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Delay Discounting and Self-Reported Impulsivity in Adolescent Smokers and Nonsmokers Living in Rural Appalachia

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Abstract

Background and Objectives—This study evaluated whether impulsivity (delay discounting and BIS-11-A) is associated with adolescent smoking status in a region with strong environmental risk factors for smoking.

Methods—Forty-two adolescent smokers and nonsmokers from rural Appalachia completed discounting and self-reported impulsivity assessments.

Results—The BIS-11-A, but not the measure of discounting, was associated with smoking status; however, neither assessment predicted smoking status once parent/best-friend smoking variables were statistically accounted for.

Discussion and Conclusions—In regions with strong environmental risk factors for smoking, delay discounting may play a more limited role in risk of initiation.

Scientific Significance—Helps to better define impulsivity as risk factors for smoking in relation to familial and broader cultural variables.

Introduction

Appalachia is a large, predominately rural region of the Eastern United States where rates of smoking for adolescents and adults are consistently higher than national averages.¹

Important risk factors for smoking among adolescents include parent and best friend smoking. Qualitative research conducted in Appalachia has identified the importance of family members who reinforce tobacco use in increasing the risk of smoking.² Also, regionally higher smoking rates increase the likelihood that adolescents will have peers who

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smoke, and there is evidence that higher rates of classmate smoking correspond to increased smoking initiation risk.³

In addition to social risk factors, there are “person variables” that increase risk of smoking. For example, delay discounting has robust associations with cigarette smoking during both adolescence and adulthood.⁴ Assessments of delay discounting involve making choices between immediate versus delayed rewards. A greater choice preference for smaller immediate outcomes at the expense of more valuable but delayed outcomes is often considered a form of impulsive behavior. Adolescent smokers discount more by delay than demographically similar nonsmokers,⁵ and some evidence suggests high rates of delay discounting increases risk of experimentation with cigarettes and initiation of smoking.⁶ Self-reported impulsivity also has robust associations with adolescent cigarette smoking status, but these assessments are only modestly associated with delay discounting.⁷ These measures provide a broader characterization of behaviors that are considered impulsive than is defined by delay discounting.

There has been no published research to compare delay discounting or self-reported impulsivity in adolescent cigarette smokers and nonsmokers from a region with smoking rates well above the national average. Here, these variables were assessed in adolescent smokers and nonsmokers recruited from rural Appalachia. Data were also collected on parent smoking status and if the adolescent's best friend smoked. The primary goal of this research was to determine whether earlier findings for delay discounting and self-reported impulsivity in adolescent smokers and nonsmokers⁶ are replicable in this unique sample.

Method

Participants

A sample of adolescent smokers and nonsmokers, aged 14–19 years, participated in this research ($N=42$). All participants were recruited from the rural Appalachian regions of Ohio and Kentucky through posted advertisements, newspaper advertisements, and word-of-mouth referrals.

Procedure

Data collection took place at the Appalachian Health Research Center or in our mobile research laboratory, which was parked at public locations (eg, Wal Mart parking lot) during data collection. The mobile lab was built on a 30' truck frame and included computer stations, interview room, bathroom, and a biological sample freezer. All biological samples collected in the mobile lab were frozen and tested at a later date. Participants and their parents or legal guardians reviewed and signed IRB approved assent and consent forms. Participants then completed a single laboratory session in private consisting of demographic and smoking-related questionnaires, an assessment of IQ (Kaufman Brief Intelligence Test-Second edition), the self-report measure of impulsivity, and the measure of delay discounting—completed in this order. We assessed IQ to determine whether the two groups differed on this variable, which has been shown to be associated with delay discounting.⁸

Participants provided samples of both breath (for carbon monoxide) and urine (for cotinine) to verify cigarette smoking status.

Delay discounting was assessed for all participants with a computerized question based delay discounting task (DDQ).⁹ For this measure, participants were presented choices between \$10 available after a specified delay (ie, 1, 2, 30, 180, 365 days) and a smaller amount available immediately (eg, “would you rather have \$10 in 30 days or \$2 now?”). This task used an adjusting amount procedure (adjusting the immediate amount in increments of \$.50) to derive indifference points between the delayed standard and immediate adjusting options for each of the five delays assessed. An indifference point reflected the smallest amount of money an individual chose to receive immediately instead of the delayed standard amount (\$10) at the specific delay. For each participant, one of his or her choices was randomly selected and honored—resulting in either immediate or delayed money. If the participant was to receive delayed money, he/she was given a postcard (addressed to the laboratory) to be mailed at the time when the payment was to be received. Upon receiving the postcard, lab personnel then mailed payment to the participant's current address. Discounting data were characterized using area under the curve (AUC). Discounting data from all participants were examined and determined to be systematic; however, data from two participants were marginally acceptable, but still included in analyses.

Self-report impulsivity was assessed using the Barratt Impulsiveness Scale-Adolescent (BIS-11-A).¹⁰ The BIS-11-A is a 30-item questionnaire designed to measure impulsiveness. Items are on a four-point scale (1 = rarely/never to 4 = almost always/always). It has been recommended that total scores are the most appropriate index of impulsivity for this age group. Higher total scores reflect greater impulsivity.¹¹

2.3 Analyses

Independent samples *t*-tests and χ^2 tests were used to compare variables across groups. A Pearson correlation was run between AUC values and BIS-11-A total scores. Binary logistic regression was used to determine whether AUC and BIS-11-A significantly predicted smoking status. An additional model was run to include parent and best friend smoking along with significant predictors from the previous model. Collinearity diagnostics were performed, and all VIF values were below 2. η^2 are reported for effects sizes for AUC and BIS-11-A data to facilitate comparisons to earlier research.

3. Results

All group comparison data, including means and standard deviations, are presented in Table 1.

There was a significant correlation between AUC and BIS-11-A, $r(41) = -.307$, $p = .048$. Higher ratings of impulsivity on the BIS-11-A were associated with greater discounting by delay. The first logistic regression model significantly predicted participants' smoking status, $\chi^2 = 7.83$, $df = 2$, $N = 42$, $p < .050$. Only the BIS-11-A was a significant predictor of smoking status ($\eta^2 = .184$). There was a small effect for delay discounting ($\eta^2 = .064$). The

second model that also included parent and best friend smoking variables was significantly predictive of smoking status, $\chi^2 = 29.77$, $df = 4$, $N = 42$, $p < .001$; however, the BIS-11-A was no longer a significant predictor in this model. Both parent and best friend smoking were significant predictors.

4. Discussion

A primary finding from this research is that delay discounting was not significantly associated with smoking status in these adolescents. This lack of association is inconsistent with earlier research from this and other laboratories.^{7,12} For example, from Reynolds et al. (2007), 25 smokers and 26 nonsmokers recruited from central Ohio (an urban region that is not in Appalachia) were compared on these measures. The smokers discounted significantly more ($\eta^2 = .095$) and rated themselves as more impulsive on the BIS-11-A ($\eta^2 = .256$) than the nonsmokers. Most importantly, the effect sizes from this earlier research are larger than the effects reported here. Across studies, these findings may suggest that other risk factors for smoking in regions like rural Appalachia override person variables like delay discounting as a risk for smoking. That is, in such populations, teens who discount little by delay may still be at high risk of smoking initiation because of other variables that promote smoking. For example, 90% of the smokers here reported having at least one parent who smoked, and 95% reported that their best friend smoked. Contrast these percentages with data collected in central Ohio (though not reported in Reynolds & Fields, 2012) where 74% of the smokers reported having a parent who smoked and 78.6% reported having a best friend who smoked. Regional differences in such smoking-related variables may reduce to some degree the potential role of variables like delay discounting to increase risk above and beyond environmental risk factors.

Self-reported impulsivity was a significant predictor of smoking status; however, this relationship became nonsignificant after controlling parent and best friend smoking. Parent and best friend variables independently predicted smoking status even after controlling for the BIS-11-A. From these data, parent and best friend smoking status are the variables primarily related to smoking status for these rural Appalachian adolescents.

A limitation of this research is that the sample is relatively small, which may limit generality of these findings to only Appalachian Ohio and Kentucky. Also, for all participants, the BIS-11-A preceded the assessment of delay discounting, which may have led to some carryover effects to the measure of delay discounting. Nevertheless, this initial evaluation highlights the possibility that regional risk factors for smoking in some locations may be strong enough that widely recognized person-variable risk factors like impulsivity become less relevant to smoking status. As such, future research is needed to better understand how impulsivity is related to smoking status in diverse populations of smokers, which may have implication for how impulsivity research should or should not inform prevention and intervention strategies in these groups.

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TABLE 1
Group comparisons on demographic and primary study variables (N = 42)

	Smokers (N = 20)	Nonsmokers (N = 22)
Age (years; M [SD])	16.6 (1.14)	16.05 (1.49)
Sex (% female)	45	50
Race (N; black:white: other)	1/19/0	0/20/1
KBIT 2 (IQ standard score; M [SD])	90.9 (12.81)	95.41 (12.94)
Cigarettes (number per day; M [SD]) ^a	15.13 (9.15) ^A	.00 (.00) ^B
Carbon monoxide (ppm; M [SD])	9.45 (4.97) ^A	2.00 (.87) ^B
Cotinine (ng/ml; M [SD])	1313.2 (624.34) ^A	.45 (.91) ^B
How many friends smoke (M [SD]) ^b	3.7 (.92) ^A	1.86 (1.04) ^B
Closest/best friend smokes (% reporting yes)	95 ^A	22.2 ^B
At least one parent smoke (% reporting yes)	90 ^A	54.5 ^B
Marijuana (M [SD]) ^c	1.75 (1.86) ^A	.36 (1.09) ^B
Alcohol (M [SD]) ^c	1.7 (1.13) ^A	.77 (.10) ^B
BIS-11-A total score (M [SD])	70.95 (11.53) ^A	61.05 (10.31) ^B
AUC from DDQ (M [SD])	.317 (.290)	.454 (.303)

Means or percentages in the same row that do not share the same superscript differ at $p < .05$.

^aCigarettes per day were calculated using a timeline follow back calendar to determine cigarettes smoked each day during the past 14 days.;

^bFriends who smoke was assessed using the following question: "How many of your friends smoke cigarettes/black & milds?": 1 = none, 2 = some, 3 = half, 4 = most, and 5 = all.;

^cDrug use was assessed with the following question: "Thinking about the past 6 months, how often have you used the following substances?": 1 = tried it, 2 = 1–2 times/month, 3 = once a week, 4 = 2–4 times/week, 5 = 5 or more times a week.