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RESEARCH REPORT

The relationship between depressive symptoms and cigarette smoking in US adolescents

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Abstract

Aims. *Data from the Teenage Attitudes and Practices Survey were analyzed to assess the relationship between depressive symptoms and cigarette smoking.* **Designs, .Setting, Participants.** *Nationally representative sample of adolescents interviewed in 1989 and again in 1993.* **Measurements.** *Prevalence rate and adjusted odds ratio for smoking at follow-up by depressive symptoms status at baseline.* **Findings.** *Adolescents with depressive symptoms were more likely than other adolescents to start smoking.* **Conclusions.** *The associations between depressive symptoms and regular smoking appears to be established by adolescence.*

Introduction

A relationship between depression and cigarette smoking has been reported among adolescents (Kaplan *et al.*, 1984; Reynolds & Rob, 1988; Covey & Tam, 1990) and young adults (Kandel & Davies, 1986, Breslau, Kilbey & Andreski, 1991, 1993). Findings among adults appear more definitive than those among adolescents; depressive symptoms at a young age often present with other psychological problems, such as difficulties at home or risk-taking behavior (Kaplan *et al.*, 1984; Reynolds & Rob, 1988; Covey & Tam, 1990; Centers for Disease Control and Prevention, 1994a), and these issues increase the difficulty of assessment of the independent effects of depression. Studies of the relationship between cigarette smoking and depression in adolescents have also not evaluated whether depression is associated with smoking initiation, smoking cessation, or both. Because smoking initiation behavior occurs largely during adolescence, this relationship has clinical implications. It is unclear whether higher rates of smoking initiation in depressed adolescents result from higher rates of experimentation with cigarettes or later stages of smoking initiation.

Data from the Teenage Attitudes and Practices Survey (TAPS), a prospective cohort study of predictors of smoking initiation among US adolescents, offer an opportunity to address these issues over a 4-year period. The longitudinal design of the study permits examination of depressive symptoms at baseline in relation to rates and patterns of smoking at follow-up.

Method

Data source

TAPS is a prospective cohort study designed to assess adolescents' knowledge, attitudes and

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practices regarding tobacco use. All adolescents between 12 and 18 years of age who resided in households selected for the last two quarters of the 1988 US National Health Interview Survey (NHIS) and the first two quarters of the 1989 NHIS were sampled in the baseline TAPS (Centers for Disease Control and Prevention, 1991). The NHIS is the principal source of information on the health of non-institutionalized US civilians and uses a multi-stage probability design that permits representative sampling of all households in the United States. The response rate for the baseline TAPS was 82% which resembles the rate of 83% of NHIS supplements (Schoenborn & Boyd, 1989). Unlike the NHIS, which is based on household face-to-face interviews, the baseline TAPS relied on computer-assisted telephone interviewing to administer a standard questionnaire in 92% of respondents. Other respondents were administered a mail interview. For the follow-up TAPS survey, interviews were conducted from February to May of 1993. All adolescents participating in the baseline TAPS interview received a letter from the Director of the National Center for Health Statistics requesting their participation in a follow-up interview. Adolescents were informed that answers provided would be considered confidential and used only for statistical purposes and that data would be used to design health promotion programs for youth. Of the 9135 adolescents in the baseline TAPS who were eligible for follow-up, 7960 (87%) responded to the follow-up TAPS (Centers for Disease Control and Prevention, 1994b). Of these 7960 respondents, we excluded 75 who had missing information about depressive symptoms, which left 7885 for our analysis.

Definitions

TAPS participants were asked at baseline and follow-up: "Have you ever smoked one cigarette?", "Have you smoked at least 100 cigarettes in your life?", and "Think about the last 30 days. On how many of these days did you smoke cigarettes?" People who answered that they had smoked one but not 100 cigarettes were considered *puff smokers*. People who had smoked at least 100 cigarettes but had not smoked in the last month were considered *former* or *experimental smokers*. Although some of these smokers may have had an established pattern of smoking and thus could be considered "former" smokers, others may have smoked casually or only for a brief time period. The term "experimental" captures the essence of smoking for some at a young age when experimentation rather than cessation is the norm. People who had smoked one cigarette and smoked on fewer than 5 days in the last month were considered *occasional smokers*. People who had smoked one cigarette and smoked on 5 or more days in the last month were considered *regular smokers*. Definitions of occasional and regular smokers were based on current smoking rather than life-time smoking. Regular smokers who smoked 10 or more cigarettes per day were considered *heavy smokers*. Puff smokers, experimental smokers, occasional smokers and never smokers were also considered *non-smokers*. Regular smokers at baseline who answered at follow-up that they had not smoked in the last 30 days and that they did not think they would be smoking 1 year from interview were considered *quitters*. People whose smoking status from baseline to follow-up changed from non-smoker to regular smoker were considered to have *initiated smoking*.

Depressive symptoms scale

We used a depressive symptoms scale developed by Mellinger *et al.* as used by Kandel & Davies (Kandel & Davies, 1986). Adolescents were asked how often in the last year they had felt too tired to do things, had trouble going to sleep or staying asleep, felt unhappy, sad or depressed, felt hopeless about the future, felt nervous or tense and worried too much about things. The first four items measure symptoms of depression or dysthymia in the *Diagnostic and Statistical Manual*, version III (American Psychiatric Association Committee on Nomenclature and Statistics, 1980), whereas the last two items measure anxiety disorders. Three responses, "never", "rarely" or "somewhat", and "often" were scored 1–3, respectively. Based on the average score, we constructed an index of depressive symptoms and multiplied it by 10 (Kandel & Davies, 1986).

We used a score of 21.8 as the cut-off value between depressed and non-depressed (Kandel & Davies, 1986), since this value has previously been validated. This cut-off is equivalent to a score of 2.18, a relatively higher value of responses to questions about depressive symptoms, with a range between "somewhat" and "often".

With this cut-off, the sensitivity, the percentage of adolescents with a psychiatrist's diagnosis of depression who were considered by this scale to be depressed, was 50% in one study (Kandel & Davies, 1982) and 71% in another (Weissman & Myers, 1978). The specificity, the percentage of people not depressed according to a psychiatrist's assessment, was 67% (Weissman & Myers, 1978). Thus, agreement between clinical diagnosis and the Mellinger scale is moderately good but imperfect in adolescent populations; disagreement between this scale and a psychiatrist's diagnosis may reflect the fact that the Mellinger scale detects a greater frequency of depressive symptoms.

Statistical analysis

To identify potentially confounding variables which affect the relationship between depressive symptoms and smoking, we assessed gender-specific initiation and cessation rates by selected variables. We also calculated adjusted gender-specific odds ratios as the measure of association between depressive symptoms status (independent variable) at baseline and smoking initiation or cessation (dependent variable) at follow-up. Gender-specific analyses considered large differences that exist in depressive symptoms and smoking initiation behavior by gender, while avoiding a multiplicity of tests for interaction across each of the many subgroups of males and females examined in this study. SUDAAN, a procedure for analyzing complex sample survey data, was used to calculate 95% confidence intervals associated with rates and to create logistic regression models.

In multivariate models, the effects of potentially confounding variables (socio-demographic variables, sports participation, household smokers and risk-taking behavior) on the relationship between depressive symptoms and smoking were examined, and only those variables found to be confounders were included as covariates (Greenberg & Kleinbaum, 1985). A potentially confounding variable is one which is moderately related to both depressive symptoms status and the outcome variable. Moderate rather than weak relationships between covariate and depressive symptoms and between covariate and outcome were used as criteria to select the most parsimonious model, namely one with the fewest number of covariates. The only exception to this criterion was the exclusion of poverty level in models of depressive symptoms and smoking cessation. Although poverty level was strongly related to both depressive symptoms and smoking cessation, poverty level was excluded as a covariate from these models because parental education had already been included. Because of the varying strengths of associations among variables in males and females, each type of model can have a uniquely different set of covariates.

To measure incidence of regular smoking and smoking cessation at follow-up, we examined the group at baseline at risk for that condition. For example, to measure incidence of regular smoking (new smokers from baseline to follow-up), we excluded regular smokers at baseline. To measure the incidence of smoking cessation at follow-up, we included only regular smokers at baseline.

We assessed three distinct stages of smoking at follow-up in relation to depressive symptoms status at baseline among specific subgroups: puff and experimental or former smoking among never smokers, occasional smoking among puff and experimental or former smokers, and regular smoking among occasional smokers. These prospective analyses include only the group examined at baseline.

Results

For all subgroups except the youngest, adolescent females were more likely than males to report depressive symptoms (Table 1). With some exceptions, adolescent males were more likely than females to start smoking. Variations in rates of smoking cessation by gender were observed across subgroups examined.

When we adjusted for the effects of other factors, depressed adolescents were significantly more likely than their non-depressed counterparts to start smoking (Table 2). Although depressed adolescents appeared to be less likely than their non-depressed counterparts to quit smoking, the 95% confidence interval indicated that this association was inconsistent, since this interval crossed unity.

Increasing frequency of depressive symptoms was also associated with graded increases in rates of smoking initiation among males and females (Tables 3). There was no relationship between quintiles of depressive symptoms score and rates of smoking cessation. The rate of heavy smoking

Table 1. *Percentage of baseline depressive symptoms and incidence of smoking initiation and cessation in a cohort of US adolescents by selected characteristics, 1989–1993**

Characteristics	Depressive symptoms		Smoking			
			Initiation		Cessation	
	Males†	Females†	Males†	Females†	Males‡	Females‡
n	3992	3893	3555	3501	437	392
Age						
10–12	16.5	15.8	10.4	12.8	15.8	0.0
13–15	13.7	21.1	16.2	13.6	18.3	14.1
16–18	15.1	28.3	14.9	13.1	15.6	17.4
Race ethnicity						
White	14.1	23.7	16.8	15.8	16.1	15.7
African American	17.1	21.5	7.9	5.7	10.9	20.5
Latino	15.3	26.0	13.6	9.9	21.3	20.8
Other	14.7	21.2	7.9	6.4	0.0	17.5
School performance						
High	11.2	19.1	11.3	10.3	22.2	19.6
Medium	17.0	27.3	17.7	15.8	15.7	17.5
Low	33.1	52.7	30.8	49.1	4.5	1.5
Poverty level						
At above	14.5	22.7	14.6	13.5	17.3	15.5
Below	16.1	30.0	17.5	12.4	11.0	22.5
Unknown	16.0	23.5	11.5	11.5	10.6	17.4
Region						
Northeast	13.6	19.7	13.0	13.9	22.0	9.6
Midwest	14.6	22.7	16.5	14.2	14.3	19.0
South	15.9	23.7	15.9	12.4	14.1	18.1
West	14.0	27.4	12.4	13.0	15.9	17.2
Rural urban status						
Urban	14.5	23.6	14.1	13.3	16.1	13.1
Rural	15.3	23.2	16.8	13.0	16.5	25.3
Parental education, years						
0–8	9.6	22.8	15.4	11.5	11.2	0.0
9–11	20.8	33.3	16.2	11.3	8.5	5.3
12 +	14.4	22.8	14.6	13.5	17.4	18.0
Sports participation						
Yes	13.7	21.1	14.2	12.9	17.1	16.5
No	17.5	27.1	16.2	13.8	15.3	16.1
Anyone else smokes in household						
Yes	16.1	26.3	18.8	17.4	13.5	13.9
No	13.7	21.1	11.6	9.8	19.8	20.4
Likes to take risks						
Yes	18.5	32.1	18.9	18.0	15.6	18.5
No	11.8	18.8	11.4	10.4	18.9	13.1
No opinion	9.3	18.8	12.0	14.3	9.0	16.1

*Teenage Attitudes and Practices Survey (TAPS), baseline and follow-up.
†Of eligible sample, 437 male and 392 female regular smokers at baseline were excluded.
‡Of eligible sample, 3555 male and 3501 female never smokers, occasional smokers, and puff smokers, and those with unknown smoking status at baseline were excluded.

among current smokers was slightly but nonsignificantly higher among those who were depressed (53%) than among those who were not depressed (48%) (data not shown).

When we examined progression of smoking from baseline to follow-up in relation to depressive symptoms at baseline, we found no differences in rates of smoking associated with any of the three smoking stages examined (data not shown). Only when data were examined from the earliest to the latest stage, namely from never smoking at baseline to regular smoking at follow-up, were differences found by depressive symptoms status at baseline (Table 4).

Table 2. *Incidence of smoking initiation and cessation in a US cohort of adolescents by depressive symptoms status, 1989–1993**

Sex	Baseline depressive symptoms	Smoking initiation				Smoking cessation			
		Yes	No	Percentage	OR (95% CI)†	Yes	No	Percentage	OR (95% CI)†
Male	No	432	2634	13.9	Referent	65	275	17.6	Referent
	Yes	98	391	19.7	1.3 (1.0–1.7)‡§	11	86	11.3	0.6 (0.3–1.2)‡§¶
Female	No	328	2434	11.8	Referent	44	192	18.4	Referent
	Yes	137	602	18.5	1.4 (1.1–1.8)‡	23	133	12.8	0.7 (0.3–1.3)‡
Both	No	760	5068	12.9	Referent	109	467	18.1	Referent
	Yes	235	993	19.0	1.3 (1.1–1.6)‡§	34	219	12.2	0.7 (0.5–1.1)‡§

*TAPS, baseline and follow-up.
†OR denotes odds ratio, and 95% CI denotes 95% confidence interval.
‡Covariates are race, school performance, risk takers, and others in household who smoke.
§Additional covariate is region.
¶Additional covariate is age.
‖Additional covariate is parental education.

Table 3. *Percentage incidence of smoking initiation and cessation by quintile of depressive symptom score in a US cohort of adolescents, 1989–1993.*

Depressive symptoms quintile score	Percentage			
	Initiation		Cessation	
	Males* (n = 3557†)	Females* (n = 3501‡)	Males (n = 437§)	Females (n = 392¶)
Quintile 1 (10.0–15.0)	12.0	6.9	15.1	11.6
Quintile 2 (16.7)	12.9	11.0	26.2	23.3
Quintile 3 (18.3)	14.6	11.1	13.6	19.9
Quintile 4 (18.3–21.7)	14.9	13.9	17.7	18.7
Quintile 5 (>23.3)	19.7	18.5	11.3	12.8

*$p < 0.05$; Cochran Mantel Test for Trend.
†437 Regular smokers at baseline excluded.
‡392 Regular smokers at baseline excluded.
§3557 Never smokers, occasional smokers, puffer smokers, and unknowns excluded.
¶3501 Never smokers, occasional smokers, puffer smokers, and unknowns excluded.

Discussion

Symptoms of depression and anxiety increase the likelihood of smoking initiation during adolescence. The magnitude of this increase is small (12.9% rate of smoking among adolescents below the cut-off value for depressive symptoms and 19% among adolescents above the cut-off), and shows a dose–response relationship. The moderate effect of depressive symptoms on the risk of smoking initiation is consistent with the fact that there are many factors associated with smoking during adolescence (Centers for Disease Control and Prevention, 1994a). The greater rates of smoking among adolescents with depressive symptoms than among other adolescents reported previously (Kaplan *et al.*, 1984; Reynolds & Rob, 1988; Covey & Tam, 1990) probably reflect group differences in rates of smoking initiation rather than smoking cessation.

Some investigators have postulated that depressed people may use nicotine as a form of self-medication in an attempt to treat their symptoms or improve their psychological well-being (Carmody, 1989; Anda *et al.*, 1990). We did not investigate why adolescents started smoking, but we did find evidence of an association between depressive symptoms and regular smoking. Initiation of smoking may occur rapidly among adolescents who feel depressed, anxious, or experience frequent stressful events.

In other studies of adolescents (Kaplan *et al.*, 1984) and young adults (Breslau, Kilbey &

Table 4. *Percentage incidence of regular smoking in a US cohort of adolescent males and females never smokers by depressive symptoms status at baseline, 1989–1993.*

Sex	Baseline depressive symptoms	Smoking stage baseline to follow-up	Sample size	Percentage (95% CI)*
		Never to regular†		
Males	No		2318	9.5 (8.2–10.8)
	Yes		325	13.7 (9.9–17.5)
Females	No		2197	7.6 (6.4–8.8)
	Yes		471	11.3 (8.3–14.3)
Both	No		4515	8.6 (7.7–9.4)
	Yes		796	12.3 (9.9–14.60) ‡

*95% CI denotes 95% confidence interval.
†Baseline occasional smokers, regular smokers, puffer smokers and unknowns excluded.
‡$p < 0.05$.

Andreski, 1991, 1993), depressive symptoms are associated with heavy smoking. The non-significant difference in rate of heavy smoking by depressive symptoms status at baseline in this study may be the result of chance variation or slower progression toward heavy smoking in this group of adolescents.

People with a high degree of sensitivity to the pleasurable effects of nicotine are more likely than others to become regular smokers (Pomerleau *et al.*, 1993). Sensitivity to nicotine may result from the interaction of genetic (Hughes, 1986; Carmelli *et al.*, 1992) and environmental influences (Reynolds & Rob, 1988), factors which also increase the likelihood of depressive symptoms early in life (Kendler, *et al.*, 1993). Because of the relatively short follow-up period in this study, it is difficult to assess the influence of a third factor, such as early childhood experiences, on the relationship between depressive symptoms and smoking initiation.

Adolescents who smoke and show symptoms of depression and anxiety may have other behavioral problems (Murphy & Price, 1988; Conrad, Flay & Hill, 1992). The risk of smoking associated with depressive symptoms may be reduced by counselling for depressive symptoms.

Although self-reported data about smoking among adults have been found to have reasonable validity (O'Toole *et al.*, 1986; Brownson *et al.*, 1989; Slattery *et al.*, 1989), similar data about smoking among adolescents are limited (Luepker *et al.*, 1989; Centers for Disease Control and Prevention, 1994a). Telephone surveys tend to classify many adolescent smokers as non-smokers, because surveys generally fail to provide the complete privacy needed by adolescents to report smoking behavior accurately. Adolescents who are depressed may also be classified as non-depressed, since they may be reluctant to report negative mood. This problem plus inclusion of symptoms of anxiety in the depressive symptom scale used in this study may contribute further to measurement error.

The rate of depressive symptoms and anxiety among non-smokers (13%) and smokers (20%) is cause for concern. The high prevalence of depressive symptoms and smoking among adolescents means that even the modest associations between depressive symptoms and smoking reported here translate into a large number of depressed adolescents who are at risk for smoking. The occurrence of depression has increased in recent decades (Weissman & Klerman, 1992), and a trend toward onset at a younger age has also been reported (Burke *et al.*, 1990; Warner *et al.*, 1992; Klerman & Weissman, 1992). Previous declines in rates of adolescent smoking in the United States have tended to level off in recent years (Nelson *et al.*, 1995); other data suggest increases in smoking rates among adolescents (Centers for Disease Control and Prevention, 1996). Because rates of smoking are higher in adolescents reporting depressive symptoms than in other adolescents, research is needed to determine whether programs that address depression help reduce teenage smoking.

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