Cigarette Consumption During Childhood and Persistence of Smoking Through Adolescence

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Background: The childhood cause of adolescent smoking requires prospective study.

Objectives: To compare prospective with retrospective estimates of childhood smoking and to test cigarette consumption and susceptibility to smoking during childhood as predictors of smoking behavior at late adolescence.

Design: Eight-year prospective study.

Setting: From February through April of 1994, 1995, and 1996, surveys were completed in elementary schools in central North Carolina; from February through May 2002, telephone interviews were completed wherever participants resided.

Participants: Of 868 age-eligible children, 737 (84.9%) provided survey data between the ages of 8 and 10 years; of these subjects, 594 (80.6%) were interviewed at the age of 17 years.

Main Outcome Measures: Current, established, and daily smoking.

Results: Current smoking was reported by 23.0% of those having never puffed on a cigarette (abstinent) in childhood vs 42.7% (odds ratio [OR], 2.45; 95% confidence interval [CI], 1.58-3.82), 50.0% (OR, 3.36; 95% CI, 1.41-8.01), 58.3% (OR, 4.41; 95% CI, 1.46-14.18), and 56.5% (OR, 4.37; 95% CI, 1.86-10.29) of those who smoked 1 or fewer, 2 to 4, 5 to 20, and more than 20 cigarettes, respectively, during childhood. Established smoking was reported by 15.0% of those abstinent in childhood vs 21.3% (OR, 1.52; 95% CI, 0.89-2.58), 40.6% (OR, 3.93; 95% CI, 1.61-9.59), 50.0% (OR, 4.96; 95% CI, 1.77-16.18), and 47.8% (OR, 5.21; 95% CI, 2.20-12.32) of those who smoked 1 or fewer, 2 to 4, 5 to 20, and more than 20 cigarettes, respectively, during childhood. Daily smoking was reported by 10.1% of those abstinent in childhood vs 11.2% (OR, 1.10; 95% CI, 0.56-2.18), 28.1% (OR, 3.45; 95% CI, 1.24-9.03), 33.3% (OR, 4.47; 95% CI, 1.29-15.84), and 39.1% (OR, 5.75; 95% CI, 2.35-14.08) of those who smoked 1 or fewer, 2 to 4, 5 to 20, and more than 20 cigarettes, respectively, during childhood. Among abstinent children, high vs low susceptibility to smoking predicted greater likelihood of current (37.5% vs 16.7%; OR, 2.98; 95% CI, 1.57-5.74), established (32.1% vs 9.3%; OR, 4.81; 95% CI, 2.29-10.07), and daily (21.4% vs 7.0%; OR, 4.02; 95% CI, 1.71-9.44) smoking at follow-up.

Conclusion: Relatively small increases in the number of cigarettes consumed during childhood are associated with significantly higher odds of current, established, and daily smoking in adolescence.


Knowledge regarding the effect of childhood smoking on future smoking behavior has come from studies that asked adolescents or young adults to recall the age or grade at which they first smoked cigarettes. Cohort data from the Monitoring the Future Study have shown that this retrospective approach underestimates the prevalence of childhood smoking. The magnitude of underestimation is unknown because, to our knowledge, no studies have compared prospective assessments obtained during childhood with retrospective reports obtained in adolescence. The present study measured initiation of smoking prospectively, when respondents were aged 8 to 10 years, and retrospectively, when the same respondents were aged 17 years. The greater the discrepancy between these 2 estimates of childhood smoking, the lower the sensitivity of the retrospective method, and the less is known with confidence regarding the long-term consequences of childhood smoking.

Because accurate recall of past events is difficult, adolescents participating in retrospective studies have been asked to re-
call when in childhood cigarette use began, not their amount of cigarette use during childhood. Thus, it is unknown whether any cigarette use in childhood, or persistent use only, raises the odds of smoking in adolescence. This study examined associations between amount of cigarette use through the age of 10 years and reports of current, established, and daily smoking in late adolescence. To our knowledge, this study is the first to examine whether cigarette use in childhood is associated with all levels of smoking in adolescence or with nicotine-dependent use specifically, and whether any amount of cigarette use in childhood is detrimental or whether a relatively high level of use is necessary to increase the odds of smoking in adolescence.

This study also examined the long-term consequences of psychological susceptibility to smoking among youth who did not initiate smoking during childhood. Susceptibility was defined as the absence of a firm commitment against smoking. One prospective validation study found that susceptibility predicted initiation of smoking among abstinent adolescents (odds ratio [OR], 3.15); another found that susceptibility predicted initiation over 2 years among abstinent children (OR, 3.74). In both of these studies, susceptibility was a stronger predictor of smoking behavior than exposure to parental smoking. To our knowledge, no studies of susceptibility to smoking have spanned childhood to adolescence, and none has tested whether susceptibility during childhood predicts likelihood of progression to advanced stages of smoking. The present study addressed this gap by testing whether susceptibility among abstinent children was associated with all or with only certain stages of smoking in adolescence, and whether a relatively high level of susceptibility was necessary to increase the odds of smoking in adolescence.

METHODS

The Child-to-Adolescent Panel Study (CAPS) was a prospective study that began data collection during childhood, measured the amount of cigarette use and susceptibility to cigarette use during childhood, and measured stage of smoking at late adolescence.

DESIGN

Baseline data were obtained from a panel of children who completed surveys between February and April of 1994, 1995, and 1996; the methods of this study have been published in detail elsewhere and are not repeated herein. Briefly, all children enrolled in the third grade during the 1993-1994 academic year at 1 of 12 elementary schools in a moderate-sized school district (total enrollment, 11,284 students) in central North Carolina were eligible to participate in a study of parenting practices, child competence, and initiation of smoking in childhood. This district was located within a 1-hour drive from The University of North Carolina at Chapel Hill, Duke University in Durham, and Research Triangle Park; the district included high-, moderate-, and low-income areas. With signed parental consent, self-report questionnaires were administered at school during the spring semesters of the third-, fourth-, and fifth-grade years. Following a protocol approved by the university’s Institutional Review Board, trained interviewers read aloud all questions and response options, and children marked responses on surveys. Of the 868 age-eligible children in the district, 737 (84.9%) had parental consent and provided complete survey data. These 737 youth were eligible for a follow-up telephone interview, conducted between February and May 2002 (mean age at follow-up, 17.1 years). With this method, all high school dropouts were eligible for inclusion at follow-up.

RECRUITMENT AT FOLLOW-UP

A search of multiple databases (primarily, the contact database from the baseline study; in addition, the North Carolina Division of Motor Vehicles drivers’ license database, Powerfinder Plus Phone Disk, the Ultimate White Pages, and ChoicePoint database) produced contact information for 687 (93.2%) of the 737 eligible adolescents. A consent form approved by the university’s Institutional Review Board was mailed to parents of these adolescents. The initial mailing was followed by reminder calls and up to 6 mailings of duplicate forms or reminder postcards. A $10 incentive was used to promote parental response (offered for consent or refusal). Of the 687 forms mailed, 20 (2.9%) produced no response (because of either passive refusal or an incorrect address), 50 parents (7.3%) actively refused, 1 family (<1%) had a child who died, and 616 parents (89.7%) consented to allow project staff to request an interview. Of the 616 adolescents with parental consent, 9 could not be reached by telephone during the data collection period, 4 were contacted but did not assent, and 603 gave assent and completed an interview. Before the interview, adolescents were asked to move to a place that was private and without distractions. Adolescents were paid $40 for being available at home during call hours and for spending up to 45 minutes on the telephone (paid even if adolescents decided not to assent once contacted by telephone). The sample included 81.8% (603/737) of eligible adolescents and 90.4% (603/667) of adolescents for whom contact information was confirmed at follow-up.

Attrition analyses using baseline data compared the demographic attributes and smoking initiation status of the 603 adolescents who completed a follow-up interview with the 134 who had completed baseline surveys but were lost to follow-up. Attrition rates did not vary significantly by age, sex, or race. Differential attrition was observed for having ever tried smoking in childhood, such that those lost to follow-up were more likely to have tried smoking by grade 5 than those retained (37.3% vs 28.2%; χ² = 4.35; P = .03). This bias would have a conservative effect on the study outcomes because children at risk for future smoking were disproportionately more likely to be unavailable for follow-up.

SAMPLE

Most (93.3%) of the adolescents in the sample were attending school at follow-up, with most (92.6%) enrolled in 11th grade. The sample was 50.2% female; and distribution by race and ethnicity was 80.8% white, 17.7% African American, less than 1% Mexican American, less than 1% Asian or Pacific Islander, and less than 1% other or more than one group. Because too few cases were available to account for variation in study outcomes across all subgroups, the analyses were restricted to the 594 white (n = 487) and African American (n = 107) youth.

MEASURES

Cigarettes smoked during childhood was indicated by the highest value of lifetime smoking reported by children through fifth grade. Each year, interviewers read aloud the question, "How..."
many cigarettes have you smoked in your whole life?,” and ordered categorical response options. Children were categorized as having never puffed on a cigarette (abstinent) through fifth grade or as having smoked 1 or fewer, 2 to 4, 5 to 20, or more than 20 cigarettes.

A reliability analysis using data from the study cohort found that children’s within-time consistency across 3 indicators of smoking (items measuring ever use, most use in 1 day, and lifetime use) was high (Kuder-Richardson 20 = 0.96 and 0.98 in the 1994 and 1995 surveys, respectively).14 Children’s over-time consistency was evaluated by looking for logic errors between baseline and the 1-year follow-up. Only between 2.0% and 2.9% of responses indicated initiation at baseline but not initiation at the 1-year follow-up. These analyses corroborate the results of other studies that have found that youth reports of smoking behavior are reliable.18,19

Susceptibility to smoking during childhood was indicated by 4 items: (1) “Do you think you will be smoking cigarettes 1 year from now?” (2) “Do you think you will be smoking cigarettes in high school?” (3) “Do you think that most kids who are like you start smoking cigarettes?” (4) “Have you ever almost tried smoking a cigarette but then decided not to?” These items measured intention to smoke in the short- or long-term, normative expectation about smoking, and ambivalence about trying smoking. The response options for items 1 to 3 were “definitely not,” “probably not,” “probably yes,” and “definitely yes.” Replicating prior prospective studies in which this measure was validated,9,10 the definitely not response indicated nonsusceptibility and the probably not, probably yes, and definitely yes responses indicated susceptibility. The response options for item 4 were “no” or “yes,” indicating nonsusceptibility and susceptibility, respectively. Responses to these items were summed over 3 years to indicate cumulative level of susceptibility to smoking among abstinent children at the age of 10 years: low (0 factors), moderate (1-2 factors), or high (3-4 factors).

Cigarette smoking outcomes in adolescence were measured using 3 indicators that are standard assessments of adolescent smoking behavior: (1) current smoking, defined as smoking at least 1 cigarette on 1 or more of the 30 days preceding the survey; (2) established smoking, defined as having smoked at least 100 cigarettes in a lifetime; and (3) daily smoking, defined as having smoked at least 1 cigarette on each of the 30 days preceding the survey.

Recalled grade at initiation of smoking was measured by asking adolescents who had ever smoked the following, “What grade were you in the first time you puffed on a cigarette?”

Three variables were used as covariates: (1) exposure to parental modeling of smoking during childhood, coded as 0 or 1 to indicate having no exposure vs having at least one parent who was a current smoker at baseline; (2) child sex; and (3) child race.

### ANALYSES

Six logistic regression analyses were conducted, whereby each adolescent smoking outcome (current, established, or daily smoking) was regressed on childhood smoking experience (using the total sample, n = 594) or on childhood susceptibility to smoking (using the subsample of abstinent children, n = 426). To maximize the stability of the ORs, a conservative approach was used to test and retain as covariates only likely confounding variables. Potential confounding variables were those that were plausible causal antecedents of the independent variables (child cigarette use and child susceptibility to smoking), and were found in preliminary analyses to have significant associations with the independent and dependent variables. The variables that met these criteria and were, therefore, included as covariates in the regression models were exposure to parental smoking in childhood, child sex, and child race.

### RESULTS

Before addressing the study questions, it was important to determine whether adolescents in the CAPS sample were like adolescents generally with regard to their smoking behavior. Table 1 presents descriptive statistics indicating current, ever daily, and frequent smoking in the CAPS sample and in the National Youth Tobacco Survey (NYTS) sample.22 The NYTS was selected as the reference database because the CAPS and NYTS used the same method to quantify current, ever daily, and frequent smoking, and because estimates specific to same-grade respondents were available from NYTS reports.22 The estimates of smoking were highly comparable across samples, a strong indication that the adolescents who composed the CAPS sample were normative with regard to cigarette use at follow-up.

### RETROSPECTIVE VS PROSPECTIVE ESTIMATES OF CHILDHOOD SMOKING

When the sample was surveyed in grades 3 through 5, 168 youth reported any cigarette use. When the sample was interviewed at follow-up, only 37 (22.0%) of the 168 prospectively identified early initiators accurately recalled that initiation had occurred in grade 5 or before. Of the 131 false-negative cases, most (n = 113) reported that initiation of smoking occurred at a later grade and the remainder (n = 18) reported that they had never tried smoking. Thus, had we been limited to retrospective data, we would have failed to identify 78.0% of those who reported initiation of smoking during childhood. To our knowledge, this is the first available evidence that retrospective estimates of early initiation of smoking can be affected by a high rate of false-negative reporting.

The follow-up survey also revealed a second type of adolescent recall bias, one that has not been reported previously, to our knowledge. Specifically, of the 70 adolescents who reported childhood initiation retrospectively,
33 never reported initiation of smoking prospectively. Thus, 47.1% of the individuals classified retrospectively as early initiators were false-positive cases.

CHILDSOHOOD CIGARETTE CONSUMPTION AND SMOKING BEHAVIOR IN LATE ADOLESCENCE

In response to annual surveys completed during grades 3 through 5, 28.3% of the sample (168/594) reported any cigarette use. When sorted by categories of cigarette use, 14.9% (n=89) smoked 1 or fewer cigarettes, 5.4% (n=32) smoked 2 to 4 cigarettes, 4.0% (n=24) smoked 5 to 20 cigarettes, and 3.9% (n=23) smoked more than 20 cigarettes through grade 5.

At follow-up, the rates of current, established, and daily smoking were 29.5%, 19.0%, and 12.5%, respectively. The odds of reporting these smoking outcomes by late adolescence increased significantly with level of cigarette consumption in childhood (Table 2). Whereas 23.0% of youth who had been abstinent in childhood were current smokers at follow-up, this rate increased to 42.7% among adolescents who had smoked 1 or fewer cigarettes (OR, 2.45; P<.001), 50.0% among adolescents who had smoked 2 to 4 cigarettes (OR, 3.30; P=.006), and 58.3% among adolescents who had smoked 5 to 20 cigarettes (OR, 4.41; P=.009) in childhood. Partitioning the between-group variance into trend components indicated a significant positive linear trend in current smoking (F=30.14, P<.001) across levels of childhood cigarette use.

The rates of established smoking among adolescents who had smoked 1 or fewer, 2 to 4, 5 to 20, and more than 20 cigarettes during childhood were 21.3%, 40.6%, 50.0%, and 47.8%, respectively. The rate among adolescents who had remained abstinent in childhood was 15.0%. The results indicate a strong association between the amount of cigarette use in childhood and the odds of progression to established smoking in adolescence. Indeed, those who had smoked 5 or more cigarettes in childhood had 5 times the odds of established smoking as peers who had remained abstinent in childhood. The trend test for established smoking indicated a significant linear trend (F=32.28, P<.001) across levels of childhood cigarette use.

Childhood experience with smoking was also a significant predictor of daily smoking at follow-up. Among those who had smoked 2 to 4, 5 to 20, and more than 20 cigarettes during childhood, 28.1%, 33.3%, and 39.1%, respectively, reported daily smoking at follow-up. Of youth who had been abstinent in childhood, 10.1% smoked daily at follow-up. By using abstinent children as the referent group, the increase in odds of daily smoking was significant, ranging from an OR of 3.45 among those who had smoked 2 to 4 cigarettes to an OR of 5.75 among those who had smoked more than 20 cigarettes during childhood. The linear trend in daily smoking across the levels of childhood cigarette use was significant (F=25.81, P<.001).

CHILDSOHOOD SUSCEPTIBILITY AND SMOKING BEHAVIOR IN LATE ADOLESCENCE

Of the 426 children who remained abstinent through grade 5, 53.3% (n=227), 33.6% (n=143), and 13.1% (n=56) had low, moderate, and high susceptibility, respectively (Table 3). The results showed that children with 1 to 2 susceptibility factors were 74% more likely to report current smoking and 84% more likely to report established smoking than peers with low susceptibility. The results also showed that children with high susceptibility had nearly 3 times the odds of current smoking (37.9% vs 16.7%; OR, 2.98; P=.001) and more than
Most of what is known about the prevalence and long-term consequences of childhood initiation of smoking is based on retrospective measurement of grade or age at initiation.\(^8\) By comparing retrospective with prospective reports of grade at initiation, this study found that the retrospective method had an unacceptably low sensitivity. Sensitivity was diminished by a high likelihood of false-negative reporting (78.0% of prospectively identified early initiators reported later or noninitiation at follow-up) coupled with a high likelihood of false-positive reporting (47.1% of adolescents who recalled initiation by grade 5 were prospectively identified as abstinent through grade 5). Although it is possible that the low sensitivity of the retrospective measure was an anomaly associated with this particular study sample (rather than to recall problems associated with retrospective assessment generally), this argument is not supported by the data. Adolescents in the CAPS sample reported normative levels of other key behavioral indicators of smoking, other studies have shown that prospective reports of youth smoking are reliable.\(^4,12,18,19\) and cohort data from the Monitoring the Future Study demonstrated that older adolescents underreport early initiation of smoking.\(^8\) Johnston et al attribute this recall bias to multiple factors. Older adolescents can forget that the event ever occurred, fail to recall when the event occurred, and redefine eligible events.\(^8\) Thus, the interpretation most clearly supported by the data is that the prevalence of childhood initiation of smoking cannot be estimated accurately using retrospective assessment with adolescents or older respondents. Indeed, if the magnitude of recall error observed among adolescents in the present study is typical, then little is known with confidence regarding the strength of the association between childhood smoking and progression to advanced stages of smoking over time.

The second issue addressed by this study was whether early experience with smoking, indicated by cigarette use while children were in grades 3 through 5, explained variation in smoking outcomes at late adolescence. The general finding was that greater experience with smoking during childhood was associated with greater odds of current, established, and daily smoking in adolescence. To our knowledge, this is the first prospective evidence of this association. Although childhood experience was expected to increase the odds of future smoking, the magnitude of the observed effect was greater than anticipated. The study found, for example, that when compared with peers who had remained abstinent through the age of 10 years, adolescents who had smoked 2 to 4 cigarettes in childhood were 3 times more likely to smoke daily, those who had smoked 5 to 20 cigarettes were 4 times more likely to smoke daily, and those who had smoked more than 20 cigarettes were 6 times more likely to smoke daily at follow-up.

These results provide important prospective evidence that the risk trajectory associated with cigarette use in childhood is steep (ie, relatively small increases in the number of cigarettes smoked during childhood were associated with substantial increases in the proportion of youth reporting smoking at late adolescence). For example, 23.0% of children who were abstinent, but 42.7% of children who had smoked 1 or fewer cigarettes, re-
ported current smoking at follow-up. That exposure to even one cigarette raised the odds of future smoking suggests the need for research to study the effects of reducing children’s access to cigarettes. As reported by Greenlund et al,23 children most frequently obtain their first few cigarettes from social sources, particularly their own or friends’ family members.23 Research on social access by adolescents24-26 should be broadened to include investigation of the epidemiology and prevention of social access to cigarettes by children.

This study also found that susceptibility to smoking among abstinent children was associated with an increased odds of smoking in adolescence. Because of the duration of this study, these analyses exceeded by several years all prior longitudinal analyses on susceptibility to smoking,9,10,27 and were the first, to our knowledge, to establish an empirical link between susceptibility in childhood and smoking behavior in adolescence. The results showed, for example, that abstinent children who reported 3 to 4 susceptibility factors had, as adolescents, a 4-fold increase in the odds of established or daily smoking when compared with peers who had low susceptibility during childhood. The observed ORs were comparable to those reported in shorter-term studies of susceptibility9,10 and, as was found in those studies, susceptibility to smoking was more strongly associated with adolescent smoking outcomes than was parental smoking.

It is remarkable that a psychological indicator of childhood intentions and normative expectations about smoking predicted smoking behavior into late adolescence. This finding provides evidence that socialization processes that engender prosmoking norms and intentions can occur during what Flay et al28 and others29 have called the “preparation stage” of smoking. More broadly, this finding indicates the need for research to delineate the socialization processes that affect the development of smoking-specific norms and intentions among abstinent children.

Despite the application of a prospective design, this study had limitations that affected the interpretation of the data. First, the sample was drawn from a school district in central North Carolina, and it is possible that other attributes of the sample (eg, regional factors) limit the generalizability of the results. Although estimates of various smoking behaviors in the study sample at follow-up were comparable to estimates of the same behaviors in same-aged adolescents, as reported by the NYTS,23 this does not provide evidence that the sample estimates were unbiased. Thus, the results should be applied judiciously to dissimilar populations of youth. In addition, this study relied on self-reported smoking behavior that was not compared with biochemical measures, it was limited to examining individual-level outcomes, and possible cluster effects due to school-level variation in factors associated with smoking behavior were not accounted for in analyses. Another limitation of this study was the lack of data collection between the ages of 11 and 16 years, inclusive. Lacking interim data, this study cannot contribute knowledge regarding initiation of smoking during early or middle adolescence or the timing of transitions through the stages of smoking.

In conclusion, relatively small increases in the number of cigarettes consumed during childhood are associated with significantly higher odds of current, established, and daily smoking in adolescence.

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REFERENCES

65 Yellow Roses

“65 Yellow Roses” on your grave I placed today
Then on my knees I got and silently prayed,
No, not for you my sweetie
For I know you’re safe in heaven
But for myself and others,
Whoms heart have never mended.
I want to thank you honey and need to apologize,
I stood by your grave today and told my reasons why.
“65 Yellow Roses” lay beautifully upon your grave
To signify the illness that took your life away.
You always knew this is the place
Where in your youth you’d lay
And all you asked and wanted is for it to be maintained.
Many people love you and many heard your plea,
For each time I come to visit
I find things placed anonymously.
“65 Yellow Roses”
I placed there today
65 Roses is what took you away.

John Faucett, MD