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Short communication

Trait anxiety and nicotine dependence in adolescents A report from the DANDY study

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Abstract

The Revised Children's Manifest Anxiety Scale (RCMAS) and the Hooked on Nicotine Checklist (HONC) were used to measure trait anxiety and tobacco dependence in a population of 581 adolescents. Smokers demonstrated higher mean RCMAS scores (9.3, S.D. = 6.5) than nonsmokers did (7.4, S.D. = 6.2, $t = -3.7$, $P < .001$). Participants with symptoms of tobacco dependence had higher RCMAS scores (mean = 11.6, S.D. = 6.0, $n = 115$) than did the participants without symptoms (mean = 7.8, S.D. = 6.0, $n = 177$, $t = -5.3$, $P < .001$). Scores on the RCMAS and the HONC correlated positively ($n = 292$, $r = .32$, $P < .001$). Participants who had felt relaxed in response to their first exposure to nicotine were also more likely to develop dependence and to report that stress caused cravings or a need to smoke. Trait anxiety and relaxation in response to the first dose of nicotine were unrelated and appear to be independent risk factors for the development of nicotine dependence and a reliance on tobacco to cope with stress.

Keywords: Trait anxiety; Nicotine dependence; Adolescents

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1. Introduction

Higher levels of trait anxiety among adult smokers as compared with nonsmokers have been seen in three studies (Pritchard & Kay, 1993; Waal-Manning & Hamel, 1978; Williams, Hudson, & Redd, 1982) but not in four others (Canals, Doménech, & Bladé, 1996; Farley & Lester, 1995; Kick & Cooley, 1997; Takemura, Akanuma, Kikuchi, & Inaba, 1999). However, all of the negative studies examined smoking status rather than nicotine dependence.

We have previously reported that a calming response from the first dose of nicotine predicts a progression to monthly smoking and higher dependency scores on the Hooked on Nicotine Checklist (HONC; DiFranza et al., 2004). Here, we examine two factors, trait anxiety and a calming response from nicotine, and their relation to nicotine dependence and the need to use tobacco to cope with stress. Under the autonomy theory of dependence, individuals who rely on tobacco to cope with stress would be considered dependent (DiFranza et al., 2002). We hypothesized that the need to use nicotine to cope with stress would be higher among anxious individuals and that, therefore, individuals with high trait anxiety would be at increased risk of losing their autonomy over tobacco.

2. Methods

The data presented here are from the Development and Assessment of Nicotine Dependence in Youth (DANDY) study. A detailed description of the methods have been published (DiFranza et al., 2000, 2002). The DANDY study followed a cohort of 679 seventh grade students over a period of 3.5 years. The data were collected by trained interviewers by means of individual interviews that were conducted in the schools approximately every 4 months between January 1998 and June 2001. Ten rounds of interviews were completed. Participants were recruited from public schools in two small Massachusetts cities. A passive consent process was used. The initial cohort represents 94% of the 721 students who were invited to participate and 76% of all seventh graders ($n = 900$). The participants had a mean age of 13 years at the outset (range 12–15). The population was 68% non-Hispanic White, 20% Hispanic, 5% Asian, 4% Black, 0.6% Native American, and 2.5% unspecified.

The current smoking status and maximum intensity of smoking was recorded. Participants were tobacco users if they had ever tried a cigarette, cigar, or smokeless tobacco, and a monthly smoker if tobacco was ever used on 2 days within any 60-day period. The participants were asked if they had ever inhaled on a cigarette and if doing so had made them feel relaxed. Previously published data on this item is discussed below (DiFranza et al., 2004).

The HONC, a measure of nicotine dependence (Table 1), was administered to all tobacco users (DiFranza et al., 2002). Endorsement of any HONC item constitutes a positive HONC and indicates a loss of full autonomy over the use of tobacco. In the DANDY study, among all tobacco users, a positive HONC was associated with a failed attempt at cessation

Table 1
Scores on the Revised Children's Manifest Anxiety Scale (RCMAS) in relation to individual items on the Hooked on Nicotine Checklist

		N	Mean RCMAS score	Standard deviation	$P <$ [a]
Have you ever tried to quit, but could not?	Yes	73	11.1	5.9	.001
	No	238	8.6	6.5	
Do you smoke *now* because it is really hard to quit?	Yes	37	10.7	5.6	.05
	No	273	9.0	6.5	
Have you ever felt like you were addicted to tobacco?	Yes	66	11.2	5.6	.001
	No	245	8.7	6.6	
Do you ever have strong cravings to smoke?	Yes	90	11.9	6.3	.001
	No	220	8.1	6.2	
Have you ever felt like you really needed a cigarette?	Yes	101	11.5	6.0	.001
	No	210	8.1	6.3	
Is it hard to keep from smoking in places where you are not supposed to, like school?	Yes	43	12.0	6.1	.001
	No	267	8.8	6.4	
When you tried to stop smoking...(or, when you have not used tobacco for a while...)					
Did you find it hard to concentrate because you couldn't smoke?	Yes	58	12.2	5.8	.001
	No	253	8.5	6.4	
Did you feel more irritable because you couldn't smoke?	Yes	66	12.3	6.0	.001
	No	244	8.3	6.2	
Did you feel a strong need or urge to smoke?	Yes	83	11.2	5.7	.001
	No	228	8.5	6.6	
Did you feel nervous, restless or anxious because you couldn't smoke?	Yes	69	11.8	5.8	.001
	No	241	8.4	6.4	

[a] Calculated with the Mann–Whitney *U* test.

(OR = 29) and continued smoking until the end of follow-up (OR = 44; DiFranza et al., 2002). Positive responses to the 10 HONC items are tallied to measure the strength of dependence. The HONC has a reliability of α=.91–.94, and HONC scores correlate with the maximum amount smoked (r=.65), the maximum frequency of smoking (r =.79), and scores on the Stanford Dependence Index (DiFranza et al., 2002; O'Loughlin, Tarasuk, DiFranza, & Paradis, 2004). Participants who reported feeling addicted, having cravings, a need to smoke, or the withdrawal symptoms of nervousness, irritability, or urges were asked if these symptoms were induced by stress.

Trait anxiety was measured with a single administration of the 37-item Revised Children's Manifest Anxiety Scale (RCMAS) during the second interview (Reynolds & Richmond, 1995). The RCMAS has a Lie subscale "designed to detect acquiescence, social desirability,

or the deliberate faking of responses,. . .or trying to please the examiner" (Reynolds & Richmond, 1995). The current report considers only the 581 participants that had not been lost to attrition by the second interview and who therefore completed the RCMAS. Comparisons between the single measure of the RCMAS and the lifetime reports of HONC symptoms and tobacco use are appropriate, as the RCMAS measures anxiety as a personality trait, which is thought to be stable over time.

The Pearson correlation coefficient was used to compare scores on the RCMAS with the HONC and the maximum amount smoked. Nonparametric tests (the Spearman correlation coefficient) were also performed. A P value of $<.05$ was used as a test of significance for the correlations. The t test and nonparametric equivalent tests (i.e., the Mann–Whitney U test) were used to compare the mean RCMAS scores for dichotomous variables. Due to multiple comparisons, a P value of $<.01$ was used as the test of statistical significance for the analyses presented in Tables 1 and 4.

3. Results

Among the participants who completed the RCMAS, 309 reported using tobacco at some time prior to their last interview, 135 smoked at least monthly and 87 smoked daily. There were no regular users of cigars or smokeless tobacco.

RCMAS scores ranged from 0 to 27. As hypothesized, RCMAS scores were significantly higher for tobacco users (Table 2) and correlated with the maximum amount smoked ($r=.28$,

Table 2
Scores on the Revised Children's Manifest Anxiety scale (RCMAS) in relation to tobacco use

		n	Mean	S.D.	t test	$P<$
Ever used tobacco?						
Yes	RCMAS score	309	9.3	6.4	−3.65	.001
No		273	7.4	6.2		
Yes	Lie subscale	309	2.3	2.2	5.96	.001
No		273	3.4	2.5		
Ever used tobacco monthly?						
Yes	RCMAS score	135	11.4	6.2	−5.56	.001
No		173	7.5	6.0		
Yes	Lie subscale	135	1.9	2.0	2.84	.005
No		173	2.6	2.3		
Ever used tobacco daily?						
Yes	RCMAS score	87	10.9	5.8	−3.01	.005
No		219	8.6	6.5		
Yes	Lie subscale	87	1.9	2.0	1.65	n.s.
No		219	2.4	2.2		

n.s.—Not significant.

$P < .001$). Tobacco users generally had lower scores on the Lie subscale which showed a weak, but significant, negative correlation with the maximum amount smoked ($r = -.14$, $P = .01$).

The HONC was completed by 292 participants (HONC score range 0–10, mean 2.1, S.D. = 3.2). The RCMAS scores correlated positively with the HONC scores ($n = 292$, $r = .32$, $P < .001$). Of the four RCMAS subscales, only the Lie subscale showed no correlation with the HONC scores. The participants with a positive HONC had higher RCMAS scores (mean = 11.6, S.D. = 6.0, $n = 115$) than the participants with a HONC score of 0 (mean = 7.8, S.D. = 6.0, $n = 177$, $t = -5.3$, $P < .001$). Scores on each of the RCMAS subscales were higher for participants with a positive HONC ($P < .001$), except for the Lie subscale, which did not differ according to HONC status. Table 1 shows that for each of the HONC symptoms, the RCMAS scores were higher for those participants reporting the symptom, with the differences reaching the .001 level of statistical significance for 9 of the 10 symptoms (Mann–Whitney U test).

RCMAS scores were significantly higher for participants with each of the six stress-induced symptoms (Table 3). Participants who felt relaxed in response to their first inhaled cigarette were twice as likely to progress to daily smoking (63.8%, $n = 47$), compared with those who did not feel relaxed (31.3%, $n = 160$, $\chi^2 = 16.2$, $P < .001$), and were more likely to report each of the 10 HONC symptoms (Table 4). All six stress-induced symptoms were more common among participants that had experienced a calming effect (statistically significant for four, Table 5). Mean RCMAS scores were not significantly higher among participants who felt relaxed with the first inhaled cigarette (11.3, $n = 40$) compared with those who did not (9.7, $n = 147$).

Table 3
Mean scores on the Revised Children's Manifest Anxiety Scale in relation to six stress induced symptoms of nicotine dependence

	N	YES Mean (S.D.)	NO Mean (S.D.)	Z	$P \leq$
Strong cravings to smoke when under stress	187	11.5 (6.0)	9.4 (6.6)	−2.2	.03
Really needed a cigarette when under stress	187	11.8 (5.9)	9.2 (6.6)	−2.9	.01
Felt addicted to tobacco when under stress	187	12.7 (5.1)	9.7 (6.6)	−2.3	.02
When trying to stop smoking...					
Felt more irritable when under stress	187	12.4 (6.5)	9.6 (6.4)	−2.2	.03
Felt a strong need or urge to smoke when under stress	187	12.3 (6.1)	9.5 (6.5)	−2.5	.01
Felt nervous, restless or anxious when under stress	187	13.7 (6.7)	9.6 (6.3)	−2.8	.01

Table 4
The relationship between relaxation in response to the first inhaled cigarette and each of the 10 symptoms of the Hooked On Nicotine Checklist

	Felt relaxed in response to the first inhaled cigarette?				
	n	Yes	No	χ^2	$P \leq$
Have you ever tried to quit, but couldn't?	207	55.3[a]	26.9	13.2	.001
Do you smoke *now* because it is really hard to quit?	206	32.6	13.1	9.4	.002
Have you ever felt like you were addicted to tobacco?	207	48.9	25.6	9.2	.002
Do you ever have strong cravings to smoke?	206	63.8	31.4	16.0	.001
Have you ever felt like you really needed a cigarette?	207	70.2	35.0	18.4	.001
Is it hard to keep from smoking in places where you are not supposed to, like school?	206	36.2	14.5	10.9	.001
When you tried to stop smoking...(or, when you have not used tobacco for a while...)					
Did you find it hard to concentrate because you couldn't smoke?	207	40.4	18.8	9.4	.002
Did you feel more irritable because you could not smoke?	207	48.9	21.9	13.2	.001
Did you feel a strong need or urge to smoke?	207	53.2	31.3	7.6	.006
Did you feel nervous, restless or anxious because you couldn't smoke?	206	48.9	25.2	9.7	.002

[a] The percent of subjects who experienced relaxation in response to the first cigarette that tried to quit but could not.

To determine if the effects of trait anxiety and a calming effect from the first cigarette were independent predictors of dependence, the population was stratified into those who had and had not experienced calm in response to the first inhalation. In both subgroups, the mean RCMAS scores were higher among participants with a positive HONC compared with participants with a negative HONC ($P < .05$ for all analyses using the *t* and the Mann–Whitney *U* tests). A logistic regression analysis was performed with HONC positive/negative as the dependent variable. Relaxation (yes/no) and RCMAS (divided into quartiles with the lowest quartile used as the reference group) were entered as independent variables. Relaxation remained a significant predictor of dependence (OR = 6.2, CI = 2.5,15.6, $P < .001$), and RCMAS scores showed a dose response relation to dependence (OR = 3.7,

Table 5
The relationship between feeling relaxed in response to the first inhaled cigarette and the later development of stress-induced symptoms of tobacco dependence in the population of 209 participants who answered the question regarding relaxation

	Felt relaxed in response to the first inhaled cigarette?			
	YES ($n=47$)	NO ($n=162$)	χ^2	$P<$
Strong cravings to smoke when under stress	46.8[a]	23.5	9.7	.002
Really needed a cigarette when under stress	55.3	25.9	14.3	.001
Felt addicted to tobacco when under stress	21.3	9.3	5.0	.025
When trying to stop smoking...				
Felt more irritable when under stress	27.7	12.3	6.4	.01
Felt a strong need or urge to smoke when under stress	25.5	17.9	1.3	n.s.
Felt nervous, restless or anxious when under stress	19.1	11.7	1.7	n.s.

n.s.—Not significant.
[a] The proportion of subjects who felt relaxed in response to the first inhaled cigarette that reported the symptom listed to the left.

CI = 1.2,11.5, $P<.025$ for the third quartile; OR = 6.3, CI = 2.0,19.1, $P<.001$ for the fourth quartile).

4. Comment

We found a robust association between trait anxiety and measures of tobacco use. Higher scores on the RCMAS were associated with all measures of tobacco use, the presence and strength of nicotine dependence, 9 out of the 10 HONC dependence symptoms, and six measures of the need to smoke in response to stress.

We term the relaxation that occurs with initial exposure a "primary relaxing effect" to distinguish it from a secondary relaxing effect resulting from the relief of nicotine withdrawal. A primary relaxing effect is predictive of monthly smoking, a higher maximum rate of smoking and the development of nicotine dependence (DiFranza et al., 2002). Here, we report that a primary relaxing effect is positively related to the strength of nicotine dependence, all 10 HONC symptoms, four measures of the need to smoke in response to stress, and the progression to daily smoking. Trait anxiety and a primary relaxing effect are independent risk factors; each is associated with a sixfold increase in the risk for the development of dependence.

It is unlikely that the primary relaxing effect would demonstrate such a persistent and robust association with the outcome measures studied here if it were based only on

expectations or social setting. Neurophysiological differences may be responsible for individual differences in the primary response to nicotine. Are individuals who experience a primary relaxing effect unique, or do all smokers experience a primary relaxing effect with continued exposure to nicotine? Do some individuals experience a primary relaxing effect with the first cigarette because they are less sensitive to the adverse effects of nicotine and are therefore able to tolerate a higher initial dose of nicotine? Do some individuals experience a primary relaxing effect at lower doses of nicotine than others do? Does tolerance to this effect develop? If individuals who experience a primary relaxing effect are unique, comparing their neurophysiological responses to nicotine with those of other smokers may provide insight into how nicotine causes dependence.

This is the first study to examine the relationship between stress-induced symptoms of dependence and anxiety. Individuals who have higher trait anxiety are at increased risk of feeling a need to smoke in response to stress. This is also true of individuals who experience a primary relaxing effect. Some smokers rely on tobacco to cope with stress due to higher levels of trait anxiety, while others may have learned to rely on tobacco to cope with stress due to an individual sensitivity to the relaxing effects of nicotine. Smokers who rely on tobacco to cope with stress might benefit from cessation strategies tailored to the cause of their reliance.

The Lie subscale data provide important support for the validity of previous reports from the DANDY study (DiFranza et al., 2000, 2002). Skeptics have suggested that the appearance of HONC symptoms within days of the onset of smoking might be an artifact resulting from smokers endorsing HONC items because they thought that the investigators would want them to. This explanation does not seem plausible in light of the data presented here. Compared with nonusers, tobacco users were consistently less likely to provide socially desirable responses, and Lie scores showed no relation to HONC status or HONC scores. Thus, there was no indication that participants who reported HONC symptoms were responding to perceived expectations. Additionally, the consistency with which RCMAS scores related to the individual HONC items makes it unlikely that the participants were fabricating HONC symptoms for any reason.

In this study, increased levels of trait anxiety and a primary relaxation response were independent risk factors for the development of nicotine dependence. Both contributed to the perceived need to smoke cigarettes to cope with stress.

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