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Perceived stress and smoking-related behaviors and symptomatology in male and female smokers

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Abstract

Introduction—Stress has been found to be a significant risk factor for cigarette smoking. Stress affects males and females differently, as does the use of smoking for stress reduction. Few studies have examined gender differences with the interrelation of perceived stress and smoking behaviors and nicotine related symptomatology. Our study investigates this association, as well as the influence of sociodemographic variables.

Methods—This is a retrospective analysis of 62 smokers (41 males, 21 females) enrolled in a smoking cessation study. At the screening visit sociodemographic information, smoking behaviors and survey measures were completed. These included the Perceived Stress Scale (PSS), Minnesota Nicotine Withdrawal Scale (MNWS), and others. Analyses were conducted using multiple linear regression models.

Results—PSS score was found to have a negative association with number of cigarettes smoked in males (slope -0.29 ± 0.08 ; $p = 0.0009$) and females (slope -0.20 ± 0.18 ; $p = 0.26$) with no difference in effect between genders ($p = 0.64$). Linear regression of MNWS on PSS revealed a positive association for both males (slope 0.41 ± 0.068 ; $p < 0.0001$) and females (slope 0.73 ± 0.14 ; $p < 0.0001$). There was a significant difference in effect between genders ($p = 0.04$).

Conclusions—A strong positive association was observed between perceived stress and nicotine withdrawal symptomatology in smokers of both sexes, with a larger effect seen in women. These findings emphasize the importance of stress reduction in smokers, which may lead to fewer withdrawal symptoms and more effective smoking cessation.

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Keywords

Perceived stress; Smoking-related symptomatology; Sex differences

1. Introduction

Perceived stress is defined as “the feelings or thoughts that a person has about how much stress they are under over a given time period” (Qian et al., 2010). Perceived stress has been found to be associated with greater odds of smoking in several cross-sectional studies (Gallo et al., 2014; Webb & Carey, 2008). Many studies have found that smokers use cigarettes to relieve stress which contributes, in part, to persistent smoking (Bryant, Bonevski, Paul, O'Brien, & Oakes, 2011; Slopen et al., 2012; Slopen et al., 2013; Stein et al., 2008). There are several theories on the role of stress and smoking behaviors. The conventional wisdom is that smokers use cigarettes to relieve stress. However, several studies have shown that while smoking may temporarily relieve perceived stress, it actually may generate or aggravate negative emotional states and propagate negative coping strategies leading to overall higher stress levels (Hajek, Taylor, & McRobbie, 2010; Parrot, 1995; Stein et al., 2008).

Several sociodemographic stressors have also been identified as being associated with a higher prevalence of smoking. These include: racial/ethnic minority status, lower income and lower education levels (Siahpush, Yong, Borland, Reid, & Hammond, 2009; Slopen et al., 2013). Further, differences have been found between the role of perceived stress and smoking between genders. One study found that perceived stress had a stronger association with nicotine dependence in women more so than men (Dupont, Reynaud, & Aubin, 2012). Another found that nicotine dependence and urges played a larger role in smoking relapse in women than men (Westmass & Langsam, 2005).

The literature is still lacking studies investigating sex differences of perceived stress associated with smoking behavior and nicotine related symptomatology. Therefore the overall study aim was to determine the relationship between perceived stress and smoking behaviors and nicotine related symptomatology during ad libitum smoking and to determine if these relationships varied by sex. The relationship between perceived stress and sociodemographic variables was also explored.

We hypothesized that perceived stress would have a positive association with smoking behaviors such as number of cigarettes smoked per day, with a stronger association in females than males. We also hypothesized that perceived stress would have a positive association with smoking related symptomatology such as nicotine withdrawal, nicotine dependence and smoking urges, with a stronger association in females than males. Lastly, we hypothesized a positive correlation between perceived stress and certain sociodemographic variables, namely lower income and minority status, and those individuals would consume an increased number of cigarettes per day, even more so for females than males.

2. Material and methods

This study was a retrospective analysis of de-identified prospectively collected data under a parent grant; “Hormones & Smoking Cessation” (NIH/NIDA 1P50-DA033942-01). The parent grant was approved in 2012 by the Institutional Review Board of the University of Minnesota. All subjects attended a detailed orientation, signed a written informed consent and were paid for their participation.

2.1 Subjects

Patient data was de-identified and collected from questionnaires during the baseline clinic visit for the parent grant. Inclusion criteria included: male or female between 18 and 40 years old; self-report of smoking ≥ 5 cigarettes/day for at least the past year; motivated to quit smoking (self-report ≥ 7 on 10-point Likert-type scale); in stable physical/mental health; understanding of the study procedures and able to provide informed consent. Exclusion criteria were: current use of other types of tobacco, nicotine replacement therapy, or smoking cessation medications; DSM-IV diagnoses for current or lifetime psychiatric disorders and other current substance dependence (except nicotine dependence).

2.2 Procedures

All subjects completed a set of self-administered questionnaires at their baseline visit when they were smoking ad libitum. These included demographics (gender, age, marital status, college graduation, income, and ethnicity), smoking habits, perceived stress and nicotine related symptomatology (Table 1). Information on smoking habits included number of cigarettes smoked per day, number of past quit attempts and longest period of smoking abstinence (Table 1). Total household income was reported categorically: < \$15,000; \$15,000-\$20,000; \$20,000-\$30,000; \$30,000-\$45,000; \$45,000-\$60,000; \$60,000-\$75,000; \$75,000+, with an imputed value of the midpoint of each category.

2.3 Neuropsychological and nicotine related measures

Perceived stress was measured by the Perceived Stress Scale (PSS) (Ezzati et al., 2013; Roberti, Harrington, & Storch, 2006). Nicotine dependence was measured by the Fagerström Test for Nicotine Dependence (FTND) (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). Nicotine withdrawal symptoms were measured by the Minnesota Nicotine Withdrawal Scale (MNWS) (Hughes & Hatsukami, 1998). Lastly; smoking urges were measured by the brief Questionnaire for Smoking Urges (QSU-1, 2, total) (Cox et al., 2001).

2.4 Statistical Analysis

Pearson or Spearman correlation analyses were obtained using the SAS (SAS Institute Inc., Cary, NC) CORR procedure, depending on skewness in the data distribution, to examine the relationship between perceived stress and smoking habits and nicotine symptomatology. Linear regression was then performed with the PROC MIXED procedure to determine significant associations between the above variables and perceived stress. Distribution of Wilcoxon scores for perceived stress and sociodemographic variables were performed with the NPAR1WAY procedure. A two tailed $p < 0.05$ was considered to be statistically significant.

3. Results

3.1 Perceived stress and smoking behavior

We found a significant inverse association between perceived stress (PSS) and number of cigarettes smoked per day in males (slope = -0.294, $p = 0.0009$), but no association in females (slope = -0.202, $p = 0.26$) (Table 2). The difference in associations between genders was not significant ($p = 0.64$). There were no associations between perceived stress and number of past quit attempts or past longest quit attempt in either men or women.

3.2 Perceived stress and nicotine withdrawal symptomatology

There was a strong positive association between the amount of perceived stress and nicotine withdrawal symptomatology (MNWS) in both males ($p < 0.0001$) and females ($p < 0.0001$), with the slope estimate for females almost twice that for males (Table 2). Further, there was a significant difference in effect between males and females ($p = 0.04$).

3.3 Perceived stress, nicotine dependence and smoking urges

There was a borderline significant Pearson correlation between perceived stress and nicotine dependence (FTND) in females ($r = -0.385$, $p = 0.085$), but not males ($r = -0.037$, $p = 0.82$). This borderline significant association remained in the linear regression for females ($p = 0.098$), who had a slope estimate more than 10 times that of males (Table 2); however the sex differences were not significant ($p = 0.17$). There was no significant correlation between perceived stress and smoking urges (QSU 1, 2, or total score) in females. There was a significant Pearson correlation between perceived stress and smoking urge as relief from negative affect (QSU 2 score) in males ($r = 0.311$, $p = 0.047$), but not with other smoking urge measures (QSU 1, total score) (Cox et al., 2001). There were no significant associations between perceived stress and smoking urges in males, females or between sexes with linear regression models.

3.4 Perceived stress, sociodemographic variables and smoking behavior

We found significantly higher perceived stress in African Americans as compared to non-African Americans (Z score = 2.101, $p = 0.04$) with Wilcoxon scores. However, the number of cigarettes smoked per day was not significantly higher in African Americans. There was a strong inverse correlation between perceived stress and household income ($r = -0.362$, $p = 0.005$). Lastly, there was a trend for positive correlation in cigarettes smoked per day and household income ($r = 0.232$, $p = 0.08$).

4. Discussion

4.1 Perceived stress and smoking behavior

Men were found to have a significant negative association between perceived stress and number of cigarettes smoked per day. Women exhibited a trend in the same direction but the association was not significant. These findings may be explained by the model for smoking behavior which states that acute nicotine deprivation leads to increased stress (Parrot, 1994, 1995). Therefore, those who smoke more cigarettes per day may have fewer periods of nicotine deprivation, causing less perceived stress. However, our results differed from a

previous study which found that heavy smokers had a higher perceived stress (Hayes & Borrelli, 2013). We are unsure how to interpret this discrepancy from the literature.

The literature also states that those with higher stress are more likely to have unsuccessful quit attempts (Slopen et al., 2013). We did not find any studies reporting stress being a predictor for number of past quit attempts or length of quit attempt and unfortunately we cannot contribute to this area as our results were insignificant.

4.2 Perceived stress and nicotine withdrawal symptomatology

To our knowledge, this is the first study to have shown that perceived stress strongly associates positively with reported nicotine withdrawal symptomatology in current smokers, with a stronger effect seen in females than males. The literature suggests that some nicotine withdrawal symptoms such as irritability, anxiety and certain physical symptoms resemble the physiological stress response and may contribute to stress-related enhancement of the desire to smoke (Richards et al., 2011). One study proposed that stress reduction from smoking is likely due to the relief of withdrawal-induced negative mood (Heishman, 1999). However, there is little behavioral evidence of this (Jarvik, Caskey, Rose, Herskovic, & Sadehpour, 1989; Pomerleau, Turk, & Fertig, 1984). Another study found that acute stress may mimic withdrawal signs, leading to the urge to smoke and enhancing its rewarding value (Childs & de Wit, 2010). Although the concept of perceived stress, which is more of a chronic form of stress, is different from acute stress, it may still have a causal effect on nicotine withdrawal symptoms (van Eck, Berkhof, Nicolson, & Sulon, 1996).

4.3 Perceived stress, nicotine dependence and smoking urges

We also found a borderline significant inverse correlation between perceived stress and nicotine dependence (FTND) in females, but not in males, whose estimated effect size was much smaller. This is similar to a previous study which found that perceived stress had a strong relationship with nicotine dependence, with a stronger effect seen in females than males (Dupont et al., 2012). Further, several other studies have shown that nicotine dependence is stronger in females than males, supporting our findings, with females smoking more for tension reduction and relaxation than males as well (Berlin et al., 2003; Westmaas & Langsam, 2005). Our only significant results between perceived stress and smoking urges are in line with the literature which shows that stress increases the urge to smoke (Niaura, Shadel, Britt, & Abrams, 2002). Further, our finding of the QSU 2 score, which measures the urge to smoke for relief from negative affect, associating with stress is similar to what was found in previous studies (Cox et al., 2001; Heishman, 1999). A larger sample may have led to more significant results, especially in females.

4.4 Perceived Stress and sociodemographic variables

Our findings of increased perceived stress among African Americans compared to Caucasians are consistent with previous studies (Slopen et al., 2012). The inverse relationship between perceived stress and household income seen in our study is consistent with previous findings (Slopen et al., 2013). Our study population was fairly young, with a mean age of about 31 years old, and a range of 19 to 40 years old. There is little in the literature concerning the association of perceived stress and smoking habits or

symptomatology in an elderly population. It may be a worthwhile investigation to see the effect of aging on these associations.

4.5 Limitations

The main limitation to our study was the small sample size, especially with females. A larger number of females would have given more statistical power for the measures assessed. Another limitation was that our cross-sectional analysis with linear regression models cannot confirm a causal relationship between perceived stress and increased nicotine withdrawal symptomatology, only association.

5. Conclusions

In summary, our study showed a strong positive relationship between perceived stress and self-reported nicotine withdrawal symptomatology in smokers, with a larger effect seen in females than males. This study warrants further investigation of stress reduction for control of withdrawal symptomatology in smokers. Also, we believe our study emphasizes the importance of patient education on nicotine withdrawal, which can cause stress-like symptoms including anxiety, anger, frustration and irritability (Hughes, 2007). Research has shown that even brief advice from medical practitioners leads to increased likelihood of quitting, and more intensive advice leads to even higher quit rates (Corelli & Hudmon, 2002). These strategies may lead to less withdrawal symptoms experienced and more successful smoking cessation, especially in females.

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Highlights

- Psychosocial stress is a significant risk factor for cigarette smoking.
- Perceived stress was strongly associated with nicotine withdrawal symptomatology.
- There was a stronger association between stress and nicotine withdrawal in females.
- Perceived stress may exacerbate nicotine withdrawal symptoms.

Table 1

Subject Demographics, Smoking Characteristics, and Questionnaire Summary.

Demographics	Men	Women	Total
Age (y) ± SD	31.5 ± 6.1	32.2 ± 5.5	31.7 ± 5.9
Percent Married (%)	14 (34.1)	3 (15.0)	17 (27.9)
Percent College Graduate (%)	7 (17.5)	6 (28.6)	13 (21.3)
Percent African American (%)	7 (17.1)	2 (9.5)	9 (14.5)
Percent Hispanic (%)	0 (0.0)	2 (9.5)	2 (3.3)
Household income (\$1,000) ± SD	35.9 ± 26.8	34.8 ± 25.1	35.5 ± 25.9
Smoking Characteristics			
Cigarettes Per Day ± SD	15.3 ± 5.8	14.5 ± 7.4	15.0 ± 6.3
Age Started Smoking (y) ± SD	17.6 ± 4.1	17.7 ± 4.4	17.6 ± 4.2
Previous Quit Attempts ± SD	5.6 ± 4.8	4.6 ± 3.7	5.3 ± 4.5
Longest Quit Period (days) ± SD	232.7 ± 697.5	161.7 ± 244.4	208.7 ± 582.9
Quit Motivation (7-10) ± SD	8.9 ± 1.1	9.0 ± 1.1	8.9 ± 1.0
Questionnaire Data			
PSS Score ± SD	19.9 ± 9.3	20.5 ± 6.5	20.1 ± 8.4
M NWS Score ± SD	16.4 ± 6.1	18.0 ± 6.2	16.9 ± 6.1
QSU 1 Score (Rewarding) ± SD	22.8 ± 7.6	22.1 ± 9.9	22.6 ± 8.4
QSU 2 Score (Relieved) ± SD	11.2 ± 5.9	12.7 ± 8.4	11.7 ± 6.8
QSU Total Score ± SD	34.1 ± 12.3	34.8 ± 17.1	34.3 ± 14.0
FTND Score ± SD	4.9 ± 2.1	4.4 ± 2.0	4.7 ± 2.0
No. Participants	41	21	62

Note: y, years-old; SD, Standard Deviation; PSS, Perceived Stress Scale; MNWS, Minnesota Nicotine Withdrawal Scale; QSU, Questionnaire for Smoking Urges; FTND, Fagerström Test for Nicotine Dependence. Values accompanied with “±” indicate: Mean ± Standard Deviation.

Table 2

Pearson correlations and linear regression analyses by sex of perceived stress with smoking habits, nicotine withdrawal and dependence.

	Male (N = 41)		Female (N = 21)		Difference between sexes	
	Correlation, <i>r</i> (<i>p</i> -value)	Regression ± SE, <i>slope</i> (<i>p</i> -value)	Correlation, <i>r</i> (<i>p</i> -value)	Regression ± SE, <i>slope</i> (<i>p</i> -value)	Regression, <i>p</i> -value	
Perceived stress (PSS score) and number of cigarettes smoked per day	-0.475 (0.002*)	-0.294 ± 0.084 (0.0009**)	-0.375 (0.09)	-0.202 ± 0.179 (0.26)	0.64	
Perceived stress (PSS score) and nicotine withdrawal (MNWS score)	0.690 (<0.0001**)	0.406 ± 0.068 (<0.0001**)	0.764 (<0.0001**)	0.728 ± 0.139 (<0.0001**)	0.04*	
Perceived stress (PSS score) and nicotine dependence (FTND score)	-0.037 (0.82)	-0.008 ± 0.034 (0.81)	-0.385 (0.085)	-0.117 ± 0.069 (0.098)	0.17	

Note: MNWS, Minnesota Nicotine Withdrawal Scale; FTND, Fagerström Test for Nicotine Dependence; SE, Standard Error; results of correlation analysis; Pearson's correlation coefficient "*r*"; results of linear regression analysis: slope estimate per one point higher PSS score, "*slope*".

* *p*-value < 0.05.

** *p*-value < 0.01.