HHS Public Access

Author manuscript

Psychol Addict Behav. Author manuscript; available in PMC 2015 September 01.

Published in final edited form as:

Psychol Addict Behav. 2014 September ; 28(3): 743–751. doi:10.1037/a0037444.

Health Risk Perceptions Predict Smoking-related Outcomes in Greek College Students

John D. Jacobson,
University of Missouri – Kansas City

Delwyn Catley,
University of Missouri – Kansas City

Hyoung S. Lee,
University of Missouri – Kansas City

Solomon W. Harrar, and
University of Kentucky

Kari Jo Harris
The University of Montana

Abstract

Health risk perception in smoking behavior was prospectively evaluated in a cluster-randomized trial for smoking cessation in Greek college students. Perceived Vulnerability (PV), Precaution Effectiveness, Optimistic Bias, and smoking behavior measures (quit attempts and cessation) were assessed in college-aged Greek student smokers at baseline, end of treatment (3 months), and follow-up (6 months). Using generalized estimating equations baseline risk perception variables and change in risk perception variables between baseline and end of treatment were examined as predictors of the dichotomous smoking outcome variables. Results revealed that higher baseline PV [OR = 1.42 (1.21, 1.68)] predicted a greater likelihood of a quit attempt (n = 267). An increased likelihood of cessation [OR = 1.41 (1.15, 1.72)] was also predicted by an increase in PV from baseline to end of treatment (n = 243). Overall results suggested that PV was the strongest predictor of smoking behavior change, supporting further examination of health risk perceptions in promoting smoking cessation among Greek college smokers.

Keywords

Smoking; College students; Motivation; Health risk; Greek students

Correspondence concerning this article should be addressed to Delwyn Catley, 5030 Cherry Street, Department of Psychology, University of Missouri-Kansas City, Kansas City, MO 64110. catleyd@umkc.edu.
John D. Jacobson, Department of Psychology, University of Missouri – Kansas City, MO; Delwyn Catley, Department of Psychology, University of Missouri – Kansas City, MO; Hyoung S. Lee, Department of Psychology, University of Missouri – Kansas City, MO; Solomon W. Harrar, Department of Statistics, University of Kentucky; Kari Jo Harris, School of Public and Community Health Sciences, The University of Montana, Missoula, MT.
Hyoung S. Lee is now at Department of Interdisciplinary Arts and Sciences, University of Washington, Tacoma

College Student Smoking

Over 19 million young adults attend colleges and universities, and although levels of college smoking have decreased over the past decade, 24.8% of all students enrolled in college continue to smoke (Substance Abuse and Mental Health Services Administration, 2011). Most smokers initiate their smoking prior to entering college, but over 10% of college smokers will begin smoking during their college years. Occasional smokers in high school are likely to become more frequent, heavy smokers in college (Schorling, Gutgesell, Klas, Smith, & Keller, 1994; Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998). College student smoking is also significant for the trajectory of future smoking behavior after college because although most students do plan on quitting prior to graduation (Levinson et al., 2007; Thompson et al., 2007), most will not (Wetter et al., 2004). As many as 60% will continue to smoke and over 15% of these may escalate their smoking (Kenford et al., 2005; Wetter et al., 2004). Smoking behavior in college may therefore represent a critical period for many students influencing whether or not they progress to become regular smokers in their adult life (Gilpin, White, & Pierce, 2005; Ling, Neilands, & Glantz, 2009).

College students also represent a unique population because although the level of smoking in college smokers varies, college students are generally lighter smokers with 41% reporting that they smoke less than 1 cigarette per day (Halperin, Smith, Heiligenstein, Brown, & Fleming, 2010). As many as half of college smokers consider themselves to smoke so little that they do not identify as smokers (Berg et al., 2009; Levinson et al., 2007). Smoking in this group is very often linked to social occasions and occurs commonly on weekends (Cronk et al., 2011). Compared to daily smokers, nondaily college smokers are more likely to be younger, African American, or members of Greek organizations (Sutfin et al., 2012). From a psychological perspective, they believe they will not have any difficulty quitting (Berg, Sutfin, Mendel, & Ahluwalia, 2012; Waters, Harris, Hall, Nazir, & Waigandt, 2006) and are generally low on motivation to quit (Levinson et al., 2007), although recent findings (Berg et al., 2012; Kotz, Fidler, & West, 2012; Sutfin et al., 2012) have brought this into question.

Risk Perception

College student smoker’s motivation to quit smoking might be explained by risk perception which is a central construct in many leading health behavior change theories including the Health Belief Model (Janz & Becker, 1984), Protection Motivation Theory (Rogers, 1975), and the Precaution Adoption Model (Weinstein, 1988). These theories all suggest that health behavior change occurs in order to reduce elevated perceptions of vulnerability to health threats. As suggested by McCaul et al. (2006), heightened risk perception may lead to the formation of negative outcome expectations (Copeland & Brandon, 2000) or motivate behavior to avoid danger and negative affect (Leventhal, Leventhal, & Cameron, 2001). Risk perception can also be changed by the provision of risk information (Kreuter & Strecher, 1995).

Risk perception has also been viewed as a multi-dimensional construct that includes perceived vulnerability, precaution effectiveness, and optimistic bias (Weinstein, 1988).

Perceived vulnerability, or the degree to which an individual feels threatened by risky health behaviors, has frequently been considered to be the motivational force behind attempts to quit smoking (McCaul et al., 2006; Weinstein, 1988). Current smokers underestimate their vulnerability to the health risks of smoking (Weinstein, Marcus, & Moser, 2005) (Tomar & Hatsukami, 2007) and this includes occasional college smokers (Morrell, Song, & Halpern-Felsher, 2010; Murphy-Hoefer, Alder, & Higbee, 2004). While no studies of college students have examined whether perceived vulnerability predicts smoking behavior change, a longitudinal study of adult daily smokers found that greater perceived vulnerability predicted the likelihood of a quit attempt and the duration of abstinence 6 months later ($r = .23$ and .28, respectively; Norman, Conner, & Bell, 1999). An intervention study for daily smokers that included an equal proportion of college student and community residents examined the effects of increasing perceived vulnerability by providing risk messages (versus non-risk messages) using a personal digital assistant. Results indicated that the intervention group had significantly more quit attempts than the control message group (53% versus 19%) and that perceived vulnerability mediated the effect of the intervention on increased contemplation of quitting (Magnan et al., 2009).

Motivation to quit smoking is also affected by perceptions regarding whether quitting smoking is an effective means of lowering health risks or eliminating other negative features of smoking. *Precaution effectiveness* is the term that has been used to refer to the extent to which a smoker believes that quitting will have these beneficial results (Weinstein, 1988). Smokers who perceive greater benefits of quitting are more likely to want to quit (McKee, O'Malley, Salovey, Krishnan-Sarin, & Mazure, 2005) and benefits of quitting are more readily recognized by those who are planning to quit (Sutton, 1990). In the case of college students, one study found that almost half of community college smokers believe that quitting will have little or no benefit to their health (Prokhorov et al., 2003). While it has been suggested that failure to perceive the benefits of quitting likely contribute to continued smoking behavior among college students (Prokhorov, Emmons, Pallonen, & Tsoh, 1996), there are no longitudinal studies that have examined precaution effectiveness as a predictor of subsequent smoking behavior.

Current smokers also perceive themselves at lower risk than other individuals who smoke (Weinstein, 1998). This tendency to perceive oneself at lower risk than others engaging in a similar behavior is termed *optimistic bias* (Janz & Becker, 1984; Weinstein, 1980). One study found that optimistic bias is even stronger in adolescent smokers compared with adult smokers (Arnett, 2000), but there are no longitudinal studies of the influence of optimistic bias on smoking behavior among college students.

In summary, studies suggest adolescents and college students are prone to low perceived vulnerability and perceived precaution effectiveness for quitting, and optimistic bias. These characteristics may contribute to continued smoking during college and after graduation; however, studies of college student smokers have been primarily cross-sectional and have not examined the relevance of these constructs for changes in smoking behavior. Furthermore, there is a need for research that simultaneously examines the different elements of risk perception to understand which are most important. Recently Borrelli, Hayes, Dunsiger, and Fava (2010) examined a number of risk perception variables as

predictors of smoking cessation among medically ill patients and found that only increased perceived vulnerability measures predicted subsequent cessation (which was increased 2 to 4 fold per unit increase in perceived vulnerability). Precaution effectiveness and optimistic bias predicted a lower likelihood of cessation only among patients who had a smoking-related illness. This may indicate that perceived vulnerability is a more powerful predictor than other risk perception measures.

Purpose

The purpose of the present study was to examine the extent to which similar risk perception constructs (i.e., perceived vulnerability, precaution effectiveness, optimistic bias) were related prospectively to smoking behavior change (i.e., quit attempts, cessation) among Greek college students participating in a smoking intervention trial. Greek students are more likely to engage in unhealthy behaviors such as smoking than their peers (Scott-Sheldon, Carey, & Carey, 2008) and the smoking intervention trial evaluated the effectiveness of Motivational Interviewing for smoking cessation relative to Motivational Interviewing for increasing fruit and vegetable intake (Harris et al., 2010). We hypothesized that individuals who were high in perceived vulnerability and precaution effectiveness at baseline and those low in optimistic bias would be more likely to quit or attempt to quit during a study designed to improve their health. We also hypothesized that any increases in perceived vulnerability and precaution effectiveness as well as decreases in optimistic bias prompted by the interventions or other encounters with health risk information during the study would be associated with increased quitting or attempting to quit.

Method

Data for this study were drawn from the Greek Health Project (Harris et al., 2010), a cluster-randomized trial examining the efficacy of Motivational Interviewing (MI) for smoking cessation (compared to MI for increasing fruit and vegetable intake). Multi-level modeling revealed that MI for smoking cessation was effective in increasing quit attempts relative to control and that MI had no significant impact on cessation.

Participants

Eligible students were members of a sorority or fraternity, had smoked at least one cigarette in the past 30 days and had not used medication to help quit smoking in that past 30 days. The fraternity and sorority system facilitated recruitment of college smokers at house meetings where students were invited to complete eligibility screening surveys for a study of “health behaviors.” At consent they were invited to enroll in a study for a counseling based intervention for tobacco use or consumption of fruits and vegetables. Students were not necessarily interested in addressing their tobacco use, but were supportive of their chapter-sponsored health program (Davidson et al., 2010; Varvel, Cronk, Harris, & Scott, 2010). Of the 452 participants enrolled (59.4% of those screened; 245 treatment arm, 207 comparison arm), 5 participants were excluded because, although eligible at screening, they did not smoke at all during the 30 days prior to baseline survey. Of these participants there were 117 who did not return to complete assessments at the end of treatment and 94 who did not return at follow-up. Due to experimenter error, precaution effectiveness data was not

obtained from 63 additional participants at the 3 month assessment. Excluding participants who were missing quit attempt data (either at end of treatment or follow-up) or precaution effectiveness data at end of treatment yielded a final sample of 267 (159 treatment arm, 108 comparison arm). There were an additional 24 participants who were missing cessation data at end of treatment or follow-up yielding a final sample of 243 for the main analysis predicting cessation.

Measures

Demographic and smoking characteristics—All assessments were obtained via a computer-administered survey. Demographics assessed included age, gender, race/ethnicity, and year in school. Other baseline measures included motivation and confidence to quit smoking (0–10 scale, 10=very motivated/confident; Boardman, Catley, Mayo, & Ahluwalia, 2005) and nicotine dependence using the 10-item Hooked on Nicotine Checklist (Wellman, DiFranza, Savageau, & Dussault, 2004; Wellman et al., 2005). The sample was composed predominantly of white, male, Greek, college-aged students who were mostly nondaily smokers with moderate levels of motivation, but high levels of confidence in their ability to quit.

Risk perception—In the absence of well-established risk perception scales, the measures used were drawn from prior research where items had been used successfully with college students (Prokhorov et al., 2003) and adult community members (Dijkstra, De Vries, & Bakker, 1996; Prokhorov et al., 2003). These items are also similar to those used in a recent study of risk perceptions among medically ill patients that used the same broad risk perception constructs (Borrelli et al., 2010). Response scales were adjusted for the purposes of our larger survey. Risk perception was assessed at baseline, end of treatment (EOT), and at 6 month follow-up (FU) and included items designed to tap perceived vulnerability (PV), precaution effectiveness (PE), and optimistic bias (OB).

Perceived vulnerability: PV was measured using three items (Prokhorov et al., 2003): ‘How much has your overall health been affected by smoking?,’ ‘How much would continuing to smoke hurt your health?,’ and ‘How much would quitting smoking help your health?’ (1 = *not at all* to 3 = *a lot*). Although the third item fit conceptually with precaution effectiveness it was retained as part of PV because of the results of factor analysis (discussed below) suggested participants perceived it as more similar to the construct of perceived vulnerability and removing the item would have weakened the measure. The Cronbach’s α for this measure was .72, .71, and .70 for baseline, EOT, and FU, respectively.

Precaution effectiveness: PE was measured with three questions: ‘If I quit smoking, my risk of …lung cancer, …heart disease, …chronic obstructive pulmonary disease will decrease.’ (1 = *will not decrease* to 4 = *will decrease a lot*; Dijkstra, De Vries, & Bakker, 1996). Cronbach’s α for PE in our sample = .92, .96, and .95 for baseline, EOT, and FU, respectively.

Optimistic bias: OB was assessed with three questions: ‘How would you compare your health to that of the average person your age?,’ ‘How would you compare your health to that

of the average nonsmoker your age?,' and 'How would you compare your health to that of the average smoker your age?'(1 = *much worse* to 5 = *much better*; Prokhorov et al., 2003; Borrelli et al., 2010). Cronbach's α for our sample = .83, .86, and .85 at baseline, EOT, and FU, respectively.

Smoking behavior outcomes—The occurrence of any *quit attempt* (yes/no) since the start of the study through EOT and FU was determined from single item assessments of whether the participant had made a serious quit attempt for at least 24 hours (Ahluwalia, Harris, Catley, Okuyemi, & Mayo, 2002; Richter, Gibson, Ahluwalia, & Schmelzle, 2001).

Level of smoking and *abstinence* in the previous 30 days at EOT and FU was determined using the Timeline Follow-Back Method (TLFB; Sobell & Sobell, 1992) which has been successfully adapted for a computer-based assessment of cigarette smoking among college students (Harris et al., 2009). Level of smoking was defined by the number of days smoked in the past 30 days. Abstinence was indicated when the TLFB indicated that there were no cigarettes smoked in the previous 30 days. Smoking in the past 30 days is commonly used to determine smoking status in surveys of youth smoking (e.g., Eaton et al., 2010). Saliva samples were collected and assessed for cotinine (Benowitz et al., 2002) from those who reported 30-day cessation at 6 months to confirm short-term abstinence and to encourage more accurate reporting of 30-day abstinence. One participant who reported abstinence was coded as continuing to smoke because cotinine values were higher than the 15 ng/ml expected for nonsmokers.

Procedures

Study procedures were reviewed and monitored by relevant institutional review boards. Recruitment and retention procedures are described in detail elsewhere (Davidson et al., 2010; Varvel et al., 2010), but in brief, eligible students in sororities and fraternities agreeing to participate were scheduled for baseline assessment where they completed a computerized survey that included demographic, health risk perception, and smoking behavior measures. Participants were then randomized by group (sorority or fraternity) to receive four 30-minute sessions one month apart of either MI focused on quitting smoking or MI focused on increasing consumption of fruits and vegetables. All four sessions were completed by 81% of participants (79% quitting smoking group, 84% fruits and vegetables group). Interventions were designed to be as similar as possible with the exception of the targeted behavior change and focused on fostering students' "internal motivation" for change. MI methods (Miller & Rollnick, 2002) were used to elicit "change talk" and highlight "discrepancy" between current (e.g., smoking) and ideal behavior (e.g., not smoking). Although the MI for smoking intervention included the provision of information on the risks of smoking and feedback concerning the link between smoking and any reported respiratory symptoms, the intervention was not designed to focus specifically on increasing risk perceptions. Counselors were trained to avoid providing advice and to minimize giving information about smoking in favor of exploring and enhancing the participant's existing sources of motivation (e.g., through discussion of pros and cons of smoking and how smoking related to participant's values). At the end of the fourth MI session (approximately 3 months after baseline assessment) and at a six-month follow-up assessment visit,

participants completed computerized surveys that included the same health risk perception and smoking behavior measures.

Statistical Analysis

Because participants were clustered within Greek chapters we calculated Intraclass Correlation Coefficients (ICCs) for dependent variables (i.e., cessation and quit attempt at EOT and FU) to determine whether multi-level modeling was necessary. Preliminary analyses included examining the factor structure of our risk perception items at baseline to ensure they were loading appropriately on the intended constructs. All nine items that constituted the three risk perception constructs (i.e. perceived vulnerability, precaution effectiveness, and optimistic bias) were entered into principal factoring analysis. Prior to the main analyses summary statistics were calculated for all variables and simple correlations between all risk perception and smoking outcome variables were also calculated. Summary statistics were also calculated for all variables and participants excluded from analyses were compared to those included on baseline characteristics.

To examine the relationship between the risk perception variables and smoking behavior we conducted a longitudinal analysis with generalized estimating equations (GEE: Liang & Zeger, 1986). GEE was used to analyze the longitudinal data while taking into account that shared variance results from each individual providing multiple reports. A benefit of using GEE is that effects of attrition on the results are minimized because individuals with incomplete data are not excluded and all available data are included (Patrick et al., 2011). Four separate sets of models were used in which either baseline or change in risk perception variables were used to predict each smoking outcome variable (i.e., quit attempt or cessation assessed at both EOT and FU). Based on prior analyses (Harris et al., 2010), treatment condition, age, and gender were included as covariates. Because college student smoking encompasses a wide range of smoking levels and higher levels of smoking are related to greater perceived health risk (Moran, Glazier, & Armstrong, 2003; Sutfin, Reboussin, McCoy, & Wolfson, 2009) it was necessary, in the determination of the independent effect of risk perceptions, to also control for baseline smoking levels in our analyses. A nested approach was used for each set of models. Covariates were examined as predictors in the first model (model 1), risk perception variables were added in a second model (model 2), and interactions between each risk perception variable and time were added in a third model (model 3). We compared the Quasilikelihood under the Independence model Criterion (QIC) between the 3 models and interpreted the model in each set with the best fit.

Results

Preliminary Analyses

ICCs for cessation at EOT and follow-up and for quit attempt at EOT and follow-up were 0.034, 0.003, 0.057, and 0.013, respectively. Since the nesting effects of chapters on smoking outcome variables were low, multi-level modeling was not employed in the subsequent analysis. Principal axis factoring of the risk perception items identified three components with eigenvalues over Kaiser’s criterion of 1 and in combination accounted for 64.8% of the variance. All items had very good to excellent item loadings after oblique

rotation, ranging from 0.72 to 0.92 on their respective component. As expected, the three OB items loaded together onto single component, the three disease specific PE items loaded together onto a second component, and the two PV items together with the general health precaution effectiveness item loaded together onto a third component. Further analyses were conducted using these variables (i.e., PV, PE, and OB).

Participant characteristics are displayed in Table 1 and descriptive statistics for risk perception and smoking behavior variables are presented in Table 2. Participants who were included in data analyses were compared to those who were not on baseline measures and no significant differences were found (all p's > .15). There were also no baseline differences between the 63 participants who did not (due to experimenter error) and those who did complete the PE assessment at month 3 (all p's > .51).

Intercorrelations Between Study Variables

Intercorrelations between risk perception variables and motivation— Intercorrelations among the key study variables are presented in Table 3. Examination of the associations between the risk perception variables revealed that the risk perception variables were modestly correlated in expected directions. Baseline and EOT values of PV were significantly negatively correlated with baseline and EOT values of OB and significantly positively correlated with baseline and EOT values of PE. There were no significant relationships between OB and PE variables. Baseline values of PV, PE, and OB were significantly negatively correlated with corresponding increases in PV, PE, and OB. Baseline OB was also significantly positively correlated with change in PV and change in PV was significantly negatively correlated with change in OB. Baseline motivation was significantly positively correlated with baseline values of PV as well as EOT values of both PV and PE.

Intercorrelations between risk perception and level of smoking—Examination of the associations between baseline level of smoking and baseline risk perception and smoking behavior variables at EOT and FU revealed that higher baseline levels of smoking were significantly associated with both lower OB, higher PV and PE. Higher baseline levels of smoking were also significantly associated with an increased likelihood of having made a quit attempt at EOT and FU but a reduced likelihood of being abstinent at both EOT and FU.

Intercorrelations between risk perception and smoking outcomes—Examination of the associations between the risk variables and smoking outcomes revealed significant positive associations between PV and having made a quit attempt but a significant negative associations between PV and abstinence at both EOT and FU. There was also a significant positive association between an increase in PV from baseline to EOT and abstinence at EOT and FU. There was also a significant negative association between baseline OB and having made a quit attempt at FU as well as a significant positive association between baseline OB and abstinence at EOT. There was a significant association between baseline PE and QA at both EOT and FU, but no significant relationship with abstinence.

Primary Analyses

For each of the four sets of analyses (baseline or change in risk perception predicting either quit attempts or cessation) the model that incorporated the covariates and the risk perception variables (i.e., model 2) had the lowest QIC. For parsimony we present in Tables 4 and 5 only the full results for model 2 along with the QIC's for all 3 models.

Quit attempts—As displayed in Tables 4 and 5, GEE analysis revealed that higher baseline PV predicted a significantly increased likelihood of a quit attempt. All other baseline and change in risk perception variables were not significantly related to quit attempts.

Abstinence—As displayed in Tables 4 and 5, GEE results revealed that higher baseline PV predicted a significantly reduced likelihood of cessation while higher baseline PE and an increase in PV predicted a significantly greater likelihood of abstinence. All other baseline and change in risk perception variables were not significantly related to abstinence.

Discussion

The purpose of this study was to examine health risk perceptions as prospective predictors of smoking behavior change among Greek college students. In our primary longitudinal analyses, which included all three risk variables and controlled for level of smoking, only PV and PE were significant predictors of outcomes. Consistent with our hypotheses, greater baseline PV predicted a greater likelihood of quit attempts and baseline PE as well as increased PV from baseline to end of treatment predicted a greater likelihood of cessation over time. This finding was consistent with the prior studies that have shown prospective links between PV and PE and smoking outcomes (Borrelli et al., 2010; Magnan et al., 2009; Norman et al., 1999); however this is the first longitudinal study among college students. One unexpected result was that higher baseline PV was related to a *reduced* likelihood of quitting. This is most likely due to the positive bivariate association between PV and level of smoking (discussed below), which is generally associated with greater difficulty in quitting (Killen, Fortmann, Telch, & Newman, 1988). The statistical model included level of smoking as a covariate but this may not have been sufficient to eliminate this effect.

Prior studies have also rarely included all three risk perception variables as predictors in the same analysis. With all three variables in the longitudinal analyses, the significant bivariate associations between OB and smoking outcomes were not maintained indicating that OB did not contribute independently over and above PV to the prediction of smoking outcomes.

Preliminary analyses explored intercorrelations between the risk perception variables and revealed that PV was positively related to PE and negatively related to OB which is consistent with prior research (Borrelli et al., 2010) and risk perception theory (Weinstein, 1988). Baseline motivation was significantly positively correlated with baseline PV as well as EOT PV and PE supporting their potential role in motivating change in smoking behavior. Preliminary analyses also found significant associations between level of smoking and OB, PV, and PE. This is consistent with prior studies (Borrelli et al., 2010; Moran et al., 2003; Sutfin et al., 2009) and indicates that those who smoke more, despite their proneness

to optimistic bias, have relatively lower optimistic bias and perceive greater risk than those who smoke less.

Examination of the bivariate associations between risk perceptions and smoking outcomes revealed that all three risk perception variables predicted outcomes. Higher PV and PE and lower OB predicted an *increased* likelihood of quit attempts while higher PV and lower OB predicted a *decreased* likelihood of cessation. We could find only one prior study that presented simple correlations between risk perceptions and smoking outcomes. In that study of adult, heavy smokers attending health promotion clinics, PV was positively related to *both* quit attempts and length of abstinence (Norman et al., 1999). In light of the link between risk perceptions and higher levels of smoking (Sutfin et al., 2012), the present study findings are likely due to the much wider range in level of smoking among college students with the result that heavier smokers with higher risk perceptions are more likely to try to quit but less likely to succeed in maintaining abstinence than their lighter smoking counterparts.

Taken as a whole, the results indicate that PV was the most potent predictor of smoking behavior change of the three perceived risk variables. PV had the strongest association with baseline motivation to quit and although the present study was not designed to establish causality, the prospective link between change (i.e., increased PV) and quit attempts and cessation provides the strongest evidence of a possible causal effect. This result is also consistent with the results of a prior study that manipulated PV and increased quit attempts (Magnan et al., 2009). The only prior study to prospectively examine all three risk variables as predictors of subsequent smoking behavior (though each was examined in a separate model) similarly found that only changes in perceived vulnerability were related to later abstinence in the entire sample (Borrelli et al., 2010). Change in optimistic bias was related to abstinence only among those with a smoking related illness; the group that is presumably least similar to the sample in the present study. Of the three risk variables examined, PV also has the most support in the literature as a predictor of smoking outcomes (Dijkstra & Brosschot, 2003; Magnan et al., 2009; Norman et al., 1999).

Examination of the means of the risk variables in the present study suggests that part of the explanation for findings is that PV was more likely to have increased from baseline to EOT than PE or OB. This suggests that PV may be inherently more susceptible to change as a result of a health focused intervention and may be the best construct to target when developing a risk perception based smoking intervention. To advance this literature it is necessary for future studies to test the effect of interventions designed specifically to manipulate and measure all of the perceived risk variables.

There are several limitations that should be considered when evaluating the results of this study. These include a significant amount of missing data due to attrition and concerns related to the measurement of risk perception, which is hindered by the lack of well-established valid and reliable measures. For example, similar to Borrelli et al. (2010) we used factor analysis to guide our formulation of risk perception measures but the scope of this study precluded conducting a confirmatory factor analysis and one item that appeared to be a better fit conceptually with PE loaded on PV. Although results were very similar when

that item was excluded (results not reported) confidence in the findings would be increased if well-validated measures were available. In addition, Borrelli et al. (2010) found that results differed in relation to current and future risk perceptions; however, the items we used were not designed to assess this distinction. Future work should address the psychometric properties of risk perception measures.

Another measurement-related limitation is that measures related to the notion of having tried to "quit" may not have been interpreted as intended by the students who smoked infrequently and did not perceive themselves as having made a quit attempt. This may have affected the measurement of PE and quit attempts, although the results with quit attempts were similar to those found with our measure of actual smoking behavior. A final caution is that results should not be generalized beyond college students similar to the predominantly Midwestern, generally healthy, white, predominantly nondaily smokers of Greek organizations included in this study.

Despite these limitations, this study is the first to show that risk perceptions, particularly increases in perceived vulnerability, prospectively relate to college smokers attempts to quit and smoking abstinence. Given the importance of risk perceptions to leading theories of health behavior change and the unique characteristics of college students, this provides encouragement to further examine the role of risk perceptions and consider interventions that increase perceived vulnerability in order to promote smoking cessation among college smokers.

Acknowledgments

Funding for this study was provided by NIH Grant R01-CA107191. This manuscript is based on a Master of Arts thesis by the first author at University of Missouri—Kansas City and represents a secondary analysis of the main outcomes paper: Harris, K., Catley, D., Good, G., Cronk, N., Harrar, S., & Williams, K. (2010). Motivational interviewing for smoking cessation in college students: A group randomized controlled trial. *Preventive Medicine, 51*(5), 387–393.

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Table 1

Characteristics of Study Participants (n= 267)

Variable	*n*(Percent)	*M(SD)*
Gender		
Female	114(45.7)	
Male	153(57.3)	
Race		
White	251(94.0)	
Asian	4(1.5)	
Biracial	6(2.2)	
Other	6(2.2)	
Age		
18	57(21.3)	
19	85(31.8)	
20	77(28.8)	
21	43(16.1)	
22	5(1.9)	
Year in school		
Freshman	59(22.1)	
Sophomore	100(37.5)	
Junior	69(25.8)	
Senior	37(13.9)	
Other	2(.8)	
Smoking level		
Daily smokers (≥ 28 days/month)	44(16.5)	
Days* (Median=6.5)(1–30)		11.5(10.3)
Cigarettes** (Median=16.5)(1–700)		57.1(94.6)
Hooked on Nicotine Checklist		2.42(2.50)
Motivation to quit		5.52(2.94)
Confidence to quit		8.91(1.92)

Note.

* Number of days smoked out of the past 30 days.

** Number of cigarettes smoked in the past 30 days.

Table 2

Means of Health Risk Perception Across Time, 30-day Quit Rates for End of Treatment (EOT) and Follow-up (FU), and Any Attempt to Quit Through EOT and FU.

Variable	Baseline		End of Treatment			Follow-up	
	n	*M(SD)*	*n*	*M(SD)*	*n*(%)	*n*	*n*(%)
Quit Attempt		-	267	-	110(41.2)	267	139(52.1)
Abstinence		-	265	-	96(36.0)	245	68(25.5)
Perceived Vulnerability	267	5.59(1.4)	267	5.90(1.4)	-		-
Precaution Effectiveness	267	10.1(2.2)	267	10.2(2.1)	-		-
Optimistic Bias	267	10.7(2.1)	267	10.8(2.1)	-		-
Change							
Perceived Vulnerability			267	.30(1.2)	-		-
Precaution Effectiveness			267	.07(2.2)	-		-
Optimistic Bias			267	.13(1.4)	-		-

Table 3

Intercorrelations for Smoking Level, Health Risk Perception Variables and Smoking Behaviors

	Baseline					Change			EOT					FU
Measure	**LOS**	**MR**	**PV**	**PE**	**OB**	**PV**	**PE**	**OB**	**PV**	**PE**	**OB**	**QA**	**A**	**QA**
Motivation Ruler	−.01													
Baseline PV	.45**	.41**												
Baseline PE	.12*	.07	.17**											
Baseline OB	−.30**	−.06	−.35**	.08										
Change PV	−.11	−.07	−.41**	−.05	.16**									
Change PE	.01	.04	.05	−.55**	−.03	.11								
Change OB	−.03	.01	.04	−.03	−.32**	−.18**	−.02							
EOT PV	.35**	.33**	.64**	.13*	−.20**	.44**	.14*	−.12						
EOT PE	.14*	.12*	.23**	.49**	.05	.06	.46**	−.05	.28**					
EOT OB	−.32**	−.05	−.33**	.06	.80**	.05	−.05	.31**	−.28**	.02				
EOT QA	.27**	.30**	.34**	.13*	−.11	−.02	.03	.01	.34**	.17**	−.11			
EOT A	−.45**	.11	−.32**	−.01	.16*	.23**	.02	.02	−.15	.02	.17**	−.06		
FU QA	.37**	.29**	.40**	.16**	−.20**	−.02	−.02	.04	.38**	.15*	−.17**	.80**	−.13*	
FU A	−.37**	.07	−.24**	.05	.09	.14*	−.05	−.05	−.16	.01	.06	−.16*	.39**	−.18**

Note. n=267. EOT=End of Treatment; FU=Follow Up; Change=Difference between EOT and Baseline values. MR=Motivation Ruler LOS=Level of Smoking (number of days smoked in past 30 days); OB=Optimistic Bias; PV=Perceived Vulnerability; PE=Precaution Effectiveness; QA=Quit Attempt; A=Abstinence.

* p<.05.

** p<.01.

Table 4

Results of Logistic Generalized Estimating Equations Analyses of Baseline Risk Perceptions as Predictors of Any Quit Attempt (n = 267) and Abstinence (n = 243).

	Any Quit Attempt			Abstinence		
Variable	***OR***	**95% CI**	***p***	***OR***	**95% CI**	***p***
Intercept	0.41	[0.23,0.74]	.003	1.32	[0.71,4.48]	.373
Smoking Group (vs. Fruits & Vegetables)	.547	[0.36,0.82]	.004	0.87	[0.58,1.32]	.526
Male (vs. being Female)	1.42	[0.92,2.18]	.105	0.78	[0.52,1.18]	.255
Age (vs. 18)						
22	0.94	[0.26,3.42]	.934	5.51	[2.22,13.6]	.000
21	0.82	[0.41,1.60]	.556	1.63	[0.82,3.21]	.158
20	1.16	[0.65,2.08]	.607	1.57	[0.86,2.86]	.136
19	1.21	[0.69,2.12]	.487	1.91	[1.05,3.49]	.034
Time - Follow-up (vs. End of Treatment)	1.62	[1.40,1.88]	.000	0.64	[0.46,0.89]	.009
Level of Smoking	1.02	[1.01,1.05]	.016	0.87	[0.84,0.91]	.000
Perceived Vulnerability	1.42	[1.21,1.68]	.000	0.78	[0.66,0.93]	.007
Precaution Effectiveness	1.05	[0.95,1.16]	.282	1.14	[1.04,1.25]	.002
Optimism Bias	0.94	[0.85,1.04]	.272	0.96	[0.85,1.09]	.600

Note. Level of smoking (days smoked per month). For the Quit Attempt set of analyses the Corrected Quasi likelihood under Independence model Criterion (QIC) for model 1, model 2, and model 3 were 1042.7, 990.0, and 994.7, respectively. For the Abstinence set of analyses the QICs for model 1, model 2, and model 3 were 702.5, 680.0, and 684.3, respectively.

Table 5

Results of Logistic Generalized Estimating Equations Analyses of Change in Risk Perceptions as Predictors of Any Quit Attempt (n = 267) and Abstinence (n = 243).

	Any Quit Attempt			Abstinence		
Variable	***OR***	**95% CI**	***p***	***OR***	**95% CI**	***p***
Intercept	0.36	[0.17,0.74]	.006	1.35	[0.63,2.85]	.434
Smoking Group (vs. Fruits & Vegetables)	0.72	[0.42,1.23]	.231	0.74	[0.45,1.23]	.252
Male (vs. being Female)	1.34	[0.79,2.26]	.273	0.83	[0.52,1.32]	.447
Age (vs. 18)						
22	1.27	[0.20,7.99]	.798	3.07	[1.07,8.80]	.036
21	0.70	[0.30,1.61]	.408	1.95	[0.90,4.22]	.090
20	0.81	[0.39,1.67]	.580	1.69	[0.85,3.36]	.135
19	0.88	[0.44,1.76]	.721	1.97	[0.99,3.95]	.053
Time - Follow-up (vs. End of Treatment)	1.64	[1.38,1.94]	.000	0.58	[0.39,0.85]	.006
Level of Smoking	1.06	[1.03,1.09]	.000	0.88	[0.84,0.91]	.000
Perceived Vulnerability	1.03	[0.84,1.28]	.720	1.41	[1.15,1.72]	.001
Precaution Effectiveness	1.00	[0.89,1.12]	.932	0.96	[0.87,1.06]	.458
Optimism Bias	1.06	[0.88,1.27]	.510	1.03	[0.86,1.23]	.712

Note. Level of smoking (days smoked per month); For the Quit Attempt set of analyses the Corrected Quasi likelihood under Independence model Criterion (QIC) for model 1, model 2, and model 3 were 1042.7, 689.5, and 694.9, respectively. For the Abstinence set of analyses the QICs for model 1, model 2, and model 3 were 702.5, 532.1, and 535.1, respectively.