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Predictors of nicotine dependence symptoms among never-smoking adolescents: A longitudinal analysis from the Nicotine Dependence in Teens Study

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ABSTRACT

Background: Recent cross-sectional studies suggest some adolescents who have never smoked cigarettes experience nicotine dependence (ND) symptoms and that exposure to second-hand smoke, social exposure to smoking, and alcohol use are plausible correlates. The aim of this study was to replicate and extend these findings by investigating possible predictors of ND symptoms longitudinally.
Method: Participants included 847 secondary school students who had never smoked cigarettes enrolled in the Nicotine Dependence in Teens Study. Adolescents completed self-report questionnaires measuring smoking status, ND symptoms, and risk factors for ND in smokers (i.e., socio-demographic indicators, social exposure to smoking, psychosocial indicators, and substance use) in 20 survey cycles from 7 to 11th grade. Generalized estimating equations, which account for repeated measures within individuals, were used to test the predictors of ND symptoms.
Results: Consistent with previous research, 7.8% of never-smokers across all cycles endorsed at least one ND symptom. Younger age ($p \leq .001$), country of birth ($p \leq .05$), peer smoking ($p \leq .001$), teacher smoking ($p \leq .05$), depression ($p \leq .05$), stress ($p \leq .001$), lower self-esteem ($p \leq .05$), impulsivity ($p \leq .05$), and alcohol use ($p \leq .001$) predicted greater ND symptoms in multivariable modeling.
Conclusions: Replicating previous cross-sectional findings, peer smoking and alcohol use predicted ND symptoms among never-smoking adolescents. Extending these findings, previous predictors only observed among ever-smokers, including socio-demographic and psychosocial indicators, also predicted ND symptoms. This longitudinal investigation demonstrated the temporal relation of the predictors preceding ND symptoms. Future research should consider longer prospective studies with younger children to capture early onset of ND symptoms and with longer follow-up to detect eventual smoking uptake.

1. Introduction

Nicotine dependence (ND) is defined by symptoms of withdrawal, tolerance, and difficulty controlling tobacco use during a 12-month period (American Psychiatric Association, 2000). According to this clinical conceptualization, daily smoking is a requisite criterion for its diagnosis. However, this notion has been challenged by research suggesting that ND can be reported not only soon after smoking initiation, but also before initiation. The aim of the present study was to identify predictors of ND symptoms in a longitudinal sample of adolescent never-smokers.

Early reports of ND symptoms have been observed among ever-smokers. DiFranza et al. (2000) found that 22% of adolescents experienced ND symptoms within the first month following consumption of at least one cigarette, with 6% reporting at least one symptom in the first two weeks. Surprisingly, a small percentage of never-smokers endorsed "really needing a cigarette" (2.5%) and "having strong cravings to smoke" (1.7%). Following smoking initiation (0 mos), 20% of adolescent smokers reported mental addiction (2.5 mos), cravings (4.5 mos), physical addiction (5.4 mos), withdrawal symptoms (11.0 mos) and tolerance (13.0 mos), well before the onset of weekly smoking (19.4 mos) and the development of ICD-10 dependence (40.6 mos; Gervais et al., 2006). Such findings provide convincing evidence that ND symptoms can be reported early in the course of smoking. Subsequent research examined

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risk factors during adolescence associated with early reports of ND among smokers.

1.1. Predictors of ND symptoms during adolescence in smoking populations

Social exposure to smoking by significant others during adolescence is associated not only with smoking behavior (O'Loughlin et al., 2009), but also with ND. Parental smoking (Brook et al., 2009; Kleinjan et al., 2012) and parental ND (Hu et al., 2011) during adolescence were found to predict ND in adolescent and adult smokers. Further, sibling smoking and peer smoking predicted ND in adolescent smokers (Audrain-McGovern et al., 2007; De Leeuw et al., 2009; Hu et al., 2011; Wileyto et al., 2009).

Psychosocial indicators have also been identified as risk factors for ND among smoking adolescents. Depressed mood and novelty-seeking predicted ICD-10 ND and loss of autonomy over tobacco use (DiFranza et al., 2007; Karp et al., 2006). Moreover, externalizing behavior problems (Hu et al., 2011; Storr, 2008) have been identified as risk factors, whereas impulsiveness was inversely associated with ICD-10 ND (DiFranza et al., 2007). With respect to substance use, alcohol has been found to predict ND among smoking adolescents (Storr, 2008; Wileyto et al., 2009).

In addition to identifying risk factors for ND, growth-modeling studies demonstrate that ND emerges through longitudinal trajectories during adolescence (Hu et al., 2008; Kleinjan et al., 2010, 2012). Trajectories are based on distinct profiles (e.g., severity, timing, symptoms). Factors predicting trajectory membership include conduct disorder, parental ND, novelty-seeking (Hu et al., 2008), parental and peer smoking, and depression (Kleinjan et al., 2010). Taken together, social exposure to smoking, psychosocial risk factors, and substance use have been found to predict ND and trajectory membership in adolescent smokers.

1.2. ND symptoms during adolescence in tobacco-naïve populations

Extant literature demonstrates ND symptoms can be reported not only by smokers, but also by never-smokers. It is plausible that second-hand smoke exposure (SHS) explains this unexpected and intriguing observation. Prokhorov et al. (2005) found that the prevalence of 5 of 7 withdrawal symptoms was similar in never- and former smokers. Bélanger et al. (2008) reported 4.6% of never-smoking 5th graders endorsed at least one ND symptom, and SHS exposure in cars (*Hedges g* = .09), sibling smoking (g = .14), and peer smoking (g = .10) were associated with ND symptoms; parental smoking was not associated (g = .06). Racicot et al. (2011a,b) found that the number of smokers among parents, siblings, and peers (g = .16) predicted ND symptoms in adolescent never-smokers. Moreover, Racicot et al. (2011a,b) found 6.2% of never-smokers endorsed at least one ND symptom at baseline. Alcohol use (g = .11) and peer smoking (g = .07) were associated with ND symptoms; parental (g = .02) and sibling smoking (g = .02) were not associated. Relatedly, never-smoking adolescents reporting ND symptoms have an increased likelihood of smoking susceptibility (Okoli et al., 2009) and smoking initiation (O'Loughlin et al., 2009). Taken together, there is emerging evidence that never-smokers endorse ND symptoms, that smoke exposure itself predicts which never-smokers will endorse these symptoms, and that ND symptoms are a risk factor for eventual initiation.

To date, cross-sectional data indicate ND has been observed in never-smoking populations, and social exposure to smoking and substance use are correlates of ND symptoms. Given that ND predicts smoking susceptibility and initiation, identifying predictors of ND symptoms among never-smokers warrants further investigation. The current objective was to identify predictors of ND symptoms in a school-based, longitudinal sample of adolescents who had never smoked. Potential predictors were selected based on previously demonstrated associations with ND in adolescent smokers and included socio-demographic indicators, social exposure to smoking, psychosocial indicators, and substance use.

2. Method

2.1. Procedure and participants

Nicotine Dependence in Teens (NDIT) is a longitudinal cohort of 1293 7th grade students, aged 12–13 years at baseline, designed to investigate the onset and development of cigarette smoking and ND. Students were recruited in a convenience sample of 10 public schools in Montréal (Québec, Canada) selected in partnership with school boards and principals. To maximize representativeness, schools were purposely selected from urban, suburban, and rural settings, as well as low, moderate, and high socioeconomic districts. Data were collected in 20 survey cycles from 1999 to 2005 (4 per school year from grade 7 to 11). Self-report questionnaires were administered at school in the language of instruction (i.e., English or French). All participants provided assent; informed parental consent was obtained in signed consent forms. NDIT received ethics approval from the *Centre de recherche du CHUM* (#ND06.087).

2.2. Measures

2.2.1. Smoking status. Smoking status was assessed at each survey cycle using two items: "Have you ever in your life smoked a cigarette, even just a few puffs?" (*No* to *Yes, more than 10 times*) and "Check the one box that describes you best…" (*I have never smoked a cigarette, even just a few puffs* to *I smoke cigarettes every day*). Never-smoking was defined conservatively as having never smoked a cigarette, not even a few puffs.

2.2.2. ND symptoms. ND symptoms were assessed with items adapted from an ND/craving symptom indicator (O'Loughlin et al., 2002a). Adolescents rated four items on a 4-point scale: "When you see other kids your age smoking cigarettes, how easy is it for you not to smoke?" (*Very easy* to *Very difficult*); "How often have you felt like you really need a cigarette?" (*Never* to *Often*); "How physically addicted to smoking cigarettes are you?" (*Not at all* to *Very*); and "How mentally addicted to smoking cigarettes are you?" (*Not at all* to *Very*). The original ND/craving symptom indicator was based on a sample of smoking adolescents and evidenced excellent internal reliability (Cronbach's α = .94), test-retest reliability (ICC = .91), and convergent validity with the Hooked on Nicotine Checklist (r = .91) and ICD-10 (r = .82). The adapted items were those four answered by never-smokers; principal components analysis revealed the original component structure was retained (i.e., all items loaded on one component; all loadings > .6). Consistent with previous scoring schemes (Bélanger et al., 2008; Racicot et al., 2011a,b), items were summed to yield a composite score (range 0–12). Prevalence data are estimated for those who endorse at least one ND symptom (i.e., non-zero score).

2.2.3. Socio-demographics. Socio-demographic data included age, sex, language spoken at home, country of birth, parental education, and perceived family income.

2.2.4. Social exposure to smoking.

2.2.4.1. Adult smoking. Adolescents indicated whether adults residing in their household smoked cigarettes, based on a list of 10 family members (e.g., mother, father, aunt). The response categories were summed to yield the total number of smoking adults (range 0–10).

2.2.4.2. Sibling smoking. Adolescents reported how many siblings, including step- or half-siblings, smoked. The response categories were summed to yield the total number of smoking siblings.

2.2.4.3. Peer smoking. Adolescents answered, "How many of the friends whom you usually hang out with smoke cigarettes?" using a 5-point scale (*None* to *Most or all*).

2.2.4.4. Schoolmate and school personnel smoking. Adolescents answered, "I see students smoke near the school" using a 3-point scale (*Not at all true* to *Very true*). A second question was asked about teachers/school staff.

2.2.5. Psychosocial indicators.

2.2.5.1. Depression. Depression was measured with the six-item Mellinger Depressive Symptoms Scale (Kandel & Davies, 1982). Adolescents rated items over the past 3 months using a 4-point scale (*Never* to *Often*). Items are summed to create a total score (range 0–18); higher scores indicate greater depression. This measure evidences good internal consistency (α = .89, Chaiton et al., 2010; α = .85, present study).