



Sex specific trajectories in cigarette smoking behaviors among students participating in the Unplugged school-based randomized control trial for substance use prevention

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ABSTRACT

Objectives: Understanding the developmental pathways and sex differences in cigarette smoking behaviors in adolescents has the potential to positively impact substance abuse prevention and to reduce smoking-related health problems. Using data from the Unplugged school-based prevention trial, we investigated different patterns of smoking behavior development among secondary school students in the Czech Republic.

Methods: Growth mixture modeling was used to examine different trajectories in cigarette smoking behaviors among male and female students (N = 1874 6th graders; 50.4% male, mean age 11.8 years at baseline) participating in the Unplugged school-based randomized control trial for substance use prevention.

Results: A two-class model characterized cigarette use as a function of sex and Unplugged intervention status. More rapid cigarette use increases were observed in females (OR = 1.17, $p = 0.01$ in both rapid/moderate and slow smoking escalator classes) as compared to males. Further, in both classes, more rapid increases in smoking were observed for the control group as compared to the intervention group (OR = 1.22, $p < 0.01$ slow escalators; OR = 1.54, $p = 0.08$ rapid/moderate escalators). There was no difference in sex distribution when comparing the two classes (OR = 1.02, $p = 0.98$).

Conclusions: This study adds to a growing literature on developmental and sex differences in cigarette use among adolescents. This research supports additional multi-year prevention strategies aimed at adolescent females and early treatment programs for adolescent smokers to prevent increasing cigarette use with age.

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1. Introduction

The long-term consequences of cigarette smoking are the leading cause of preventable death, causing 5.4 million deaths annually worldwide, and is projected to increase to (World Health Organization and Regional Office for Europe, 2008). Tobacco use often is initiated in adolescence (Mowery, Brick, & Farrelly, 2000). Tobacco smoking in childhood and adolescence negatively influences lung functions including respiration, decreases physical fitness, and increases the risk of developing cardiovascular diseases later in life (CDCP – Centers for Disease Control & Prevention, 2008). The Czech Republic has one of the highest prevalences of tobacco use among youth in the European Union member states (EU) and is also high compared to youth in the United States (Hibell et al., 2009; Johnston, O'Malley, Bachman, & Schulenberg, 2011). There is a clear

need for the development and implementation of the effective prevention interventions.

The developmental history leading to established smoking is an important consideration when designing and evaluating prevention interventions. The developmental history can be characterized by following the smoking stages: preparation (nonsmoker's positive ideas and beliefs about smoking), initiation (the first few tries), becoming a smoker, and maintenance of smoking (Leventhal & Cleary, 1980; Mayhew, Flay, & Mott, 2000). In the last decade, a number of adolescent tobacco smoking trajectories were introduced in the literature, ranging from three to six distinct classes (Brook et al., 2008; Brook, Zhang, Brook, & Finch, 2010; Chassin et al., 2008; Colder et al., 2001; Costello et al., 2008; Karp et al., 2005; Riggs et al., 2007; Stanton et al., 2004; White, Pandina, & Chen, 2002). The age of smoking onset and the speed of escalation of tobacco use may predict symptoms of nicotine dependence and tolerance among novice adolescent smokers (Karp et al., 2005). Colder et al. (2001) identified an 'early rapid escalators' group as smokers with early onset (at age 13) who rapidly became heavy smokers; 'late moderate escalators' who smoked occasionally up until age 15 but progressed to moderate smoking; 'late

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slow escalators' who began to increase their smoking to light levels after age 15; 'stable light smokers' who smoked 1–2 cigarettes per month; 'stable puffers' who smoked a cigarette sporadically. Adolescents in the rapid cigarette smoking escalators class may be considered a group with increased smoking-related health risks and in need of intervention.

Another issue to consider is widely reported sex differences in cigarette smoking behaviors in adolescence (DiFranza et al., 2002; Mermelstein, 1999; Richardson, Memetovic, Ratner, & Johnson, 2011; Thorner, Jaszyna-Gasior, Epstein, & Moolchan, 2007). Guo, Reeder, McGee, and Darling (2011) report a higher prevalence of daily smoking in female students as compared to daily smoking males. Czech 16 year old females (45%) reported higher past month cigarette use as compared to Czech males of the same age (36%) (Hibell et al., 2009).

Risk factors that increase the probability of experimentation and established smoking may be modified by substance abuse prevention interventions, some of which produce sex specific effects. School-based prevention programs comprise one approach in preventing smoking in childhood and adolescence (Faggiano et al., 2008). Thomas and Perera (2006) conducted a review of school-based tobacco and other drug prevention interventions. They found 16 high quality prevention studies with follow-up periods longer than six months and that used the social influence or combination of social competence and social influence models. The review showed minimal sex-specific effects within these higher quality randomized controlled trials. However, in a recent European multi-country, school-based substance abuse prevention trial (Vigna-Taglianti et al., 2009), short-term (3 months) sex differences in the comprehensive social influence substance abuse prevention intervention was found, with a statistically significant positive treatment effect among boys in frequent smoking and daily smoking groups as compared to no effect among girls.

More recently, additional statistical methods are being used to better understand the trajectories of smoking behaviors and are also used in the planning of substance use prevention interventions. There are a considerable number of studies published using conventional growth modeling (Muthén, 2004) for longitudinal data (Brown, Catalano, Fleming, Haggerty, & Abbott, 2005; DeGarmo, Eddy, Reid, & Fetrow, 2009; Griffin, Botvin, & Nichols, 2006; Hecht, Graham, & Elek, 2006; Khoo, 2001; Liu, Flay, & Aban Aya Investigators, 2009; Mason, Kosterman, Hawkins, Haggerty, & Spoth, 2003; Wills, Ainette, Stoolmiller, Gibbons, & Shinar, 2008; Wood et al., 2010). Taylor, Graham, and Cumsille (2000), using latent growth modeling of change and efficacy, found statistically significant positive differences in reported cigarette use and lower rates of growth for reported cigarette use in the intervention group in the Adolescent Alcohol Prevention Trial (AAPT) as compared to the control group. However, the use of this technique to examine the effect of a prevention intervention on different trajectories in cigarette smoking behaviors and sex is scarce.

The present study uses growth mixture modeling (Muthén & Shedden, 1999) to examine different trajectories in cigarette smoking behaviors in male and female students participating in the Unplugged prevention intervention.

2. Methods

We have previously reported on the design and conduct of this prevention trial in detail (Gabrhelik et al., 2012; Miovisky, Stastna, Gabrhelik, & Jurystova, 2011), as well as on the intervention (van Der Kreeft et al., 2009) and description of the study population (Gabrhelik et al., 2012). We provide a brief summary below.

2.1. Study design and intervention

The study was designed as school-based, prospective, randomized controlled prevention trial conducted with 6th grade students (11–13 years) in the Czech Republic.

The intervention consists of 12 units, each lasting 45 min. The Unplugged prevention curriculum is based on the comprehensive social influence (CSI) model (McGuire, 1961; Sussman et al., 2003; Sussman et al., 2004; Tobler, 1986). In addition to the introductory unit, three units are focused on adolescents' substance-specific knowledge and attitudes (on alcohol, tobacco, and other drugs), four units address interpersonal skills, and four focus on intrapersonal skills (van Der Kreeft et al., 2009). The teacher, who delivers the intervention, is provided with a handbook to lead him/her through each standard structured lesson (unit's schedule, theme, objectives, supportive materials needed, a suggested introductory activity, description of the core activities, and conclusion). Teachers received 12 h of training in the Unplugged method and an additional 2.5 h of technical issue assistance (Adamkova et al., 2009). The Unplugged Teacher's Handbook provided teachers with student learning objectives, teaching aids, and core activities for each unit. Each student is provided with a colored personal workbook. The 2007 revised version of the Unplugged intervention materials translated into Czech was used. The 2007 Unplugged revised version has a new lesson order, changed graphics in the student workbook, shortened lessons for easier implementation, and the addition of innovative 'ice-breaker' activities in the Teacher's Handbook.

The baseline testing of self-reported substance use was conducted in September 2007. The intervention was delivered to the intervention arm during the school year of 2007/2008. Five follow-up assessments took place at the end and at the beginning of each school year (June/2008, Sept/2008, June/2009, Sept/2009, and June/2010).

Data were collected using the Czech version (Csémy et al., 2006) of the 2003 European School survey Project on Alcohol and other Drugs (ESPAD) questionnaire (Hibell et al., 2009). Student self-administered questionnaires were facilitated by trained Unplugged staff. Student participants used uniquely constructed codes to ensure confidentiality and to allow researchers to match questionnaires to individual students across all follow-up assessments.

The fidelity of the intervention delivery was tracked. All 12 lessons (100% of prevention program units) were delivered in all schools in the intervention arm in one academic year. Substance abuse prevention activities, independent of the trial intervention, were also monitored in both the intervention and the control groups (Jurystova et al., 2009). No interfering external substance abuse prevention interventions were reported.

The study was reviewed and approved by an independent ethics committee in the Czech Republic and the Johns Hopkins University Bloomberg School of Public Health Institutional Review Board.

2.2. Study population

The study sample consisted of 1874 6th grade students (11–13 years) from three regions in the Czech Republic. Eighty schools were randomized to either the intervention (40 schools; 1022 students, 54.5%) or control (34 schools; 944 students, 50.4%) arm in 2007. A total of 1874 6th graders (50.4% males, mean age 11.8 years) were tested at baseline and 1761 students (51.45% males, mean age 14.5 years) were tested at the final follow-up (2 years after the intervention). Data on the ethnic composition of the sample were not collected due to minimal ethnic variation and previous research showing no effect of ethnicity on outcomes in Czech school populations (e.g. Miovisky, Mioviska, Trapkova & Rehan, 2006; Miovisky, Mioviska, Rehan & Trapkova, 2007).

The present study explored the effect of the Unplugged intervention on cigarette smoking behaviors among primary-school age youths. Smoking behaviors were assessed over six time points: September 2007, June 2008, September 2008, June 2009, September 2009, and June 2010. Table 1 shows the smoking behaviors of the youths by sex at baseline.

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