

# The Relevance of Stress and Eating to the Study of Gender and Drug Use

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## INTRODUCTION

Cigarette smoking is the single most preventable cause of death and illness in our country; it exacts a staggering toll on health services and runs up high health costs (Grunberg et al. 1997; U.S. Department of Health and Human Services 1989). Cigarette smoking involves the self-administration of an addictive drug, nicotine (U.S. Department of Health and Human Services 1988). Cigarette smoking incidence in the United States differed between men and women for decades, but recently became similar (Grunberg et al. 1997; Centers for Disease Control 1991). Now it is plausible that gender differences in smoking behavior could reverse as more girls than boys begin to smoke. Understanding why people smoke and how to help prevent smoking by women and men, and by girls and boys, deserves our attention.

Eating behavior is central to survival, but the U.S. population, particularly women, appears to be obsessed with reducing body weight (Brownell 1991; Rodin 1993). Diet pills, diet programs, and images of low ideal body weights and shape are pervasive in U.S. society and account for a remarkable amount of income. Yet obesity is on the rise in the United States (Brownell and Rodin 1994). Because eating behavior and body weight have been related to drug use and abuse (Grunberg and Baum 1985, pp. 25-62), the study of these topics is important in the consideration of gender and drug use.

Stress-induced illnesses, chronic fatigue syndrome, and the role of stress in causing marital and family strife all seem to be on the rise. Stress also affects cigarette smoking, other drug use, and eating (Greeno and Wing 1994; Grunberg and Baum 1985, pp. 25-62; Kosten et al. 1986; O'Doherty 1991; Shaham et al. 1992, 1993; Shiffman and Wills 1985). Therefore, how stress affects substance use by women and men is worth considering (Baum and Grunberg 1991).

This chapter addresses cigarette smoking, other drug use, and eating as these topics relate to gender, stress, and each other and uses examples from research to highlight the value of studying cigarette smoking, other drug use, and eating behavior along with the important variables of gender and stress. This chapter is not meant to be exhaustive. It is meant to illustrate the importance of these variables and to focus interest and future work on them.

## **CIGARETTE SMOKING**

### **Smoking and Gender**

Roughly one out of four women and one out of four men smoke cigarettes in the United States today (Grunberg et al. 1997; U.S. Department of Health and Human Services 1989). These statistics are remarkable in light of the changes since 40 years ago, when roughly the same proportion of women but more than 50 percent of men smoked (Centers for Disease Control 1991; U.S. Department of Health and Human Services 1989). Because as many or more adolescent girls now smoke as do adolescent boys (U.S. Department of Health and Human Services 1994), U.S. society could soon have more female than male smokers. Outside the United States, the statistics and gender differences are more pronounced. In Japan, for example, 15 percent of women and roughly 70 percent of men smoke. In Indonesia 5 percent of women and 75 percent of men smoke (Crofton 1990; Grunberg et al. 1991). As the tobacco industry continues to penetrate Asian markets, there is the disturbing likelihood that the lives and health of Asian women will suffer. It is, therefore, important to determine the causes of these gender differences in tobacco use and how to prevent increased use. Cigarette use is a result of the availability of products, perceptions of health risks, perceptions of benefits, attitudes toward this behavior, and psychopharmacologic effects of the product (Grunberg et al. 1991, 1997; U.S. Department of Health and Human Services 1989). With regard to smoking and gender, it is important to determine which variables contribute to use by females compared with males, including psychological, behavioral, pharmacological, and biological factors.

An unfortunate example regarding smoking and gender illustrates how well-intentioned programs can go awry because of a lack of understanding of gender differences and smoking. In an attempt to protect the public from the dangers of smoking, public health advocates

long have encouraged a decrease in the nicotine and tar content of cigarettes. Logically, less nicotine and tar content should expose individuals to fewer toxic effects of a given cigarette. However, two important matters were not taken into account. First, most smokers are addicted, and they smoke to self-administer nicotine (U.S. Department of Health and Human Services 1988). Therefore, reduced nicotine content often results in smokers adjusting their smoking topography by either increasing the number of cigarettes smoked or increasing the number of puffs or depth of inhalation per cigarette (Kozlowski et al. 1980; U.S. Department of Health and Human Services 1988). This “compensatory smoking” can actually increase the health risks of smoking. Second, with regard to gender differences and smoking, women may be more sensitive to nicotine than are men (Bättig et al. 1982; Silverstein et al. 1980), a finding consistent with studies with female laboratory animals (Bättig 1981; Grunberg et al. 1986, 1987; Levin et al. 1987; Rosecrans 1971, 1972). Therefore, women may smoke less when nicotine yields from tobacco products are high and smoke more when nicotine yields are low.

#### **Smoking, Eating, Body Weight, and Gender**

It is now well established that smoking is inversely related to body weight and decreases consumption of certain foods (e.g., sweet-tasting, high-carbohydrate foods) (Grunberg 1990, pp. 273-316, 1992; U.S. Department of Health and Human Services 1988). These clinically significant relationships have suggested investigations that have revealed the actions of nicotine, the primary pharmacological agent of addiction in tobacco. For these effects, nicotine has greater actions on females (women and animals) than on males (Grunberg et al. 1986, 1987, 1991; Levin et al. 1987; Winders and Grunberg 1989). These studies have revealed that women gain relatively more weight after smoking cessation than do men and that the most effective behavioral and pharmacological treatment strategies for smoking cessation and prevention should have somewhat different emphases for women and men.

#### **Smoking, Stress, and Gender**

Stress increases smoking (Shiffman and Wills 1985; U.S. Department of Health and Human Services 1988). Some investigators argue that smoking is calming or anxiolytic, but there is little support for this

interpretation (U.S. Department of Health and Human Services 1988). Other investigators argue that smoking is not anxiolytic but that smoking cessation results in an abstinence phenomenon that includes increased anxiety or stress (Schachter 1978). Therefore, the argument goes, smokers who continue smoking are less anxious than smokers who are abstinent, but smoking *per se* is not anxiolytic (Schachter 1978). Alternatively, smoking increases during stress because stress alters the effects of smoking (Grunberg and Kozlowski 1986; Grunberg et al. 1983; U.S. Department of Health and Human Services 1988). It would be valuable to determine whether there are gender differences in the effects of stress on smoking, smoking on stress, smoking abstinence as a stress response, smoking abstinence on stress responses, and stress on smoking relapse and the role of nicotine or relative potency of nicotine on stress-smoking interactions.

#### **Smoking, Drug Use, and Gender**

Smoking is highly correlated with the use of licit and illicit drugs (Henningfield et al. 1990). Smoking is commonly associated with alcohol consumption (DiFranza and Guerrera 1988; Kozlowski et al. 1986, 1993) and increases during drinking (Griffiths et al. 1976; Henningfield et al. 1984; Keenan et al. 1990; Mintz et al. 1985). Cigarette smoking and alcohol consumption are considered to lead to the subsequent use and abuse of illicit drugs, including marijuana and cocaine (Kandel et al. 1992). Given the facts that nearly 90 percent of all smokers begin smoking during adolescence and that adolescents are particularly vulnerable to illicit drug use (U.S. Department of Health and Human Services 1994), the relationships and mechanisms by which smoking translates into the use of other addictive drugs are important but unresolved. In this context, gender has never been addressed as a variable in terms of its relationship to multiple drug use or the “gateway” hypothesis. Because gender differences exist in sensitivity to nicotine (Grunberg et al. 1991) and because recent animal research suggests gender differences in response to the effects of opiates (Brown et al. 1995; Klein et al. 1997), it is logical to postulate that gender differences exist in the relationship between cigarette smoking and other drug use. Furthermore, the study of these relationships might reveal biobehavioral and neuropharmacological mechanisms of action with clinical and

treatment applications. For now, however, little is known about these relationships.

## **DRUG USE**

### **Drug Use and Gender**

Gender differences exist in the use of licit and illicit drugs (Lex 1991). For example, more men than women drink and abuse alcohol, use cocaine, and use marijuana (Lex 1991). The epidemiology is a first critical step, but researchers must move on to address causality and mechanisms. There are clear data that gender differences exist with specific drugs, which presents opportunities to access populations to study psychological, social, behavioral, and biological mechanisms that may contribute to these important differences.

Animal studies allow for careful evaluation of behavior and biology with regard to drug use. Recent studies indicate that female rats self-administer more opiates than do male rats (Brown et al. 1995; Klein et al. 1997), but male rats exhibit more withdrawal behaviors (Klein et al. 1997). In addition, animal studies provide a useful tool to manipulate drug history and environmental conditions that may play a role in gender differences related to drug use and abuse. Recent studies have manipulated environmental stress in male and female rats, have allowed subjects to self-administer opiates, and have reported that there are gender differences in responses to environmental stressors and in opiate self-administration (Brown and Grunberg 1995; Brown et al. 1995).

### **Drug Use, Stress, and Gender**

A recent series of laboratory studies examined the effects of stressors on opiate self-administration by male and female rats (Brown et al. 1995; Klein et al. 1997; Shaham 1993; Shaham et al. 1992, 1993). Physical stressors (e.g., immobilization, mild electric foot shock) increased opiate self-administration by male rats during the initiation, maintenance, and relapse phases of the studies compared with no-stress conditions (Shaham 1993; Shaham et al. 1992, 1993). A different stressor (predictable foot shock) also increased opiate self-administration by male rats compared with unpredictable foot shock (Klein et al. 1997).

For female rats, predictable foot shock increased opiate self-administration compared with unpredictable foot shock, but unpredictable foot shock increased opiate self-administration over no-stress control conditions for only half the females (Klein et al. 1993, 1997). This latter finding indicates that individual differences in responses among females are important (Klein et al. 1993). Furthermore, environmental stressors (e.g., housing conditions) decreased opiate self-administration by female rats but had no effect on opiate consumption by male rats (Brown et al. 1995). This study also revealed sex differences in drug sensitivity under stress (e.g., drug-induced deaths among females despite lower amounts of drug consumption) (Brown et al. 1995). This finding would not have been uncovered by a study that lacked the inclusion of stress and gender as independent variables. Much work is still needed to determine the role stress plays for females and males in drug self-administration.

#### **Drug Use, Eating, and Gender**

The relationship between nicotine and eating (as discussed above under “Smoking, Eating, Body Weight, and Gender”) reveals that there are gender differences consistent with the widely reported concerns of women about weight gain after smoking cessation. As a result of reports that female laboratory animals, as well as human females, are more sensitive to the effects of nicotine and nicotine cessation on behavioral and biological variables related to body weight and eating behavior, clinical studies have followed up on these issues (U.S. Department of Health and Human Services 1988). These studies led to new research studies of diet, mood, and stress (Greeno and Wing 1994; Grunberg and Klein 1995; Grunberg and Straub 1992; Klein et al. 1996). In a similar vein, drug use (other than nicotine) and eating by females and males is an important but understudied area that also may reveal mechanisms and treatment strategies that are not obvious from studies that avoid multiple variables. For example, various drugs (e.g., opiates, cocaine, amphetamines) are known to affect eating behavior (e.g., Levine and Morley 1983), but are there gender differences in these effects? Food deprivation affects drug self-administration (Carroll and Meisch 1984, pp. 47-88), but what about the effects of gender? Specific food consumption (e.g., craving for carbohydrates, specific nutrient selection) is related to specific neurochemicals (e.g., serotonin) that are altered by specific drugs (e.g., nicotine, opiates) (Grunberg 1986; Kanarek and Marks-Kaufman 1988,

pp. 1-25; Marks-Kaufman 1982; Marks-Kaufman and Lipeles 1982). On a clinical level, it is known that depression is associated with changes in eating behavior (American Psychiatric Association 1994), but little is known about how best to deal with this problem in men compared with women. The interactions among drug use, eating, and gender are indeed complicated, but they are worth exploring.

## **EATING**

### **Eating and Gender**

Within a chapter on drugs, it is a judgment call whether to include information about eating. We certainly are not suggesting that eating is synonymous with drug use and abuse, but many of the biological and psychosocial variables and mechanisms involved in drug use also are involved in eating behavior. It also has been suggested that the same biological processes that underlie eating regulation are involved in drug addiction and craving (Grunberg and Baum 1985, pp. 25-62). Whether or not this is true, this conceptual framework is a tool to design investigations, categorize and critique available literature, delineate important avenues, and develop specific hypotheses that are yet to be explored.

There are gender differences in eating that are obvious and others that are less obvious. In general, men consume more food, of all types, than do women. In U.S. society, women tend to be more concerned about body weight and more self-conscious about what they eat and in front of whom (Brownell 1991; Rodin 1993). Women are markedly more likely to suffer from anorexia nervosa and bulimia nervosa (Hsu 1989). Women and men both have a high prevalence of obesity, with women in lower socioeconomic groups showing the highest prevalence rates (Centers for Disease Control and Prevention 1993). It is relevant to consider the research and clinical literature on eating and eating disorders in men and women to search for major, reliable findings that may be applicable to drug use.

### **Eating, Stress, and Gender**

Recently, there has been a growing interest in the relationships among eating, stress, and gender. Greeno and Wing (1994) published a substantial review of the stress and eating literature and noted that

several studies have considered gender. A few studies have addressed eating, stress, and gender using experimental paradigms and controlled environments. These studies have revealed that stress and eating are related but in different ways for men and women. Moderate stress seems to increase the eating of specific foods by women, whereas stress generally decreases eating by men (Grunberg and Klein 1995; Grunberg and Straub 1992; Klein et al. 1996). In this context, it is relevant to consider animal studies on eating and stress (e.g., Morley and Levine 1980; Morley et al. 1983) to draw from already established paradigms. These studies, however, did not consider gender. As discussed above under "Eating and Gender," we advocate the consideration of the eating literature in the present context because there are important parallels within appetitive behaviors between eating and drug use and because there is a substantial, available literature on eating behavior that avoids the difficulties of working with illicit drugs.

## CONCLUSION

Although a fair amount is known about nicotine, other addictive drugs, stress, and gender differences, investigations rarely have examined two or more of these variables at a given time. The study of several of these variables reveals interactions and may uncover effects to infer mechanisms of action or moderating variables (Baron and Kenny 1986). Studies of gender and substance abuse are beginning to receive attention as evidenced, for example, by the contributions to this volume. However, even these well-intentioned and thoughtful investigations tend to be limited in scope to the study of drug "X" in women or in men. Although this is certainly valuable, there is much more that can and should be done.

Studies of substance use and abuse should include licit and illicit drugs. Eating behavior also should be included in the consideration of substance use and gender, because eating behavior by women and men involves many biological and psychological processes that are relevant to drug use. In addition, eating disorders, and their relative prevalence in women and men, provide valuable information in the present context.

Stress is another important construct to consider in the examination of gender differences in drug use. This construct is useful as a tool to determine how drug-taking, drug effects, and eating behaviors change in females and males, with and without stress. Stress is a commonly



reported contributor to drug use and relapse to drug use. Because stress affects the organism on psychological, behavioral, physiological, and biochemical levels, it is a relevant and useful tool to study responses regarding drug use by females and males.

Finally, we advocate the inclusion of studies of gender, stress, and drug use in which drug use includes cigarette smoking and alcohol use. Moreover, we advocate the consideration and study of eating behavior as a comparison behavior with drug use in the context of stress and gender. This chapter provides some examples to highlight our position and to reveal the value of this approach.

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