

## **Lifetime cumulative adversity, mental health and the risk of becoming a smoker**

Donald A. Lloyd & John Taylor  
*Florida State University, USA*

**ABSTRACT** We analyze the effect of stress exposure on the transition to heavy smoking, in a community sample of 1747 young adults in Miami, Florida. The effects of distal life stress are assessed in the context of recent stress exposure. Distal stress exposure predicts smoking independently of recent stress. Intervening stressful events do not appreciably mediate the influence of distal stress. We investigate the extent to which stress effects may be mediated by psychiatric and substance dependence disorders. We conclude that the effect of social stress on the risk for smoking is additive over time. The significant independent effect of early stress exposure implies that youths who are at greater risk for eventual heavy smoking may be identified at ages considerably younger than peak initiation age.

**KEYWORDS** *adolescent smoking; mental health; stress; substance dependence*

**ADDRESS** Donald A. Lloyd, Department of Sociology and Center for Demography and Population Health, Florida State University, Tallahassee, FL, 32306-2240, USA. [Tel: (850) 644-1753; fax (850) 644-8818; e-mail: dlloyd@fsu.edu]

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### **Introduction**

In this article we address the hypothesis that exposure to adverse experiences accumulated relatively early in life as well as later on contributes to the risk for subsequent initiation of heavy smoking. Most research on risk factors for smoking initiation among young people has focused on contemporaneous social psychological influences that arise from parent and peer relationships (e.g. Engels et al., 1999; Vega and Gil, 1998; Wagner and Atkins, 2000), or on its association with recent stressful events (Koval and

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Pederson, 1999; Wills et al., 2002). Although such factors appear to contribute to the risk for experimental smoking, they represent only a portion of those that are likely to influence regular tobacco use. Emerging evidence supports the hypothesis that adverse experiences encountered at any time, including early in life, can have enduring health consequences (Ben-Shlomo and Kuh, 2002; Kuh and Hardy, 2002; Turner and Lloyd, 1995, 2003). From this perspective, early adversity is potentially important in two ways: (1) it is part of the substrate upon which subsequent etiological factors may operate in the progression toward heavy smoking behavior; and (2) it may have significant long-term consequences for smoking that are independent of recent circumstances. However, to our knowledge, no previous study has examined the significance of lifetime cumulative exposure to social stress as a predictor of heavy smoking.

The present study incorporates a more comprehensive index of exposure to life adversities than has been previously employed in community-based research, and sets exposure to adversities in time relative to the transition to heavy smoking. We assess stress exposure over the life course, distinguishing early major events from more recent events. The role of both distal and proximal experiences of psychiatric and substance use disorders is also considered. This analytic approach, we believe, represents an advance in providing a more adequate test of the stress hypothesis. Our report is informed by a stress-process model (Billings and Moos, 1982; Dohrenwend and Dohrenwend, 1981; Pearlin et al., 1981; Turner and Lloyd, 1999), set within a life-course perspective (Ben-Shlomo and Kuh, 2002; Kuh and Hardy, 2002), and treats stress exposure and psychological health as precipitating as well as intervening factors in the development of the smoking habit.

## **Background**

### ***Stress and smoking***

Abundant research has established a link between smoking and stress. Studies that have focused on the temporal ordering between stress and smoking initiation generally conclude that exposure predicts starting to smoke rather than the reverse (US Department of Health and Human Services, 1988; Will et al., 2002). Fairly strong evidence links recent negative life events and chronic strains to smoking (Ganz, 2000; Kassel et al., 2003; Siqueira et al., 2000). Other studies have reported dose-response relationships between stress and increases in tobacco use (Dugan et al., 1999; Epstein and Perkins, 1988; Henker et al., 2002). Thus, it seems clear that recent and ongoing adversities increase risk for smoking.

Less attention has been given to the possible role of more distant stressful experiences, with only a handful of studies addressing the issue. Some of these studies have relied on rather unique study populations. For example both Beckham et al. (1995) and Shalev et al. (1990) report that

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veterans who met criteria for post-traumatic stress disorder were more likely to smoke than men in the general population, and Acierno et al. (1996) found higher rates of smoking among women who were victims of sexual violence compared to non-victims. The Adverse Childhood Experiences Study (ACE) (Anda et al., 1999; Felitti et al., 1998) employed a broader population base of over 9000 members of a primary care clinic. They report a strong and graded relationship between exposure to childhood adverse experiences (assessed in terms of eight types of trauma or chronic disadvantage) and age of smoking initiation. Acierno et al. (2000) report pronounced increases in risk of current regular cigarette use among those exposed to trauma, including witnessing trauma, compared to those who had not witnessed or experienced such events.

***Mental illness and substance use problems as predictors of smoking***

Breslau et al. (2003) have recently reported from a prospective study that incidence of nicotine dependence is positively associated with exposure to a traumatic event, and that the risk increases dramatically if the event resulted in post-traumatic stress disorder. An association between depression and smoking is widely recognized. Indeed, significant associations have been found between smoking and depression, anxiety and substance use disorders (Black et al., 1999; Jorm et al., 1999; Shiesha, 1999). Being depressed predicts increased likelihood of heavy smoking, experiencing more severe symptoms of withdrawal, and more difficulty quitting smoking (Covey, 1999; Myers, 2001). Both current and former smokers report higher depression than those who have never smoked (Pomerleau et al., 2003). Depression has also been specifically linked with smoking initiation among adolescents (Escobedo et al., 1998). Similarly, adolescent substance users are at elevated risk for smoking in general and heavy smoking in particular (Myers and Brown, 1997).

Other psychiatric diagnoses have also been linked to increased risk for smoking. Lambert and Hartsough (1998) found that young adults who had attention deficit/hyperactivity disorder (ADHD) as children were twice as likely to be smokers at age 17 (46 vs. 24%) and to meet criteria for lifetime tobacco dependence (40 vs. 19%) than their non-ADHD counterparts. Additional research shows that adolescents who endorsed six or more moderately severe ADHD symptoms were over three times as likely as those who did not meet this threshold to have ever been smokers, and were almost three times as likely to be current smokers (Tercyak et al., 2002). Thus, it seems clear that psychiatric disorders in general, and early conduct problems in particular, constitute significant risk factors for the initiation and persistence of smoking.

It is widely assumed that smoking is a coping response to stressful experience (Graham, 1987; Kassel et al., 2003; Koval and Pederson, 1999), including the experience of psychiatric illness. This interpretation implies that the

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relationship between stress exposure and smoking may be at least partially mediated by intervening psychological distress or disorder. For example it has been shown that mental illness and alcohol and drug use problems are linked to the prior experience of major and potentially traumatic life events (Lloyd and Turner, 2003; Turner and Lloyd, 1995), suggesting their possible intervening role in the relationship between stress and smoking.

The focus of the present analysis is not *whether* respondents smoke but *when they became heavy* smokers, and on what previous factors distinguish them from those who did not. We define as the time of transition to heavy smoking the age when a participant first smoked more than 10 cigarettes in a day, not when he or she first tried a cigarette. This distinction recognizes that not everyone who experiments with smoking becomes a regular smoker. Consistent with previous research, we regard this threshold as indicative of heavy smoking (Cornelius et al., 2001), a significant and well-documented health-endangering habit in a young population.

We view smoking as a health risk behavior that arises within a life course trajectory. Accordingly, this study takes into account experiences and circumstances throughout a person's past to predict smoking initiation. This approach allows us to judge whether it is fruitful, as life-course theory would suggest, to include long-past events in estimating the risk that a youth or young adult will start smoking. Accordingly, we employ separate measures of relatively recent and distal life events.

We address three specific questions. First, are the effects of stress on the risk for transition to heavy smoking cumulative or do recent stressors mediate prior stress effects in a causal chain? Second, is the stress-smoking relationship an artifact of joint association with a prior psychiatric, substance use or personality disorder? And third, to what extent are observed stress effects on smoking transition mediated by the intervening onset of psychiatric or substance use disorders?

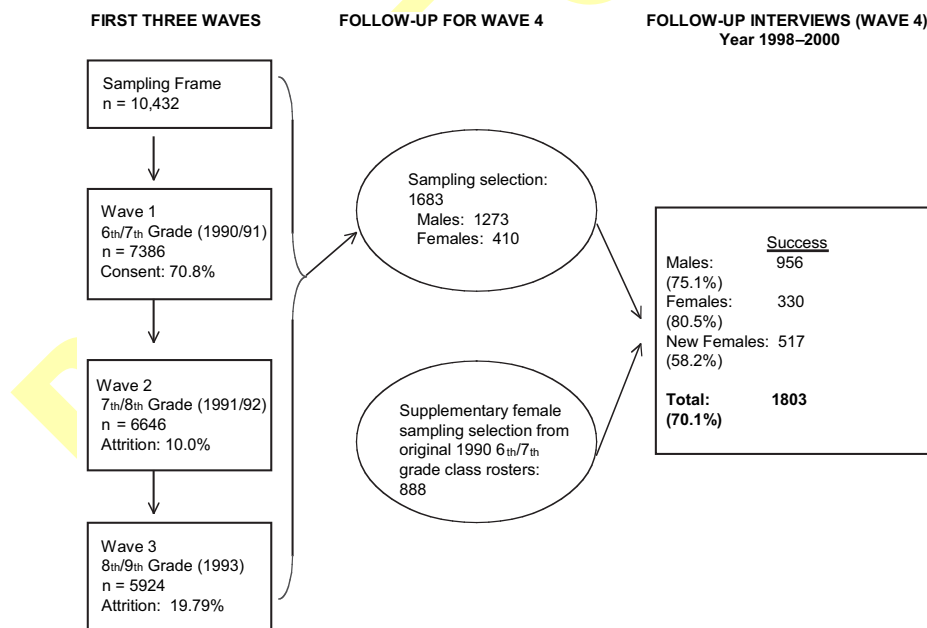
### **Sample**

This study builds on a previous three-wave investigation based in the Miami-Dade public school system (Vega and Gil, 1998). All 48 of the county's public middle schools and all 25 public high schools as well as alternative schools participated. Questionnaires were administered annually between 1990 and 1993 beginning in grades 6 and 7 and ending when participating students were in grades 8 and 9. Detailed analyses provided assurance that wave 1 participants were highly representative of the population from which they were drawn and that this was also true for the wave 3 participants, despite a nearly 20 percent attrition across the three data points (Vega and Gil, 1998). The primary starting point for the present investigation was a large and representative sample of 8th and 9th grade boys and a smaller representative sample of 8th and 9th grade girls numbering 5924 at wave 3.

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All eligible female participants in the earlier investigation ( $n = 410$ ) and a random sample of 1264 male participants were selected for wave 4 follow-up. The target sample was drawn such that 25 percent were non-Hispanic white, 25% were African American, 25% were of Cuban ancestry, and 25% represented 'other Hispanic' groups. All female participants from the original study within one of these ethnic categories were also selected for follow-up. Because the original study included a relatively small number of girls, a supplementary sample was randomly drawn from the Miami-Dade county 1990 sixth and seventh grade class. Overall, 70.1% of the target sample was successfully interviewed. By far the greatest loss occurred among the new sample of females who had no previous involvement in the study. A success rate of 76.4% was achieved among those from the original sample, despite the fact that many had left home for college or other reasons. The sampling procedures are summarized in Figure 1.

Comparisons suggest that our achieved sample is reasonably representative of the population from which it was drawn. However, a bias with respect to parental socioeconomic status associated with the 41.8% loss rate was found among the supplementary sample of girls. To correct for this bias, female participants have been differentially weighted to achieve a distribution on SES that approximates that observed for male participants. Most (93%) of the 1803 young adults participating in the study were between 19 and 21 years of age when interviewed between 1998 and 2000. A total of



**Figure 1** Sampling framework.

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56 cases were omitted from analysis; approximately half of these were of non-qualifying ethnicity, and the remainder were excluded due to missing data.

## Measures

### *Time of transition to heavy smoking*

Participants in the follow-up interview were asked if they had ever smoked more than 10 cigarettes in a day. Those who said they did so were asked, 'How old were you when you first started to smoke more than 10 cigarettes a day?' We use the reported age as the period of transition. Support for this distinction is provided by previous research. Sargent et al. (1998) found that the rate of successful cessation among 12 to 18-year-old daily smokers of 10 or more cigarettes was only 6.8%, compared with 46.3% among less heavy smokers.

### *Lifetime exposure to adverse experiences*

Exposure to stressful life events was assessed using a 41-item checklist that covered three general types of experience. Nine items could be characterized as 'major events', which are social adversities that are not typically violent in nature. Examples include parental divorce and failing a grade in school. Thirteen items cover 'traumatic events' that imply force or violence, for example rape, physical and emotional abuse, and being injured with a weapon. The remaining events refer to events that directly happened to others, but were witnessed or heard about by the participant. Such events include seeing someone killed and witnessing serious physical or emotional abuse, hearing of a friend's suicide or rape, and death of a relative or close friend. The complete list of items and their prevalence rates has previously been published (Turner and Lloyd, 2003).

Using a checklist format, participants were asked one at a time whether each event had occurred. For each event they had experienced, participants also reported the number of times it happened, the age at first occurrence and, in the case of multiple occurrences, the age at last occurrence. The stressor count represents the number of different events experienced.<sup>1</sup> To ensure that the only events counted had occurred before the onset of heavy smoking, we used the age of first occurrence in forming the cumulative adversity scores.

We measure the accumulation of stress across all events combined, distinguishing them only by the time they happened, throughout the period at risk. Persons for whom transition to heavy smoking had occurred in a given year are no longer at risk for this transition in subsequent years. Cumulative adversity is measured by a count of the number of different events experienced; multiple occurrences of the same event are not counted. In our survival analysis we refer to the year at risk for transition as the *index period*. We distinguish adversities that are distal and proximal relative to

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the index period. Proximal adversities are those occurring at one year of age younger than the index period; distal adversities are a count of all those that happened at least two years before. No stressors occurring in the index year are counted.

We employed a life history calendar (LHC) based on that developed by Freedman et al. (1988) as an aid in achieving accurate recall of significant life course experiences. This calendar traces five categories of experience. The first three involved a process in which respondents described divisions in their lives in terms of where they lived (country, city or street as appropriate), landmark events such as birth of a sibling, getting a driver's license or leaving school and the teachers or best friends they had during various years. These dimensions are completed at the beginning of the interview one at a time, each building on the information already in hand. The calendar is employed at three points in the interview: (1) for questions on the age of occurrence of major/traumatic lifetime events; (2) for questions about the onset and last occurrences of substance use and related problems; and (3) for questions on the age at first and last occurrence of psychiatric disorder episodes. In each of these sections, the question of temporal order is addressed using all information available through scanning both upward and across the LHC. Thus, a reported first onset of major depression, for example, would be placed on the calendar in relation to other psychiatric disorders, if any, substance disorders, if any, major life events, teachers and/or best friend at the time, landmark or transition events, and place of residence. This procedure and the fact that the recall period for this young population was relatively short, argues for the reliability of the data employed in these analyses.

***Psychiatric disorder and substance dependence***

Data on the lifetime occurrence of psychiatric and substance disorders were obtained through computer-assisted personal interviews that allowed estimation of DSM-IV diagnoses. Our basic instrument was the Michigan Composite International Diagnostic Interview (CIDI) that was employed in the National Comorbidity Survey (NCS) (Kessler et al., 1994). The CIDI is a fully structured interview, based substantially on the Diagnostic Interview Schedule (DIS) (Robins et al., 1981) and designed to be administered by non-clinicians trained in its use (Robins et al., 1988; World Health Organization, 1990). Using the Michigan CIDI, as updated by NCS researchers to cover DSM-IV criteria, we assessed major depression, dysthymia, generalized anxiety disorder, social phobia, panic disorder, alcohol abuse and dependence, drug abuse and dependence, post-traumatic stress disorder (PTSD) and antisocial personality disorder. These latter two modules had been borrowed from the DIS (Robins et al., 1981) for the NCS. Evidence for the validity of Michigan CIDI diagnostic estimates, evaluated against structured clinical reinterviews (Spitzer et al., 1990), have been reported for most NCS disorders, including affective disorders (Blazer

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et al., 1994), anxiety disorders (Wittchen et al., 1995), addictive disorders (Nelson et al., 1996; Warner et al., 1995), and PTSD (Kessler et al., 1995).

Along with the Michigan CIDI, our assessment instrument included a reliable module (Horton et al., 1998) taken from the revised DIS (Robins et al., 1995) to assess attention deficit (AD) and hyperactivity disorder (HD), and included items to allow assessment of childhood conduct disorder. The NCS strategy of a preliminary screening process was extended to also include the lifetime use of individual licit and illicit drugs. The goal of this extension was to reduce any fall-off in reporting that might be occasioned by learning, during the course of the interview, that positive responses and not negative responses to drug questions tend to be followed by a large battery of additional questions.

### **Demographics**

Ethnicity is measured by the respondents' own group identification. Because this sample is in the transition to adulthood, SES is estimated in terms of parental education, income and occupational prestige level (Hollingshead, 1957). These data were obtained from parent interviews and supplemented where necessary by information provided by the young adult participants. Scores on these three status dimensions were equally weighted and combined in a summary measure of SES.

### **Results**

A total of 27.4% of the sample reported having ever smoked more than 10 cigarettes in a day, with a mean transition age of 16.9 years ( $SD = 1.8$ ). The range of transition ages, from 12 to 23 years, indicates the extent to which the relative timing of stress exposure and beginning heavy smoking should be taken into account in order to assess the causal relevance of stress for smoking. Because the experience of some lifetime adverse events, especially recent stressors, may have occurred *after* people started heavy smoking, we used survival analysis to model the hazard of smoking transition across ages 12 to 23 as a function of *prior exposure* to stress.

Table 1 shows the structure of the data employed in our survival analysis. Of the 1747 respondents at risk when they were 12-years old, five started heavy smoking that year and 1742 survived the year without transition. The rate of smoking transition at age 12 is thus five in 1747, or 0.3%. Once transition had occurred, the heavy smokers were excluded from subsequent age-specific estimates using the person-year data. Thus, to assess chances of transition at age 13, the group at risk is the portion that survived age 12, shown in the second row as 1742 respondents. Among those at still at risk at 13 years of age, 13 more started heavy smoking. Beginning with the age 18 risk set, not all who survived the year without transition appear in the next risk set because they were younger than 23 years when interviewed. A total of 464 started heavy smoking by the time they were interviewed;

*Lloyd & Taylor: Adversity, Mental Health and Smoking***Table 1** Number at risk and conditional probability of transition to heavy smoking by age (unweighted data)

Age	Number at risk	Number survived	Number initiated	Conditional probability of initiation
12	1747	1742	5	.003
13	1742	1729	13	.007
14	1729	1701	28	.016
15	1701	1649	52	.031
16	1649	1553	96	.058
17	1553	1479	74	.048
18	1479	1371	108	.073
19	1351	1296	55	.041
20	898	873	25	.028
21	356	349	7	.020
22	98	98	0	.000
23	18	17	1	.056
Total	14321		464	

the remaining 1283 participants are right-censored, meaning it is unknown whether they eventually made a transition to heavy smoking.

Each participant is represented in the data for each year he or she was at risk for first making a transition to heavy smoking. The last year of observation for the survival analysis is the earliest of (1) when the participant reported he or she first smoked more than 10 cigarettes in a day, or (2) the year the question was asked (wave 4). The lifetime prevalence of disorders preceding and inclusive of the index year was: psychiatric disorders 25.1%; drug dependence 14.8% and alcohol dependence 9.8%. These rates of disorder prior to or concurrent with the start of heavy smoking suggest that they are at least statistically viable predictors. The cumulative count of adverse events prior to transition or censoring was 3.5 (SD 3.4).

The survival analysis employs two types of predictor variable. Gender, ethnicity and socio-economic level of origin, which vary across individuals but remain constant for each person, are time-invariant predictors. In contrast, cumulative stress exposure scores and mental health and substance dependence statuses may change for a person over time. Both time-invariant and time-varying predictors are added to the equation to estimate their effects by logistic regression in person-period data (Allison, 1984; Singer and Willett, 1993). The effect of time is modeled with a quadratic function (Singer and Willett, 2003).<sup>2</sup>

We also distinguish between distal and proximal psychiatric disorder and substance dependence onsets. Distal onsets of such disorders are defined as those that occurred at ages two or more years younger than the index year, the same scheme as distal adversities. However, because proximal onset disorders will be analyzed as mediators of proximal as well as distal

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exposure to adversities, we allowed onsets of psychiatric and substance that occurred in the index year as well as the year before to be included in the measures of proximal disorders. Our primary interest is in the effect of cumulative exposure to stressful events, which are counted only if they occurred before the index period.

The results are shown in Table 2, with effects represented by logistic regression coefficients; these are the estimated amount of change in the log-odds of smoking transition for a one-unit increment in the predictor variable score, averaged across time periods. Our test for interaction between the predictors and time (not shown) supported the assumption of proportional hazards in these models. The effects of time, gender, ethnicity and SES are controlled in all models.

Distal exposure to adversities is a significant positive predictor of smoking transition. Mediation of this effect would be indicated by a meaningful proportionate reduction in the magnitude of its coefficient when a plausible mediating variable is added hierarchically to the model. We added proximal adversities in model 2, which reveals that the effects of distal stress are not appreciably explained by more recent stress exposure. The apparent effect size of proximal stressors is more than double that of the distal measure, but they are independent predictors of the smoking transition. Because the two measures of stress do not differ in content, but are distinguished only by when the stressors occurred, we interpret these effects as additive over time.

Unstandardized logistic regression coefficients are presented because the stress exposure measures are counts, not categories. To view the relative distal and proximal stress relationships with smoking in terms of odds ratios, we computed the relative odds of smoking transition at high versus low levels of exposure on each stress measure, based upon the empirical distributions of stress by age 18 and the coefficients estimated in model 2. The mean cumulative adversity scores for that period were 4.97 (SD = 3.68) distal stressors, and .96 (SD = 1.26) proximal stressors. We first compared participants with a level of exposure to distal adversities one standard deviation above the mean to those with exposure one standard deviation below the mean. The estimated odds of transition are double at the higher level of distal exposure compared with lower exposure (OR = 1.97), controlling for proximal stress. The comparable odds ratio for the effect of proximal adversity, controlling for distal stress, is slightly less (OR = 1.56).

The question remains whether the association between stress and heavy smoking is merely an artifact of a shared association with prior psychiatric or substance dependence disorders. This competing hypothesis is addressed in model 3, where indicators of distal psychiatric disorder, drug dependence and alcohol dependence are added. Results show that while onset of drug dependence at an age two or more years younger is associated with increased risk of transition, the net effects of exposure to adversities hardly

*Lloyd & Taylor: Adversity, Mental Health and Smoking***Table 2 Hazard of smoking transition regressed on lifetime cumulative adversity and disorders**

	1. <i>b</i>	2. <i>b</i>	3. <i>b</i>	4. <i>b</i>	5. <i>b</i>
Distal adversities (before age <i>t</i> -1)	.103***	.092***	.082***	.074***	.053***
Proximal adversities (at age <i>t</i> -1)		.230***	.228***	.173***	.154***
Distal psychiatric disorder (initial onset before age <i>t</i> -1)			.050	-.020	-.017
Distal drug dependence (initial onset before age <i>t</i> -1)			.721*	.818**	.725*
Distal alcohol dependence (initial onset before age <i>t</i> -1)			.615	.749	.694
Proximal psychiatric disorder (initial onset between ages <i>t</i> -1 and <i>t</i> )				.316	.272
Proximal drug dependence (initial onset between ages <i>t</i> -1 and <i>t</i> )				1.427***	1.405***
Proximal alcohol dependence (initial onset between ages <i>t</i> -1 and <i>t</i> )				.815***	.722**
Childhood ADHD					.205
Childhood conduct disorder					.559***
Intercept	-36.666***	-34.568***	-35.212***	-33.817***	-34.266***

Notes: \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ . Coefficients are logistic regression estimates.  $N = 1747$  respondents represented over as many as 12 1-year periods at risk for transition, defined as reported age when first smoked more than 10 cigarettes in a day. The data analyzed thus has 14321 person-periods, during which 464 people first smoked more than 10 cigarettes in a day. Psychiatric disorders include depression, dysthymia, panic disorder, generalized anxiety, social phobia and PTSD. Coefficients are unstandardized logistic regression estimates. Data are weighted to align distributions of family SES across gender. The effects of time, gender, ethnicity and socio-economic status are controlled.

change. Earlier psychiatric and substance dependence problems do not account for the effects of stress.

Model 4 assesses whether the observed stress effects on smoking transition are mediated by contemporaneous or subsequent onset of psychiatric and substance dependence disorders. Again, these factors are counted only if they first occur during the index period or the year before. We can see that both proximal drug and alcohol dependence, though not proximal psychiatric disorder, increase the risk of heavy smoking, with stress exposure controlled. Comparing the coefficients for adversities between models 3 and 4 shows that these factors partially mediate the effects of stress. Additional analysis (not shown) suggested that the observed mediating effect is primarily through the onset of drug dependence disorder. However, the net effects of both distal and proximal exposure to

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adversities remain significant predictors of smoking transition independent of the effects of lifetime psychiatric and substance dependence disorders.

The final question we addressed was whether all of the above associations could be due to the observed tendency for children who behave badly to both get themselves into stressful situations and engage in a high level of smoking. Previous studies have linked attention deficit hyperactivity disorder (ADHD) and childhood conduct disorder (CD) to increased stress exposure and criminal behavior as well as to smoking among adolescents (Babinski et al., 1999; Grover, 2002; Tercyak et al., 2002). To test this challenge to the stress hypothesis, we added measures of childhood ADHD and CD to the final model. This test left our conclusions unchanged: lifetime exposure to adversities significantly predict the transition to heavy smoking among adolescents and young adults, despite adding controls for several potentially confounding factors. This relationship is only minimally mediated by intervening disorders, and their inclusion does not alter the relative importance of either distal or more recent stress exposure for smoker status risk.

## Discussion

The results of the foregoing survival analysis show, we believe for the first time, that cumulative exposure to adversities is an important predictor of differences in risk for developing the heavy smoking habit. The effects of stress are not totally explained by prior psychiatric, substance dependence or personality disorders, and they are not substantially mediated by intervening mental health problems. Nor are the effects of distal stressors explained by more proximal stress exposure. The limited amount of stress effect mediation that does occur was primarily attributable to drug dependence disorder.

It could be interpreted that our global distal stress score masks an underlying stress proliferation process (Pearlin, 1999), which could lead to overestimating the importance of individual distal stressors for eventual health behaviors and conditions. The apparently persistent effect of distal stress despite control for proximal events could be attributed to adverse events that spawned stress in other domains. But some people may cope with adverse experiences better than others (Pearlin and Schooler, 1978). To the extent that effective coping would mitigate stress proliferation, we might expect proximal stress to mediate the impact of distal stress only among those with limited coping resources.

We do not have measures of coping ability in the present data. Nonetheless, to test the possibility that our findings may be driven by a particular subset of reported events, we regressed the smoking outcome on three stress counts that individually represented the three groups of adversities (described above) for the entire duration preceding the index period. The results (not shown) demonstrated statistically independent, additive

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relationships (each coefficient  $p < .01$ ). This finding supports the interpretation of statistically additive, and conceptually cumulative, effects of a lifetime history of distal and proximal stress exposure on the risk for heavy smoking. But it remains for future studies to address potential mechanisms (such as contemporary peer and family influences that may be related to conditions of stress) that would link distal stress exposure with subsequent smoking behavior, in addition to psychiatric and substance disorders.

Because our temporal cut point of one year to distinguish proximal and distal factors relative to the index period was chosen arbitrarily, we conducted a sensitivity analysis to determine whether our findings would be affected by choosing a different cut point. All of the regression models were re-estimated after changing the dividing line to one year earlier. This increased the number of events counted as proximal, and decreased the number of distal events, while their sum did not change. Every effect reported above was replicated, so we conclude that the findings are not an artifact of the chosen cut point.

We acknowledge the limitations that are inherent in retrospective survey methods. While the young age of this cohort and the careful application of the life calendar presumably minimize recall and temporal ordering problems, our findings may still be affected by recall error. A possible competing hypothesis is that these results may arise from 'state-dependence' bias, which would occur if individuals with a current psychiatric or substance use disorder would be more likely to remember and/or report having experienced stressful events than are those same individuals when they are relatively free of disorder symptoms. We previously reported a rough test of this hypothesis using the same sample, which compared the number of adversities reported by those with current or very recent disorders and those reported by currently healthy but previously disordered participants. The data suggested no evidence for state dependence bias (Turner and Lloyd, 2003).

The hypotheses investigated in this report could be more compellingly supported if the same data were prospectively gathered. However, there seems little prospect of a community-based study that will gather such data prospectively on a sufficiently large sample and over a long enough period to more convincingly assess the central questions examined here.

This article demonstrates the utility of considering a wide array of negative life events that may have occurred over a long period of time in the assessment of risk for smoking. Yet we believe the findings to be conservative, because the measures of stress represent the number of different events experienced but not the number of occurrences of any particular one. Related to this point is that despite the comparatively wide array of items in our index of stress exposure it cannot be claimed that such exposure is fully accounted for; the measure can only be regarded as a sampling of the total range of stressful events that are likely to be encountered.

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The substantive interpretation of the statistical associations of different counts of stressors with any outcome depends in part upon the relative meaning of 'high' and 'low' exposures within their empirical distributions. We concluded that the effect of distal stress is more important than the regression coefficient would indicate because the distributions of the two exposure measures across participants have to be taken into account. Comparing the relative magnitude of effects of distal and proximal adversities in terms of location in the distributions of adversity scores revealed that distal stress is a surprisingly powerful predictor of heavy smoking.

The findings conclusively support the assertion of life course epidemiology that information from the duration of the life course helps to predict eventual health behavior. The significant independent effect of early stress exposure suggests that youths who are at risk for eventual heavy smoking may be identified at ages considerably younger than peak smoking initiation age. Smoking prevention strategies should therefore be aimed at persons much younger than the age known to be that of greatest risk for smoking initiation, and such efforts should focus on youths with stressful histories.

**Notes**

1. Some events, such as witnessing abuse, were often reported as happening 'hundreds of times', which made measurement by counting the total number of occurrences across all checklist events infeasible. Additionally, using frequency of occurrence would unduly over-represent chronic conditions. Thus the stress measure may be interpreted as the variety of stressful experiences rather than their rate of recurrence.
2. Time could also be specified in discrete-time event history models using a series of dummy indicators, whose coefficients are analogous to multiple intercepts, however we selected the more parsimonious polynomial function. Comparison of model fit statistics for alternative specifications of time in model 5 in Table 2 showed that constraining the effect of time to a quadratic function fit the data as well as the less parsimonious version,  $R^2 = 15.92$ , 9 df,  $p > .05$ . Stress coefficients estimated in the context of unconstrained time effects were identical to those reported in Table 2.

**References**

- Acerno, R., Kilpatrick, D., Resnick, H., Saunders, B. and Best, C. (1996). Violent assault, posttraumatic stress disorder, and depression: Risk factors for cigarette use among adult women. *Behavior Modification*, 20, 363–84.
- Acerno, R., Kilpatrick, D.G., Resnick, H., Saunders, B., De Arellano, M. and Best, C. (2000). Assault, PTSD, family substance use, and depression as risk factors for cigarette use in youth: Findings from the National Survey of Adolescents. *Journal of Traumatic Stress* 13(3), 381–96.
- Allison, P.D. (1984). *Event history analysis: Regression for longitudinal event data*. Beverly Hills, CA: SAGE Publications.
- Anda, R.F., Croft, J.B., Felitti, V.J., Nordenberg, D., Giles, W.H., Williamson, D.F. and Giovino, G.A. (1999). Adverse childhood experiences and smoking during

*Lloyd & Taylor: Adversity, Mental Health and Smoking*

- adolescence and adulthood. *Journal of the American Medical Association*, 282(17), 1652–8.
- Babinski, L.M., Hartsough, C.S. and Lambert, N.M. (1999). Childhood conduct problems, hyperactivity-impulsivity, and inattention as predictors of adult criminal activity. *Journal of Child Psychology & Psychiatry & Allied Disciplines*, 40(3), 347–55.
- Beckham, J.C., Roodman, A.A., Shipley, R.H., Hertzberg, M.A., Cunha, G.H., Kudler, H.S., Levin, E.D., Rose, J.E. and Fairbank, J.A. (1995). Smoking in Vietnam veterans with post-traumatic stress disorder. *Journal of Traumatic Stress*, 8, 461–72.
- Ben-Shlomo, Y. and Kuh, D. (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, 31, 285–93.
- Billings, A.G. and Moos, R.H. (1982). Stressful life events and symptoms: a longitudinal model. *Health Psychology*, 1, 99–117.
- Black, D.W., Zimmerman, M. and Coryell, W.H. (1999). Cigarette smoking and psychiatric disorder in a community sample. *Annals of Clinical Psychiatry*, 11, 129–36.
- Blazer, D.G., Kessler, R.C., McGonagle, K.A. and Swartz, M.S. (1994). The prevalence and distribution of major depression in a national community sample: The National Comorbidity Survey. *American Journal of Psychology*, 151, 979–86.
- Breslau, N., Davis, G.C. and Schultz, L.R. (2003). Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Archives of General Psychiatry*, 60, 289–94.
- Cornelius, J.R., Lynch, K., Martin, C.S., Cornelius, M.D. and Clark, D.B. (2001). Clinical correlates of heavy tobacco use among adolescents. *Addictive Behaviors*, 26, 273–7.
- Covey, L.S. (1999). Tobacco cessation among patients with depression. *Primary Care*, 26, 691–706.
- Dohrenwend, B.S. and Dohrenwend, B.P. (1981). The 1980 Division 27 Award for Distinguished Contributions to Community Psychology and Community Mental Health: Barbara Snell Dohrenwend and Bruce P. Dohrenwend. *American Journal of Community Psychology*, 9, 123–64.
- Dugan, S., Lloyd, B. and Lucas, K. (1999). Stress and coping as determinants of adolescent smoking behavior. *Journal of Applied Social Psychology*, 29, 870–88.
- Engels, R.C.M.E., Knibbe, R.A., de Vries, H., Drop, M.J. and van Breukelen, G.J.P. (1999). Influences of parental and best friend's smoking and drinking on adolescent use: A longitudinal study. *Journal of Applied Social Psychology*, 29, 337–61.
- Epstein, L.H. and Perkins, K.A. (1988). Smoking, stress, and coronary heart disease. *Journal of Consulting and Clinical Psychology*, 56, 342–9.
- Escobedo, Luis G., Reddy, M. and Giovino, G.A. (1998). The relationship between depressive symptoms and cigarette smoking in US adolescents. *Addiction*, 93, 433–40.
- Felitti, V.J., Anda, R.F., Nordenberg, D., Williamson, D.F., Spitz, A.M., Edwards, V., Koss, M.P. and Marks, J.S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The

*health: 10(1)*

- Adverse Childhood Experiences (ACE) Study. *American Journal of Preventative Medicine*, 14(4), 245–58.
- Freedman, D., Thornton, A., Camburn, D., Alwin, D. and Young-DeMarco, L. (1988). The life history calendar: A technique for collecting retrospective data. In C.C. Clogg (Ed.), *Sociological Methodology*, pp. 37–68. Ann Arbor, MI: Institute for Social Research, University of Michigan.
- Ganz, M.L. (2000). The relationship between external threats and smoking in Central Harlem. *American Journal of Public Health*, 90, 367–71.
- Graham, H. (1987). Women's smoking and family health. *Social Science and Medicine*, 25, 47–56.
- Grover, S. (2002). Conduct disorder as an adaptive response to situational stress. *Ethical Human Sciences & Services*, 4(3), 229–34.
- Henker, B., Whalen, C.K., Jamner, L.D. and Delphino, R.J. (2002). Anxiety, affect, and activity in teenagers: monitoring daily life with electronic diaries. *Journal of the American Academy of Child and Adolescent Psychiatry*, 41, 660–70.
- Hollingshead, A.B. (1957). *Two Factor Index of Social Position*. New Haven, CT: A.B. Hollingshead.
- Horton, J., Compton, W. and Cottler, L.B. (1998). Assessing psychiatric disorders among drug users: reliability of the revised DSM-IV. In L. Harris (Ed.), *Problems of drug dependence*, NIDA research monograph, pp. 43–95. Washington, DC, NIH Publication.
- Jorm, A.F., Rodgers, B., Jacomb, P.A., Christesen, H., Henderson, S. and Korten, A.E. (1999). Smoking and mental health: results from a community survey. *The Medical Journal of Australia*, 170, 74–7.
- Kassel, J.D., Stroud, L.R. and Paronis, C.A. (2003). Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. *Psychological Bulletin*, 129(2), 270–304.
- Kessler, R.C., McGonagle, K.A., Zhao, S. and Nelson, C.B. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. *Archives of General Psychiatry*, 51, 8–19.
- Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M. and Nelson, C.B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*, 52, 1048–60.
- Koval, J.J. and Pederson, L.L. (1999). Stress, coping and other psychosocial risk factors: A model for smoking in grade 6 students. *Addictive Behaviors*, 24, 207–18.
- Kuh, D. and Hardy, R. (2002). *A life course approach to women's health*. Oxford: Oxford University Press.
- Lambert, N.M. and Hartsough, C.S. (1998). Prospective study of tobacco smoking and substance dependencies among samples of ADHD and non-ADHD participants. *Journal of Learning Disabilities*, 31, 533–44.
- Lloyd, D.A. and Turner, R.J. (2003). Cumulative adversity and post-traumatic stress disorder: Evidence from a diverse community sample of young adults. *American Journal of Orthopsychiatry*, 73, 381–91.
- Myers, M.G. (2001). Cigarette smoking treatment for substance abusing adolescents. In E.F. Wagner and H.B. Waldron (Eds.), *Innovations in Adolescent Substance Abuse Interventions*, pp. 263–84. Amsterdam: Pergamon.
- Myers, M.G. and Brown, S.A. (1997). Cigarette smoking four years following treatment for adolescent substance abuse. *Journal of Child and Adolescent Substance Abuse*, 7, 1–15.

*Lloyd & Taylor: Adversity, Mental Health and Smoking*

- Nelson, C.B., Little, R.J.A., Heath, A.C. and Kessler, R.C. (1996). Patterns of DSM-III-R alcohol dependence symptom progression in a general population survey. *Psychological Medicine*, 26(3), 449–60.
- Pearlin, L.I. and Schooler, C. (1978). The structure of coping. *Journal of Health and Social Behavior*, 19, 2–21.
- Pearlin, L.I., Lieberman, M.A., Menaghan, E.G. and Mullan, J.T. (1981). The stress process. *Journal of Health and Social Behavior*, 22, 337–56.
- Pearlin, L.I. (1999). Stress and mental health: a conceptual overview. In A.V. Horwitz and T.L. Scheid (Eds.), *A handbook for the study of mental health: Social contexts, theories, and systems*, pp. 161–75. New York: Cambridge University Press.
- Pomerleau, C.S., Zucker, A.N. and Stewart, A.J. (2003). Patterns of depressive symptomatology in women smokers, ex-smokers, and never smokers. *Addictive Behaviors*, 28, 575–82.
- Robins, L.N., Helzer, J.E., Croughan, J.L. and Ratcliff, K.S. (1981). National Institute of Mental Health Diagnostic Interview Schedule: Its history, characteristics and validity. *Archives of General Psychiatry*, 38, 381–9.
- Robins, L.N., Wing, J., Wittchen, H.-U., Helzer, J.E., Babor, T., Burke, J., Farmer, A., Jablenski, A., Pickens, R., Regier, D., Sartorius, N. and Towle, L. (1988). The Composite International Diagnostic Interview: An epidemiologic instrument suitable for use in conjunction with different systems and in different cultures. *Archives of General Psychiatry*, 45, 1069–77.
- Sargent, J.D., Mott, L.A. and Stevens, M. (1998). Predictors of smoking cessation in adolescents. *Archives of Pediatrics and Adolescent Medicine*, 152, 388–93.
- Shalev, A., Bleich, A. and Ursano, R.J. (1990). Post-traumatic stress disorder: Somatic comorbidity and effort tolerance. *Psychosomatics*, 31, 197–203.
- Shiesha, S. (1999). Selections from the current literature: smoking and depression. *Family Practice*, 16, 202–5.
- Siqueira, L., Diab, M., Bodian, C. and Rolnitzky, L. (2000). Adolescents becoming smokers: The roles of stress and coping methods. *Journal of Adolescent Health*, 27, 399–408.
- Singer, J.D. and Willett, J.B. (1993). It's about time: using discrete-time survival analysis to study duration and timing of events. *Journal of Educational Statistics*, 18, 155–95.
- Singer, J.D. and Willett, J.B. (2003). *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. New York: Oxford University Press.
- Spitzer, R.L., Williams, J.B.W., Gibbon, M. and First, M.B. (1990). *Structured Clinical Interview for DSM-III-R: Patient Edition (SCID-P, Version 1.0)*. Washington, DC: American Psychiatric Press.
- Tercyak, K.P., Lerman, C. and Audrain, J. (2002). Association of attention-deficit/hyperactivity disorder symptoms with levels of cigarette smoking in a community sample of adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 41, 799–805.
- Turner, R.J. and Lloyd, D.A. (1995). Lifetime traumas and mental health: the significance of cumulative adversity. *Journal of Health and Social Behavior*, 36, 360–76.
- Turner, R.J. and Lloyd, D.A. (1999). The stress process and the social distribution of depression. *Journal of Health and Social Behavior*, 40, 374–404.
- Turner, R.J. and Lloyd, D.A. (2003). Cumulative adversity and drug dependence in young adults: racial/ethnic contrasts. *Addiction*, 98, 305–15.

*health: 10(1)*

- US Department of Health and Human Services (1988). *The health consequences of smoking: Surgeon general's report*. Washington, DC: DHHS.
- Vega, W.A. and Gil, A.G. (1998). *Drug use and ethnicity in early adolescence*. New York: Plenum Press.
- Wagner, E.F. and Atkins, J.H. (2000). Smoking among teenage girls. In E.F. Wagner (Ed.), *Nicotine addiction among adolescents*, pp. 93–110. New York: Haworth Press.
- Wang, M.Q. (2001). Social environmental influences on adolescents' smoking progression. *American Journal of Health Behavior*, 25, 418–25.
- Warner, L.A., Kessler, R.C., Hughes, M., Anthony, J.C. and Nelson, C.B. (1995). Prevalence and correlates of drug use and dependence in the United States: Results from the National Comorbidity Survey. *Archives of General Psychiatry*, 52, 219–29.
- Wills, T.A., Sandy, J.M. and Yaeger, A.M. (2002). Stress and smoking in adolescence: A test of directional hypotheses. *Health Psychology*, 21: 122–30.
- Wittchen, H.-U., Kessler, R.C., Zhao, S. and Abelson, J. (1995). Reliability and clinical validity of UM-CIDI DSM-III-R generalized anxiety disorder. *Journal of Psychiatric Research*, 29, 95–110.
- World Health Organization. (1990). *Composite international diagnostic interview (CIDI), version 1.0*. Geneva: World Health Organization.

### **Author biographies**

DONALD A. LLOYD is Assistant Professor in the Department of Sociology, faculty associate of The Center for Demography and Population Health, and affiliate member of the Pepper Institute on Aging and Public Policy at Florida State University. He studies the relationship between the cumulative stress exposure and mental health and substance use problems, and the long-term social status consequences of early on-set psychiatric and substance use disorders.

JOHN TAYLOR is Assistant Professor of Sociology at Florida State University and a faculty associate of The Center for Demography and Population Health. His current research includes a study of the role of early self-derogation in disordered dieting (with Lacey Sischo and Patricia Yancey Martin), and a study on the conditional relationship between religiosity and psychological distress (with A. Henry Eliassen and Donald A. Lloyd).