



Perceived stress and poly-tobacco product use across adolescence: Patterns of association and gender differences



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ABSTRACT

Perceived stress—an endophenotype indicative of the tendency to appraise stress as frequent, unpredictable and unmanageable—is associated with adolescent cigarette smoking. It is unclear whether this association: (1) extends to alternative tobacco products, like electronic cigarettes and hookah (tobacco water pipe), which are increasingly popular among youth, and (2) differs by gender. In this report, data were drawn from a population-based longitudinal cohort of youth in Southern California. Perceived stress was assessed at baseline (7th or 8th grade; 2010). Electronic cigarette, hookah, combustible cigarette, and cigar use were assessed at a 4-year follow-up (11th or 12th grade; 2014). After adjusting for confounders, polytomous logistic regressions showed that a standardized baseline perceived stress score ($M = 0$, $SD = 1$) predicted electronic cigarette, hookah, combustible cigarette, and cigar use and a poly-tobacco use index at the 4-year follow-up in the overall sample. Interactions between perceived stress and gender were also observed (Interaction P s < 0.05), which demonstrated that the association of perceived stress with tobacco product use and poly-use were stronger in females (ORs for current use range: 1.47 to 1.72) than males (ORs range: 0.93 to 1.31). Adjusting for baseline perceived stress, the change in perceived stress from baseline to follow-up was also positively associated with use and poly-use of most tobacco products in females and in males to some extent. In the current era in which teen use of alternative tobacco products is increasingly common, adolescent tobacco use and poly-use research and prevention strategies should address gender-specific origins of tobacco product use risk and consider perceived stress and other emotional endophenotypes in such risk pathways.

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1. Introduction

The association between mental health and increased risk of combustible cigarette smoking among adolescents is complex and extends across diverse forms of psychopathology (Kandel et al., 1997; Patton et al., 1998; Minichino et al., 2013; Hockenberry et al., 2011). Perceived stress (Cohen et al., 1983)—a heritable tendency (Federenko et al., 2006) to appraise negative events and resultant stress in one's life as frequent, unpredictable and uncontrollable along with a lack of resources to cope with negative events—is a putative endophenotype of several psychiatric

syndromes implicated in cigarette smoking, including anhedonic depression (Pizzagalli, 2014), anxious dysthymia (Niculescu and Akiskal, 2001), psychosis (Myin-Germeys and van Os, 2007), post-traumatic stress (Connor et al., 2007), and various personality disorders (Trull et al., 2010). Adverse environments (Cohen et al., 1993), genetically determined neurobiological stress system dysregulation (Bogdan et al., 2013), and the interaction of these two factors (Otte et al., 2007) are presumed to underlie perceived stress. Consequently, perceived stress could demarcate a broad array of etiological sources and mental health problems relevant to smoking. As brief preventive psychosocial interventions can effectively reduce perceived stress among youth (Deckro et al., 2002), perceived stress may be a useful marker of protracted risk for smoking and a fruitful target for tobacco use prevention.

The empirical association between perceived stress and

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smoking among adolescents has been consistent across various populations (Fields et al., 2009; Kim and Park, 2016; Lorenzo-Blanco and Unger, 2015) and robust after controlling for confounding influences (Finkelstein et al., 2006; Siqueira, L. et al., 2000; Sussman et al., 1998). A potential explanation for this association is that adolescents with high perceived stress may turn to tobacco use as a pharmacological means of coping with sources of distress that are otherwise unmanageable. Given that perceived stress could be derived from core difficulties in behavioral and emotional regulation, uptake of tobacco use as a maladaptive means of coping with distress may be disproportionately likely in youth with high levels of perceived stress. That is, behavioral and emotional regulation disturbances could be a common underlying vulnerability for perceived stress, tobacco use, and other emotional-behavioral conditions. Consistent with this notion, adolescents with higher levels of perceived stress are more likely to cite tension reduction as a motive for smoking (Bonilha et al., 2013).

Despite well-documented evidence that perceived stress may increase risk of adolescent smoking, associations between perceived stress and the use of increasingly popular alternative tobacco products, such as electronic cigarettes (e-cigarettes), hookah (tobacco water pipe) and cigars, have not yet been widely investigated (c.f., see Brikmanis and Doran, 2017 for one such study in young adults). This is an important gap in the literature, given that conventional cigarette use has steadily declined while in 2015 an estimated 16%, 7%, and 9% of US high school students used e-cigarettes, hookah, and cigars, respectively, within the past 30 days (Singh et al., 2016). Accordingly, we chose to study four tobacco products (i.e., e-cigarettes, cigarettes, cigars and hookah) that are the most commonly used by youth and together account for 84.2% of all tobacco product use (Singh et al., 2016).

Another gap is the dearth of data on gender differences in the association of perceived stress with tobacco use. Poor mental health and stress have been shown to be a stronger risk factor for smoking uptake among females as compared to males (Byrne and Mazanov, 2003; Audrain-McGovern et al., 2015; Yue et al., 2015). Thus, research examining whether the association between perceived stress and smoking extends to new and emerging alternative tobacco products should also consider the role of gender/sex. Evaluating whether gender modifies the extent to which perceived stress confers risk for alternative tobacco product use can inform gender-specific multi-product tobacco prevention strategies.

To address these questions, perceived stress was examined as a predictor of later tobacco product use in a population-based cohort of southern California adolescents. We hypothesized that youth with higher levels of perceived stress in early adolescence (i.e., 12–14 years old) would be more likely to report ever use and past 30-day use of conventional cigarettes, e-cigarettes, hookah and cigars and poly-users of multiple tobacco products four years later (i.e., 16–18 years old). We also tested the hypothesis that the association between perceived stress and subsequent tobacco product use would be stronger in females than in males. Some evidence suggests that in addition to static levels of perceived stress prospectively increasing risk of smoking, trajectories of increasing perceived stress may also predict combustible cigarette use (Cohen and Lichtenstein, 1990). Thus, a supplemental aim was to examine the association of changes in perceived stress from baseline to follow up with tobacco product use at follow-up.

2. Materials and methods

2.1. Sample and procedures

Participants were initially recruited into the Southern California Children's Health Study (CHS) in 2003—a longitudinal study

involving schools in 12 communities across southern California (for additional details see McConnell et al., 2006). Perceived stress was originally measured when participants were in 7th or 8th grade (Spring 2010; i.e., baseline time point in the current report). Tobacco product use and perceived stress were assessed four years later when participants were in 11th or 12th grade (Spring 2014; follow-up). At both assessments participants completed questionnaires in school classrooms under the supervision of study staff. Of the 3212 participants who were surveyed at baseline, 1914 (60%) completed the 4-year follow-up. Participants who completed both waves of assessment but did not provide data on perceived stress or at least one tobacco product use outcome ($N = 63$) were excluded from this report, leaving a total of 1851 participants included in the analyses of this report (see Supplementary text and Supplementary Table 1 for an attrition analysis). Because there were intermittent missing responses across each outcome, each analysis was restricted to participants for whom data were available on that respective outcome (N s ranged from 1842 to 1849, see Table 2). The study protocol was approved by the University of Southern California Institutional Review Board.

2.2. Measures

Perceived stress: The 4-item version of the Perceived Stress Scale (PSS; Warrtig et al., 2013), an extensively validated measure of perceived stress appropriate for use in adolescent populations (Martin et al., 1995), was the primary predictor in this study. The PSS instructs respondents to report on experiences in the past month with the following questions: How often have you felt: 1) That you were unable to control the important things in your life?; 2) Confident about your ability to handle your personal problems?; 3) That things were going your way?; and 4) That difficulties were piling up so high that you could not overcome them? Participants selected the following response options (“Never” = 0; “Almost never” = 1; “Sometimes” = 2; “Fairly often” = 3; and “Very often” = 4). After reverse scoring questions two and three, an overall composite stress score was calculated as the sum of the four questions (ranging from 0 to 16). For the primary analyses the baseline raw sum score was standardized ($Mean = 0$; $Standard Deviation = 1$) to facilitate interpretation of risk estimates by presenting the results on a common effect size metric comparable to other studies that may use measures with different quantitative scaling properties. Change in stress was calculated by subtracting the raw perceived stress composite score at baseline from the score at follow-up; this change score was standardized in the same fashion.

Tobacco product use: Questionnaires assessed the use of traditional and alternative tobacco products at follow-up, including combustible cigarettes, e-cigarettes, hookah, and cigars (Barrington-Trimis et al., 2015). Participants were asked whether they had ever used each product and, if so, the number of days they used each product in the past 30 days. Responses to these two questions were used to classify participants into one of three use categories for each product. Participants who reported having “never tried” a specific product (i.e., not “even one or two puffs”) were classified as “never users.” Participants who had used a product but not in the last 30 days were classified as “prior users.” Participants who had used a product during the past 30 days were classified as “current (past 30-day) users” of that product. We also computed two poly-tobacco product use outcomes: (a) the total number of different tobacco products a participant had ever used, ranging from 0 to 4, and (b) the total number of different tobacco products a participant had used in the past 30 days (0 vs. 1 vs. 2 vs. 3 or 4).

Covariates: Self-administered questionnaires completed by the

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