 100%) were nicotine dependent at baseline according to the HONC, and the 2 craving indicators suggested that approximately 85% of participants in both samples reported craving and felt like they really need a cigarette at baseline. Relatively more TABADO participants however reported physical addiction (72% vs 55%) and all 4 withdrawal symptoms.

Table 3 reports changes in cigarette smoking and ND indicators from baseline to the 3- and 12-month follow-ups. At 3-months, 4% to 6% of participants in both samples reported that they did not smoke. At 12-months, 3% to 8% of NDIT participants and 6% of TABADO participants did not smoke. After adjustment for age, sex and parental smoking, the difference between baseline and the 12-month follow-up in the percentage of quitters was 5% to 10% in NDIT, and 6% in TABADO. Among those who continued to smoke, the mean number of cigarettes smoked per day increased from 9 to 12 cigarettes per day in NDIT, and from 12 to 14 cigarettes per day in TABADO. In TABADO, the mean HONC score increased from 6.3 to 8.0, suggestive that these daily smokers may have become more dependent on average over time. However, none of the other ND symptom indicators changed over time in either sample.

Discussion

In this study, we compared cigarette smoking, ND indicators and quit rates over 1 year across samples of adolescent daily smokers ages 15 to 17 in France and Quebec to better understand the natural course of cigarette smoking in different social contexts. Specifically we assessed whether the early natural course of cigarette smoking, nicotine dependence and cessation differ markedly by social context.

Distal influences on social context

Our review of country-specific tobacco control policies (Supplementary Table 1), surveillance data as well as data from NDIT and TABADO, suggests that participants grew up in different social contexts with diverse proximal and distal influences on smoking. More distally, both Quebec and France banned smoking on school playgrounds (2005 in Quebec, 2008 in France) and prohibited the sale of tobacco products to minors (1993 in Quebec, 2009 in France), but the temporality

Table 1. Baseline characteristics of NDIT (2001–2005, Canada) and TABADO (2008–2009, France) daily smokers with and without complete data at baseline and both the 3- and 12-month follow-up.

	PARTICIPANTS WITH COMPLETE DATA					
	NDIT			TABADO		
	YES (N = 123) ^{a,b}	NO (N = 154)	<i>P</i>	YES (N = 111) ^b	NO (N = 107)	<i>P</i>
<i>Sociodemographic indicators</i>						
Male, %	27.6	31.8	.52	77.5	90.6	.01
Age, y, mean (SD)	15.3 (0.5)	16.1 (0.8)	≤.001	16.1 (0.7)	16.1 (0.7)	.09
Single-parent family, %	17.1	24.8	.17	20.7	30.8	.09
Mother university-educated, %	41.4	39.5	.80	–	–	–
French-speaking, %	46.3	45.5	.90	100.0	100.0	1.00
Parent socio-professional category, %	–	–	–			.30
Very advantaged				3.9	8.0	
Advantaged				31.1	21.0	
Neither advantaged nor disadvantaged				13.6	10.0	
Disadvantaged				47.6	56.0	
Very disadvantaged				3.9	5.0	
School location, %			.86			.72
Rural	21.1	19.4		4.5	2.8	
Suburban/urban	78.9	79.9		95.5	97.2	
School socioeconomic status, %			.25	–	–	–
High/medium	70.7	63.0				
Low	29.3	37.0				
<i>Cigarette smoking indicators</i>						
Age at first whole cigarette, mean (SD)	11.4 (1.7)	11.1 (1.9)	.17	12.4 (2.0)	11.9 (2.1)	.06
Parent(s) smoke, %	50.4	45.8	.50	69.4	76.6	.29
Sibling(s) smoke, %	45.5	48.7	.65	43.2	48.6	.50
Friend(s) smoke, %	100.0	99.3	– ^c	82.0	85.0	.59

Abbreviations: NDIT, Nicotine Dependence in Teens Study; TABADO: TABagisme chez les ADOlescents.

Bold indicates that values are statistically significant at $p < 0.05$.

^aNDIT sample included 95 participants with a total of 123 observations in the pooled database. Standard errors were corrected for multiple observations of the same participant.

^bDenominators may differ because of missing data.

^c*P*-value not computed because there were too few data points for inference.

of the implementation of these measures and their level of enforcement and/or adherence differed. The tobacco sales ban had been in effect in Quebec for almost 10 years when NDIT data for this analysis were collected in 2001 to 2005. Data collection in TABADO took place during the 2008 to 2009 academic year, concurrent with extension of the tobacco sales ban to minors under age 18 in 2009 (ie, the tobacco sales ban to minors under age 16 was implemented in 2003). It is possible that, compared to France, the earlier timeline and stronger

adherence to prohibition in Quebec reflected and/or induced more deeply rooted negative social norms toward smoking.²⁰

Proximal influences on social context

Overall, 35% of TABADO participants were from very advantaged backgrounds, and a recent study²¹ suggests that only 12% of apprentices in vocational training centers had mothers who had graduated from university. This compares to 41% of NDIT

Table 2. Comparison of baseline characteristics of daily smokers ages 15 to 17 years in NDIT (2001–2005, Canada) and TABADO (2008–2009, France).

	NDIT (N = 123) ^{a,b}	TABADO (N = 111) ^b
<i>Sociodemographic indicators</i>		
Male, %	27.6	77.5
Age, y, mean (SD)	15.3 (0.5)	16.1 (0.6)
Age, y, %		
15	67.5	13.5
16	30.0	60.4
17–18	1.6	26.1
Single-parent family, %	17.1	20.7
Mother university-educated, %	41.4	–
Parent socio-professional category, %	–	
Very advantaged		3.9
Advantaged		31.1
Neither advantaged nor disadvantaged		13.6
Disadvantaged		47.6
Very disadvantaged		3.9
French-speaking, %	46.3	100.0
School location, %		
Rural	21.1	4.5
Suburban/urban	78.9	95.5
<i>Cigarette smoking indicators</i>		
No. cigarettes smoked per day, mean (SD)	9.4 (8.1)	11.5 (6.5)
Age at first whole cigarette, mean (SD)	11.4 (1.7)	12.4 (2.0)
Parent(s) smoke, %	50.4	69.4
Sibling(s) smoke, %	45.5	43.2
Friend(s) smoke, %	100.0	82.0
<i>Nicotine dependence symptoms</i>		
HONC, mean (SD)	7.0 (2.2)	6.3 (2.8)
HONC, % dependent (any yes or score of at least 1/10)	100.0	95.6
Physical addiction, %	54.9	72.2
Craving, %	84.3	85.2
Felt like you really need a cigarette, %	84.6	83.5
Withdrawal symptoms, %		
Trouble concentrating	31.9	44.2
Feel irritable or angry	34.4	49.0
Feel strong urge or need to smoke	57.5	76.5
Feel nervous, anxious or tense	31.7	67.3

Abbreviations: NDIT, Nicotine Dependence in Teens Study; TABADO: TABagisme chez les ADOlescents.

^aNDIT sample included 95 participants with a total of 123 observations in the pooled database.

^bDenominators may differ because of missing data.

Table 3. Comparison of cigarette smoking and nicotine dependence indicators over time among daily smokers in NDIT, 2001 to 2005, Canada (n= 123)^{a,b} and TABADO, 2008 to 2009, France (n= 111).^b

	BASELINE	3-MONTH FOLLOW-UP	12-MONTH FOLLOW-UP	ADJUSTED 12-MONTH DIFFERENCE ^c (95% CI)
<i>Cigarette smoking status</i>				
NDIT, %				
Did not smoke in past 3 months	0.0	6.4	8.0	9.5 (3.1, 5.9)
Current smoking status				
Non-smoker	0.0	4.1	3.3	5.3 (0.2, 10.3)
Smoke daily or nondaily	100.0	95.9	96.7	-5.3 (-10.3, -0.2)
Smoke daily	100.0	89.4	86.9	-13.7 (-20.8, -6.7)
TABADO, %				
Ex-smoker	0.0	4.5	6.3	5.5 (0.6, 10.5)
<i>No. cigarettes smoked/day, mean (SD)</i>				
NDIT	9.4 (8.1)	11.0 (8.7)	11.8 (8.0)	2.4 (0.8, 3.0)
TABADO	11.5 (6.5)	11.3 (7.2)	13.5 (6.7)	2.0 (0.8, 3.1)
<i>Nicotine dependence symptoms</i>				
HONC, mean (SD)				
NDIT	7.0 (2.2)	7.1 (2.2)	6.9 (2.4)	0.0 (-0.5, 0.4)
TABADO	6.3 (2.8)	-	8.0 (1.8)	1.4 (0.9, 1.9)
HONC, % dependent				
NDIT	100.0	99.1	99.1	-1.7 (-4.7, 1.4)
TABADO	95.6	-	100.0	3.6 (-1.0, 8.1)
Physical addiction, %				
NDIT	54.9	50.4	48.8	-5.8 (-13.2, 1.6)
TABADO	72.2	-	80.8	4.2 (-6.5, 15.0)
Craving, %				
NDIT	84.3	81.3	82.0	-1.0 (-12.0, 9.9)
TABADO	85.2	-	85.6	0.6 (-9.2, 10.5)
Felt like you really need a cigarette, %				
NDIT	84.6	80.2	78.9	-4.8 (-13.8, 4.3)
TABADO	83.5	-	85.7	8.6 (-1.1, 18.3)
Withdrawal symptoms, %				
Trouble concentrating				
NDIT	31.9	31.0	34.2	-0.1 (-11.3, 11.2)
TABADO	44.2	-	42.1	2.3 (-10.9, 15.4)
Feel irritable or angry				
NDIT	34.4	36.0	34.2	-0.6 (-10.7, 9.4)
TABADO	49.0	-	52.1	4.5 (-7.3, 16.3)

(Continued)

Table 3. (Continued)

	BASELINE	3-MONTH FOLLOW-UP	12-MONTH FOLLOW-UP	ADJUSTED 12-MONTH DIFFERENCE ^c (95% CI)
Feel strong urge or need to smoke				
NDIT	57.5	52.7	49.5	-7.8 (-19.3, 3.6)
TABADO	76.5	–	79.6	-0.5 (-13.1, 12.2)
Feel nervous, anxious or tense				
NDIT	31.7	40.7	35.1	1.7 (-9.3, 12.7)
TABADO	67.3	–	61.7	– ^d

Abbreviations: NDIT, Nicotine Dependence in Teens Study; TABADO: TABagisme chez les ADOlescents; HONC, Hooked on Nicotine Checklist.

Bold indicates that the 95% confidence intervals do not include the value of 0.

^aNDIT sample included 95 participants with a total of 123 observations in the pooled database.

^bDenominators may differ because of missing data.

^cAdjusted for age, sex and parental smoking. In NDIT, the standard errors were corrected for multiple observations of the same participant.

^dCould not be computed due to small cell sizes.

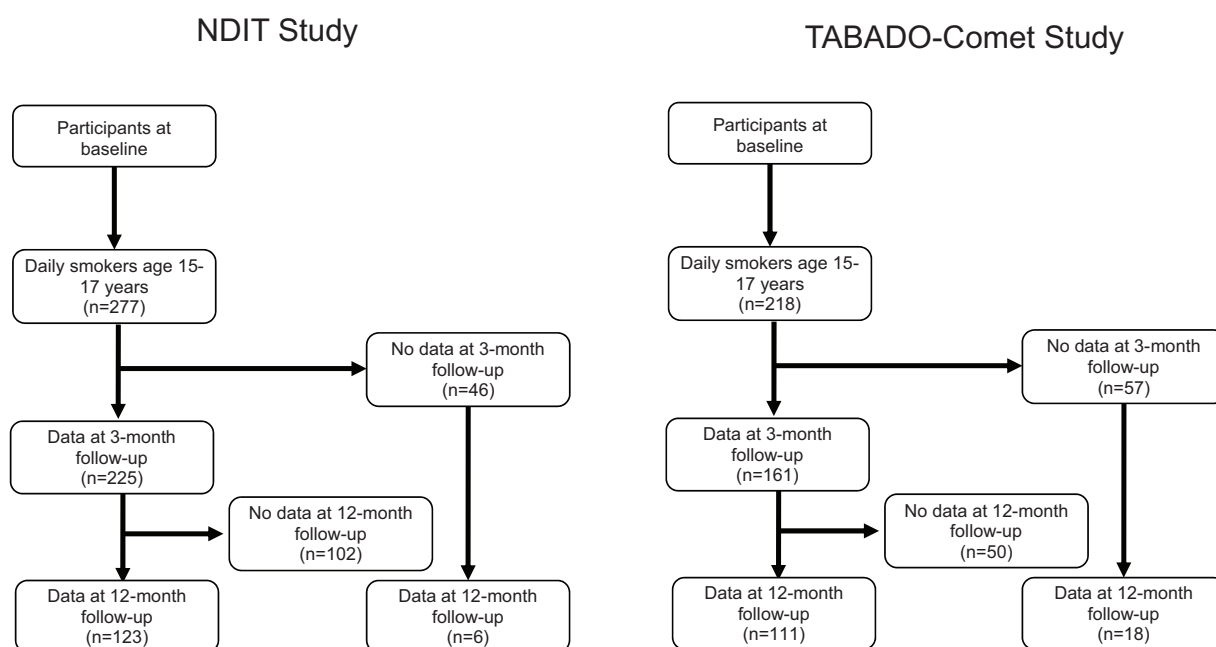


Figure 1. Description of NDIT (2001–2005, Canada) and TABADO (2008–2009, France) study samples.

participants with university-educated mothers and suggests that TABADO participants were possibly more disadvantaged from an SES perspective. In addition, NDIT participants were enrolled in a traditional school-based education curriculum, whereas TABADO participants alternated between school and practicums with an employer. Early exposure to a working environment may have influenced smoking behavior—60% of vocational apprentices indicated that more than half their colleagues were smokers.²¹ Language spoken may proxy cultural differences. Montreal is home to French- and English-speaking populations, and the prevalence of smoking is traditionally lower among Anglophones,²² whereas the TABADO sample was 100% French. Finally, relatively more NDIT participants attended schools located in rural areas. This may offset some of the imbalances in exposure to smoking-promoting factors across samples if as suggested in the literature, adolescents

living in rural areas are heavier smokers,²³ have parents who are more permissive with respect to smoking,^{23,24} have higher exposure to cigarette smoking,²³ less strict adherence to restrictions on youth sales and easier access to tobacco products.²⁴

Social context in TABADO and NDIT

Our results suggest that relatively more apprentices were exposed to parental smoking compared to NDIT participants (69 vs 50%). In a recent study, Gagné et al showed that 60% of apprentices believe that more than half of their colleagues smoke,²¹ suggestive of higher exposure to smoking in this population. Based on these distal and proximal profiles, we hypothesize that TABADO participants were exposed to a social context in which pro-smoking norms were in the process of evolving into anti-smoking norms. Further, a relatively

high proportion of participants lived in families with less favorable socio-professional backgrounds.²¹ Compared to young adults in more advantaged environments, those in disadvantaged environments may feel trapped by pro-smoking norms and perceive that they have little control over their smoking behavior.^{25,26} NDIT participants on the other hand, were enveloped in a more solidly anchored anti-smoking norm linked with lower parental smoking. Relatively more NDIT participants however, reported that their friends smoked, suggestive that smoking in NDIT may be undertaken as a social activity shared with friends.

Differences in baseline characteristics

In addition to differences in social context, there were notable differences across samples at baseline in age, age of smoking initiation and number of cigarettes smoked per day. Further TABADO participants apparently began smoking 1 year later than NDIT adolescents although differences in age at onset across samples could reflect a forward telescoping recall bias in TABADO. Specifically, when smoking characteristics are assessed retrospectively as in TABADO, adolescents who initiated early tend to report an older age at initiation rather than the actual age.²⁷ In NDIT responses were collected prospectively so that telescoping bias was less likely. However, if accurate, cigarette consumption seemingly increased more rapidly among TABADO participants prior to baseline (ie, 11.5 in TABADO vs 9.4 cigarettes per day in NDIT). In addition to more pro-smoking social norms in France, this difference could reflect that apprentices in vocational training centers are remunerated so that access to cigarettes is a lesser issue. Further, TABADO participants were more exposed to adult smoking in the workplace. However, despite baseline differences in cigarette consumption, at 1-year follow-up both samples consumed about 12 to 14 cigarettes per day, which mirrors cigarette consumption levels among adult smokers in Québec (15.6)⁴ and in France (13.6).¹⁰

Differences in physical addiction and withdrawal

At baseline, higher proportions of TABADO participants reported physical addiction and withdrawal symptoms. The difference may reflect that TABADO participants were heavier smokers than NDIT participants, which perhaps “tipped the iceberg” in terms of experiencing withdrawal symptoms and reporting physical addiction. TABADO participants were older than NDIT participants and were therefore possibly more aware of, and able to articulate, that the symptoms they experienced were in fact withdrawal symptoms. It could also be that TABADO participants had more experience trying to quit than NDIT participants and were able to attribute their lack of success to ND. Finally, it is possible that the symptoms reported, especially lack of concentration and anxiety, reflect health issues other than ND (eg, reduced sleep duration²⁸) in TABADO participants.

Similarity in craving

Despite differences in social contexts, marked baseline demographic differences as well as differences in some ND symptoms, 85% of participants in both samples reported craving and really needing a cigarette at baseline. This remarkable similarity may reflect the neurobiology of nicotine exposure and suggests that the natural course of ND is similar in young smokers despite differing social contexts and demographic characteristics. That reports of craving and other ND symptoms remained stable over 1 year suggests that there may be a ceiling in ND symptoms among novice smokers and that the ceiling is attained at or earlier than 3 to 4 years after smoking initiation. These data therefore suggest overall that the social context, while likely influencing the prevalence of smoking, may have little impact on the natural course of cigarette smoking after initiation.

Cessation was infrequent

At 12-months, cessation was infrequent in both samples, reflecting how difficult it is, even for adolescents relatively early in the natural course of cigarette smoking, to quit. The prevalence of smoking cessation is approximately 7% in adolescents,²⁹ mirroring the 7.4% reported in adults.³⁰ Adolescents report a serious desire to quit and serious quit attempts soon after the first puff, but it takes almost 3 years after first puff before they realize and articulate that they smoke because they cannot quit.³¹ It may take many months for novice smokers to learn to link their smoking with ND symptoms experienced and to finally understand that these symptoms prevent them from quitting at will.

Implications

The high levels of ND and the low cessation rates in both samples underscore that adolescents who smoke daily likely need (intensive) intervention to quit. Although tobacco control policies are well-ensconced in both France and Quebec, they were not enough to prevent sustained nicotine-dependent smoking in NDIT or TABADO. Pharmacotherapy to help adolescent smokers combat ND symptoms in addition to counseling adapted to the local social context will likely be needed to promote sustained cessation. Perhaps even more important, programs aimed at preventing first puff and sustained smoking after first puff should be components of an integrated strategy that combines prevention and cessation interventions targeting adolescents throughout the early natural course of cigarette smoking within a social context in which non-smoking norms prevail.

While there are rigorous studies evaluating the efficacy of pharmacotherapy in adolescents, the findings are equivocal² so that the optimal mix of cessation interventions in specific settings and contexts is not yet known. Important issues are that youth early in the natural course of smoking onset may not

recognize ND symptoms or realize that they are addicted, and that many do not believe that pharmacotherapy works.³² Future cessation interventions could focus on educating young smokers about the natural course of ND, provide opportunities to self-evaluate level of ND, assess perceptions of pharmacotherapy and educate on how pharmacotherapy works, including level of effectiveness. Program planners must also take the social context in which interventions are implemented into account. For example, lower self-efficacy and pessimism about quitting are more often observed in low SES smokers.¹⁶ These smokers also receive less social support and are more exposed to strong pro-smoking social norms during quit attempts. Strategies in this subgroup should therefore focus on developing and reinforcing self-efficacy and confidence in the ability to quit, and on avoiding relapses induced by unfavorable social contexts.^{16,21} Implementation of such interventions should include creation of social, school, familial, and professional (for apprentices) environments favoring cessation success. Overall, cessation programs targeting adolescents should include pharmacological strategies combined with interventions to develop psychosocial skills tailored to the specific needs of the target groups. If based on the proportionate universalism principle,³³ these interventions could help reach adolescents who are not influenced by current tobacco control policies, and thus contribute to reducing smoking-related inequalities.

Limitations

Limitations of this study include loss to follow-up and the small samples in both NDI and TABADO which limited precision. Residual confounding remains possible despite adjustment for age, sex and parental smoking in the estimation of mean differences over time. Finally, the wording of several questionnaire item differed across samples. However, the French and Quebec teams critically reviewed each questionnaire item and retained only those with a high probability of yielding equivalent information.

Conclusion

Despite differing social contexts and baseline characteristics across samples, the natural course of early cigarette smoking, ND and cessation was similar among daily smokers in France and Quebec over 1 year. Eight-five percent of participants in both samples reported craving at baseline, suggestive that regardless of social context, ND symptoms are well-established in daily smokers 3 to 4 years after smoking onset. Quitting long-term in naturalistic settings is infrequent. These data reinforce that prevention of first puff and sustained smoking in adolescents is primordial. For those who become daily smokers, cessation interventions adapted to the specific social context are needed, in addition to pharmacotherapy.

ORCID iD

Jennifer O'Loughlin  <https://orcid.org/0000-0001-7240-7588>

Supplemental material

Supplemental material for this article is available online.

REFERENCES

- Sargent JD, Unger JB, Leventhal AM. Recommendations from the USPSTF for prevention and cessation of tobacco use in children and adolescents. *JAMA*. 2020;323(16):1563-1564. doi:10.1001/jama.2019.22312
- Fanshawe TR, Halliwell W, Lindson N, Aveyard P, Livingstone-Banks J, Hartmann-Boyce J. Tobacco cessation interventions for young people. *Cochrane Database Syst Rev*. 2017;(11). doi:10.1002/14651858.CD003289.pub6
- Bancej C, O'Loughlin J, Platt RW, Paradis G, Gervais A. Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies. *Tob Control*. 2007;16(6):e8. doi:10.1136/tc.2006.018853
- Reid J, Hammond D, Rynard V, Madill C, Burkhalter R. *Tobacco Use in Canada: Patterns and Trends, 2017 Edition*. Propel Centre for Population Health Impact, University of Waterloo; 2017.
- Burke NJ, Joseph G, Pasick RJ, Barker JC. Theorizing social context: rethinking behavioral theory. *Health Educ Behav Off Publ Soc Public Health Educ*. 2009;36(5 suppl):55S-70S. doi:10.1177/1090198109335338
- Pasick RJ, Burke NJ. A critical review of theory in breast cancer screening promotion across cultures. *Annu Rev Public Health*. 2008;29:351-368. doi:10.1146/annurev.publhealth.29.020907.143420
- Logan S, Spencer N. Smoking and other health related behaviour in the social and environmental context. *Arch Dis Child*. 1996;74(2):176-179.
- WHO. *WHO Framework Convention on Tobacco Control*. Geneva: World Health Organization; 2004.
- Santé Canada. Enquête de surveillance de l'usage du tabac au Canada (ESUTC) : aperçu général des données historiques, 1999 à 2011. Tableau 3 - Pourcentage des fumeurs quotidiens, selon le groupe d'âge et le sexe chez les Canadiens âgés de 15 ans et plus, Canada, 1999 à 2011. <https://www.canada.ca/fr/sante-canada/services/publications/vie-saine/aperçu-general-donnees-historiques-1999-2011.html#t8>
- Beck F, Guignard R, Richard J-B, Wilquin J-L, Peretti-Watel P. Augmentation récente du tabagisme en France : principaux résultats du Baromètre santé, France, 2010. *BEH*. 2011;(20-21):230-233.
- Guilbert P, Baudier F, Gautier A. *Baromètre Santé 2000 : Résultats. Volume 2*. INPES; 2001:473.
- Statistique Canada. Enquête la santé dans les collectivités canadiennes. Tableau 13-10-0096-01 Caractéristiques de santé estimations annuelles Québec. <https://www150.statcan.gc.ca/t1/tbl1/fr/cv.action?pid=1310009601>. Published online 2017. Accessed March 16, 2019.
- El-Khoury Lesueur F, Bolze C, Melchior M. Adolescents and smoking: early emergence of social inequalities. DePICT, a French national survey (2016). *Bull Epidemiol Hebd*. 2018;(14-15):283-290.
- Institut de la statistique du Québec. *Résultats de l'Enquête Sur La Population Active Pour Le Québec*. Institut de la statistique du Québec; 2017:4. <http://www.stat.gouv.qc.ca/statistiques/travail-remuneration/resultats-epa-201712.pdf>
- OCDE. Taux de chômage harmonisés (HUR) (indicateur). <https://data.oecd.org/fr/unemp/taux-de-chomage-harmonises-hur.htm#indicator-chart>. Published 2019. Accessed March 15, 2019.
- van Wijk EC, Landais LL, Harting J. Understanding the multitude of barriers that prevent smokers in lower socioeconomic groups from accessing smoking cessation support: a literature review. *Prev Med*. 2019;123:143-151. doi:10.1016/j.ypmed.2019.03.029
- Minary L, Cambon L, Martini H, et al. Efficacy of a smoking cessation program in a population of adolescent smokers in vocational schools: a public health evaluative controlled study. *BMC Public Health*. 2013;13:149. doi:10.1186/1471-2458-13-149
- DiFranza JR, Savageau JA, Fletcher K, et al. Measuring the loss of autonomy over nicotine use in adolescents: the DANDY (Development and Assessment of Nicotine Dependence in Youths) study. *Arch Pediatr Adolesc Med*. 2002;156(4):397-403.
- O'Loughlin J, Dugas EN, Brunet J, et al. Cohort Profile: The Nicotine Dependence in Teens (NDIT) Study. *Int J Epidemiol*. 2015;44(5):1537-1546. doi:10.1093/ije/dyu135
- Nuyts PAW, Kuijpers TG, Willemsen MC, Kunst AE. How can a ban on tobacco sales to minors be effective in changing smoking behaviour among youth? — A realist review. *Prev Med*. 2018;115:61-67. doi:10.1016/j.ypmed.2018.08.013
- Gagné T, Omorou AY, Kivits J, Alla F, Minary L, groupe RESIST. [Socioeconomic profile and smoking among adolescents in vocational training]. *Rev Epidemiol Sante Publique*. 2018;66(6):375-383. doi:10.1016/j.respe.2018.09.005
- Brochu D, Gratton J. *Le Tabagisme et La Fumée de Tabac Dans l'environnement à Montréal-Centre*. Direction de la santé publique, Régie régionale de la santé et

- des services sociaux de Montréal-Centre; 1998:40. <http://www.santecom.qc.ca/Bibliothequevirtuelle/santecom/35567000016920.pdf>. Accessed April 11, 2019.
23. Bernat DH, Choi K. Differences in cigarette use and the tobacco environment among youth living in metropolitan and nonmetropolitan areas. *J Rural Health*. 2018;34(2):80-87. doi:10.1111/jrh.12194
 24. Hart JL, Walker KL, Sears CG, et al. The “state” of tobacco: perceptions of tobacco among Appalachian youth in Kentucky. *Tob Prev Cessat*. 2018;4. doi:10.18332/tpc/81857
 25. Pateman K, Ford P, Fitzgerald L, et al. Stuck in the catch 22: attitudes towards smoking cessation among populations vulnerable to social disadvantage. *Addiction*. 2016;111(6):1048-1056. doi:10.1111/add.13253
 26. Glenn NM, Lapalme J, McCreedy G, Frohlich KL. Young adults' experiences of neighbourhood smoking-related norms and practices: a qualitative study exploring place-based social inequalities in smoking. *Soc Sci Med* 1982. 2017;189:17-24. doi:10.1016/j.socscimed.2017.07.021
 27. Bright BC, Soulakova JN. Evidence of telescoping in regular smoking onset age. *Nicotine Tob Res*. 2014;16(6):717-724. doi:10.1093/ntr/ntt220
 28. Kaminski A, Nauerth A, Pfefferle PI. [Health status and health behaviour of apprentices in the first year of apprenticeship - first results of a survey in vocational training schools in Bielefeld]. *Gesundheitswesen Bundesverb Ärzte Öffentl Gesundheitsdienstes Ger*. 2008;70(1):38-46. doi:10.1055/s-2007-1022528
 29. US Department of Health and Human Services. *Efforts to prevent and reduce tobacco use among young people*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012. <https://www.ncbi.nlm.nih.gov/books/NBK99240/>. Accessed May 14, 2020.
 30. Babb S, Malarcher A, Schauer G, Asman K, Jamal A. Quitting smoking among adults - United States, 2000-2015. *MMWR Morb Mortal Wkly Rep*. 2017;65(52):1457-1464. doi:10.15585/mmwr.mm6552a1
 31. O'Loughlin J, Gervais A, Dugas E, Meshfedjian G. Milestones in the process of cessation among novice adolescent smokers. *Am J Public Health*. 2009;99(3):499-504. doi:10.2105/AJPH.2007.128629
 32. Dugas E, Wellman R, Kermack A, Tremblay M, O'Loughlin J. Reasons young smokers do not use NRT even when it is available free-of-charge: An exploratory study. *Can J Addict*. 2016;7:14-21.
 33. Marmot Review Team. *Fair Society, healthy lives: strategic review of health inequalities in England post 2010*. 2010:242. <http://www.parliament.uk/documents/fair-society-healthy-lives-full-report.pdf>