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Smoking, Traumatic Event Exposure, and Posttraumatic Stress: A Critical Review of the Empirical Literature

Matthew T. Feldner¹, Kimberly A. Babson¹, and Michael J. Zvolensky²

¹University of Arkansas

²University of Vermont

Abstract

The current review critically examines the extant empirical literature focused on the associations among cigarette smoking, trauma, and posttraumatic stress. Inspection of the extant literature suggests smoking rates are significantly higher among persons exposed to a traumatic event relative to those without such exposure. Moreover, smoking rates appear particularly high among persons with posttraumatic stress disorder (PTSD). In terms of the direction of this relation, evidence most clearly suggests posttraumatic stress is involved in the development of smoking. Significantly less is known about the role of trauma and PTSD in terms of cessation outcome. Limitations of extant work, clinical implications, and key directions for future study are delineated.

Keywords

smoking; posttraumatic stress; comorbidity; trauma; PTSD

Cigarette smoking continues to be one of the leading preventable causes of death and disease in the U.S., resulting in healthcare costs that rank among the highest in the country [U.S. Department of Health and Human Services (USDHHS), 2004]. Large-scale efforts targeting smoking cessation have helped address this problem (USDHHS, 2000), but the negative impact of smoking is still widely evident. For example, more than 1 in 5 (22%) adults [Centers for Disease Control and Prevention (CDC), 2004] and almost 1 in 4 (24%) youth (Johnston, O'Malley, Bachman, & Schulenberg, 2004) in the U.S. currently smoke. Moreover, though smokers often are motivated to quit, the majority (approximately 90–95% of self-quitters and 60–80% of those in treatment programs) relapse (Cohen et al., 1989). Scholars have suggested smokers who fail at quitting may have unique attributes that increase their probability of smoking (Hughes, 1993; Pomerleau, 1997). Although various characteristics may increase the risk of relapse (e.g., heavier smoking levels), psychological disorders and related vulnerability factors have increasingly been recognized as playing a prominent role in quit success (Hughes, 1993; Zvolensky & Bernstein, 2005; Zvolensky, Bernstein, Marshall, & Feldner, in press).

Smokers with anxiety disorders represent a common, albeit understudied, segment of the smoking population who are at heightened risk for relapse (Lasser et al., 2000). For example,

Correspondence concerning this article should be addressed to Dr. Matthew T. Feldner, Intervention Sciences Laboratory, University of Arkansas, Department of Psychology, 216 Memorial Hall, Fayetteville, AR 72701, 479-575-4256 (phone), 479-575-3219 (facsimile). Electronic mail may be sent to mfeldne@uark.edu.

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recent research in this domain has indicated panic attacks, panic disorder, and pre-morbid risk factors for panic problems (e.g., elevated anxiety sensitivity) are related to the maintenance of smoking (Zvolensky, Feldner, Leen-Feldner, & McLeish, 2005). Similarly, posttraumatic stress problems may be related to smoking (Lasser et al., 2000). Despite research being conducted on traumatic events, posttraumatic stress disorder (PTSD), and smoking, there has not been a comprehensive review of this literature. This hinders efforts to systematically evaluate the nature of this database, distill key findings, and explicate the methodological limitations of extant work.

To address these gaps, the current review evaluates the empirical literature focused on smoking, traumatic event exposure, and posttraumatic stress reactions. This review will significantly extend the only previous review in this area (Beckham, 1999) in several important ways. First, there have been several pertinent studies conducted since this review. Second, we include studies on traumatic responding generally, as opposed to focusing exclusively on PTSD. Finally, this comprehensive approach highlights areas in this literature in need of further investigation. To accomplish these goals, the first section discusses the operational definitions used in regard to key constructs considered in the review. The second section provides a detailed review of empirical studies that have examined associations between smoking and traumatic event exposure as well as trauma-related sequelae. This section is partitioned into several subsections, such as the prevalence of smoking among traumatic event-exposed persons and such prevalence among persons with PTSD, to highlight themes within this literature and cull out specific relations within this broader topic area. Finally, we conclude with a discussion of general conclusions regarding this literature to inform recommendations for further study in this area.

Current Approach to Key Constructs

Smoking

Several developmental stages of smoking are implicitly embedded within the current review. Models of the progression of smoking behavior across the course of use suggest there are relatively distinct and generally well-specified stages, which include *initiation*, *maintenance*, and *relapse* (Flay, 1993). The initiation stage reflects smoking on the initial few “experimentation trials” and continued irregular use over time. The maintenance stage includes regular cigarette smoking ranging from weekly to daily use; it is in this stage of smoking that individuals will be most apt to develop nicotine dependence. The term nicotine dependence is typically used to denote the display of (1) regular or compulsive use and (2) the presence of specific withdrawal symptom profiles upon abstinence [American Psychiatric Association (APA), 2000]. In general, nicotine dependent individuals will be more apt to smoke heavier amounts than those not classified as nicotine dependent, yet being a regular cigarette smoker does not uniformly indicate that an individual is nicotine dependent (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994). In the relapse stage, individuals who have attempted to stop smoking return to smoking after a period of abstinence. An additional stage occasionally discussed is *lapse* (Brown, Kahler, Zvolensky, Lejuez, & Ramsey, 2001). Although relapse typically denotes returning to pre-cessation attempt smoking levels, lapse reflects returning to smoking but at a lesser rate.

Trauma and Posttraumatic Stress

A traumatic event is an event during which an individual experiences perceived threat and the experience of helplessness, terror, or horror (APA, 2000). Traumatic event exposure is indexed in a variety of ways (e.g., structured interview, checklist) and has been defined in different ways across studies. For instance, reporting psychological distress after a natural disaster has been used to index traumatic event exposure (Gleser, Green, & Winget, 1981), whereas other

studies have required self-reported peri-traumatic helplessness, terror, or horror (Feldner et al., in press). Also, exposure to a single type of event, such as combat exposure, often is measured without assessment of exposure to other traumatic event types (Koenen et al., 2005). In contrast, other studies measure exposure to any type of traumatic event, without controlling for type of exposure (Lipschitz et al., 2003). In the service of comprehensiveness, we review any study that indexed either of these constructs via any of the aforementioned methods and related them to any type of smoking behavior.

Posttraumatic stress disorder is a disorder of recovery, characterized by an inability to recover from a stress reaction to a traumatic event (Kessler et al., 1995). A failure to recover from symptomatic reactions to traumatic event exposure among a substantial minority of trauma-exposed individuals can be contrasted to the majority of trauma-exposed individuals who recover from exposure within the first few months post-exposure (Gilboa-Schechtman & Foa, 2001; Kilpatrick & Resnick, 1993). There are multiple ways to index the degree to which an individual fails to recover from traumatic event exposure, which is important to consider as studies of smoking-PTSD comorbidity have utilized various approaches to indexing the severity of posttraumatic reactions. One approach is to examine total symptom severity, which is typically calculated as a sum of frequency and intensity ratings of each of the *Diagnostic and Statistical Manual – Fourth Edition – Text Revision* (DSM-IV-TR; APA, 2000) defined symptoms of PTSD (Blake et al., 1995; Foa, 1995). A second approach is to examine symptom intensity within empirically supported types, or clusters, of PTSD symptoms (Lyons, Gerardi, Wolfe, & Keane, 1988). There are three specific clusters (APA, 2000): reexperiencing (e.g., intrusive thoughts, nightmares), avoidance (e.g., trying to not think about a traumatic event), and hyperarousal (e.g., easily startled) symptoms. Finally, failure to recover from exposure to a traumatic event also is frequently indexed via meeting diagnostic criteria for PTSD, which include the following: exposure to a traumatic event, which is followed by at least one reexperiencing symptom, three or more avoidance/numbing symptoms, two hyperarousal symptoms, and these symptoms have lasted for at least one month resulting in clinically-significant distress or impairment (APA, 2000).

Study Selection Criteria

We conducted a literature search with electronic search engines (i.e., PsycINFO and MEDLINE) to examine data bases using all combinations of the following key words: smoking or nicotine or cigarettes and trauma or posttraumatic stress disorder (or PTSD) or acute stress disorder (or ASD). We also collected all articles cited in these investigations that appeared potentially relevant to the review. Overall, these searches yielded 62 articles. Studies were then included only if they were focused on smoking and posttraumatic stress reactions or traumatic event exposure, which excluded several of these studies.

It is important to note here that several studies have examined smoking-anxiety comorbidity, but have focused generally on anxiety disorders rather than traumatic event exposure and related sequelae specifically. In particular, anxiety disorder diagnoses often have been collapsed across specific conditions into general categories that include various anxiety disorders (e.g., Breslau, 1995; Brown, Lewinsohn, Seeley, & Wagner, 1996; Degenhardt, Hall, & Lynskey, 2001; Kandel, Huang, & Davies, 2001). Similarly, several studies have examined the relation between certain specific anxiety disorders, such as panic disorder, but information regarding traumatic event exposure and posttraumatic stress problems has not been reported (e.g., Amering et al., 1999; Breslau & Klein, 1999; Johnson et al., 2000; Pohl, Yeragani, Balon, Lycaki, & McBride, 1992). Given the marked structural and functional differences between these various types of anxiety conditions and anxiety-related emotional states (Lang, 1993), these studies are useful for understanding anxiety disorder-smoking associations generally, but they are not appropriate for explicating the nature of the relations among smoking, traumatic

event exposure, and posttraumatic stress. Accordingly, we focus only on those studies that have examined smoking in association with traumatic event exposure or posttraumatic sequelae. To comprehensively review all studies while simultaneously control the length of the current review, key methodological aspects of studies are presented in table format, rather than discussed in the text. Specifically, see table 1 and table 2 for an alphabetical listing of individual studies' key methodological characteristics and analytic approach/results, respectively. This approach also allowed for a more detailed discussion of conclusions and limitations of this literature as a whole.

Evidence Regarding the Relations among Smoking, Traumatic Event Exposure, and PTSD

The natural starting point for an inspection of the nature of the smoking-traumatic event/PTSD relations is considering the extent to which these problems co-occur. We first review comparisons of smoking rates between persons with, versus without, PTSD and a study that estimated smoking rates among persons with PTSD without a comparison group. We then review studies investigating smoking rates among persons exposed to traumatic events, wherein persons were exposed to traumatic events without PTSD or PTSD diagnoses were not reported. Finally, we review the limited evidence pertaining to the prevalence of PTSD and traumatic event exposure among smokers. Studies within these sections are reviewed in order of generalizability, beginning with the most broadly representative samples.

Prevalence of Smoking among Persons with PTSD

Lasser and colleagues (2000) examined smoking status according to psychiatric diagnoses utilizing a nationally representative sample of adults. Smoking status was assessed by a question asking participants "if they are a daily smoker." Of those with a lifetime diagnosis of PTSD, 45% were current smokers and 63% reported a lifetime history of smoking; these rates were significantly greater than rates of current smoking among individuals without mental illness (22% and 39%, respectively). Among persons with diagnoses of PTSD in the past month, 44% were current smokers and 58% were lifetime smokers; these percentages also are significantly higher than those observed among persons with no mental illness in the past month.

Hapke and colleagues (2005) assessed the associations among PTSD, traumatic event exposure, nicotine dependence, and smoking among a random sample of adults living in northern German cities. Trauma exposure was assessed using a checklist of nine traumas, which included, for example "You've had a terrible experience during war," and "You were a victim of a rape attack." Smoking status was split into two groups: ever-smokers (at least 1 cigarette/day for more than a week) and current smokers (continued this smoking behavior within 4 weeks prior to the interview). Significantly higher rates of ever-smoking, current smoking, ever being nicotine dependent, and current nicotine dependence were observed among persons with PTSD (75%, 60%, 39%, and 33%, respectively) compared to those without a history of traumatic event exposure (58%, 36%, 19%, and 10%, respectively). When these analyses were conducted as a function of gender, the pattern of results was comparable for women. However, among men, PTSD was only associated with current nicotine dependence.

Acierno, Kilpatrick, Resnick, Saunders, and Best (1996) examined smoking rates as a function of PTSD among a representative sample of adult women. Lifetime smoking history was indexed via the question "Have you ever smoked cigarettes, at least occasionally?" and current smoking was indexed via the question "Do you currently smoke cigarettes, at least occasionally?" Women with a lifetime history of PTSD were more than twice as likely to report a lifetime history of smoking compared to women without a history of PTSD (72% and 54%,

respectively). Similarly, current smoking was more than twice as likely among women with, versus without, a lifetime history of PTSD (40% and 24%, respectively) and with, versus without, current PTSD (44% and 26%, respectively).

A separate study by Acierno and colleagues (2000) examined PTSD and smoking among adolescents. Current regular smoking (indexed via the question “During the past 30 days, on how many days did you smoke cigarettes?”) was defined as smoking at least 15 of the last 30 days. Among both boys and girls, positive histories of PTSD were associated with a two-fold increase in likelihood of current regular smoking. However, among boys and girls, after controlling for race, familial substance use, and traumatic event exposure, PTSD was not related to current smoking.

In a study of women receiving outpatient services at a Veterans Affairs (VA) facility, Dobie and associates (2004) examined self-reported smoking rates during the past year as a function of PTSD. A self-report PTSD symptom checklist was mailed to participants and used to screen for PTSD. The specific question measuring smoking was not identified. Women screening positive were more likely to endorse past-year smoking than those screening negative (39% compared to 22%, respectively).

Finally, Buckley, Susannah, Bedard, Dewulf, and Greif (2004) examined the relation between smoking, as identified in medical records (specific questions not described), and PTSD among military veterans. This sample was compared to representative population estimates derived from the NCS (Lasser et al., 2000). Higher smoking rates were observed among persons with PTSD compared to the general population (45% and 22%, respectively). Also, smokers with PTSD were relatively heavy smokers, with 73% smoking at least 20 cigarettes per day.

One study also estimated smoking rates in a treatment-seeking sample with PTSD where rates were not compared to other groups (e.g., nonpsychiatric control groups, traumatic event exposed only). Beckham and colleagues (1995) reported a smoking prevalence of 60% among Vietnam veterans with PTSD, with 26% of smokers smoking 20 or fewer cigarettes, 34% smoking between 21 and 25 cigarettes, and the remaining 40% smoking more than 25 cigarettes per day.¹

Summary—There is a general consensus across studies indicating both lifetime and current smoking rates are significantly higher among persons with either a lifetime history of, or current, PTSD compared to persons without these psychological characteristics. Several of these studies examined representative samples strengthening confidence in the finding. This pattern seems relatively age-invariant, as evidenced by a similar pattern among adults and youth and there is evidence that PTSD is associated with increased smoking rates across genders. On average, it appears that in the U.S. approximately 45% of persons with current PTSD are current smokers, which can be compared to the general population, where current smoking rates are approximately 22%. Another general conclusion is that PTSD-smoking comorbidity appears at least as prevalent as many other forms of smoking-psychopathology comorbidity. For instance, while formal statistical comparisons were not conducted, current smoking rates observed among persons with PTSD in the NCS data were higher than those observed among persons with other types of mental illness that have been linked to smoking, including major depressive disorder and panic disorder (36.6% and 35.9%, respectively). Finally, persons with PTSD appear to be heavy smokers, with over 70% smoking more than 20 cigarettes per day and typically high levels of nicotine dependence.

¹Two other studies of treatment seeking samples examined the point prevalence rates of smoking via chart review, but are not reviewed as the number of subjects with PTSD in these studies was too low to draw strong conclusions (Baker-Morrisette, Gulliver, Wiegel, & Barlow, 2004; Morrisette, Brown, Kamholz, & Gulliver, 2006; Upadhyaya, Brady, Wharton, & Liao, 2003).

Prevalence of Smoking among Persons Exposed to Traumatic Events

Investigators also have explored the relation between exposure to traumatic events and smoking levels. In Hapke and colleagues (2005) study described above, significantly higher rates of ever-smoking, current smoking, ever being nicotine dependent, and current nicotine dependence were endorsed by traumatic event-exposed persons without PTSD (64%, 39%, 26%, and 14%, respectively) relative to persons without such exposure (58%, 36%, 19%, and 10%, respectively). When analyzed as a function of gender, the pattern of results was comparable for women. However, among men, traumatic event exposure without PTSD was only related to greater current and lifetime nicotine dependence. Regarding specificity to traumatic event type, results demonstrated the highest likelihood for ever and current smoking and nicotine dependence was among rape victims, with similar odds ratios emerging for those sexually abused. Compared to non-exposed persons, those who witnessed a traumatic event or who had a “terrible experience” during a war were not significantly more likely to smoke or be nicotine dependent.

In Acierno and associates’ (1996) study with adult women described above, lifetime assault history was indexed via reports of previous rape or physical assault and recent assault was defined as these types of assault occurring during the two years preceding the assessment. Women with a history of assault were more than twice as likely to report a lifetime history of smoking relative to women without such a history (71% versus 53%, respectively). Comparably, women who were, versus were not, recently assaulted were more likely to report current smoking (44% compared to 26%, respectively).

In their study of adolescents, Acierno et al. (2000; described above) also examined the role of histories of experienced and witnessed assault in current smoking. Assault was indexed via a structured telephone-administered interview. Specifically, witnessing violence (did you see someone shoot, stab, or attack another or threaten another with a weapon), physical assault (been threatened or attacked with weapon, attacked with the threat of serious injury, beaten up and hurt badly), and sexual assault (forced sexual contact) were measured. Among both boys and girls, positive histories of the following assault types were significantly associated with at least a two-fold increase in the likelihood of current regular smoking compared to adolescents without these histories (ranging between 4% and 8%): witnessing violence (13% and 16%, respectively), physical assault (14% and 20%, respectively), and sexual assault (17% and 23%, respectively). These relations remained among girls after controlling for race and familial substance use. However, among boys, after controlling for these factors, physical assault and witnessed violence, but not sexual assault, were associated with an increased likelihood of current smoking. Importantly, low sexual assault levels among boys necessitate caution in interpreting this finding.

In a second study of youth, Kaplan and colleagues (1998) investigated the association between smoking and physical abuse among adolescents. A non-abused group, wherein participants were excluded for the presence of traumatic event exposure, was compared to a group of physically abused youth, wherein participants were excluded for histories of sexual abuse. Significantly more of the physically abused adolescents reported lifetime and current smoking than non-abused adolescents (42% and 36%, respectively, versus 13% and 13%, respectively). Moreover, after controlling for other risk factors (e.g., one biological parent in the home, female gender, greater age), physical abuse was associated with a three-fold increase in likelihood of both lifetime and current smoking relative to non-abuse.

Weaver and Etzel (2003) examined the relations among nicotine dependence, traumatic event exposure [physical, psychological, and sexual interpersonal violence (IPV)], and symptoms of PTSD among victims of severe battering. Thirty-six participants (58%) reported current smoking, of which 18 (50%) reported smoking less than 10 cigarettes per day and 16 (43%)

were relatively nicotine dependent. Also, among smokers, nicotine dependence was positively related to severity of sexual coercion, trauma-related dominance/isolation, severity of total, reexperiencing, and arousal symptoms of PTSD, and negatively related to recency of violence.

In another study of IPV and smoking, IPV was operationally defined as physical violence or sexual abuse within 12 months of the interview, where the perpetrator was an intimate partner (i.e., current/former boyfriend, girlfriend, or spouse; Lemon, Verhoek-Oftedahl, & Donnelly, 2002). Interview questions (not described) indexed physical and sexual violence and were used to index IPV. History of IPV was categorized as follows: physical and/or sexual IPV (i.e., hit, threatened with a gun, choked, raped, and punched); psychological IPV without physical or sexual IPV (i.e., verbal threats); no IPV. Current smoking (coded dichotomously: yes/no) was defined as smoking 100 cigarettes in their lifetime and smoking at the time of the interview. Current smokers were compared to former smokers and nonsmokers. Current smoking rates among those who had experienced physical or sexual IPV, psychological IPV, and no IPV were 44%, 34%, and 23%, respectively. Results also suggested that a history of physical or sexual, but not psychological, IPV increased the likelihood of current smoking compared to those with no IPV history.

Weinbaum and colleagues (2001) examined factors related to being a female victim of intimate partner physical domestic violence (IPP-DV). Histories of IPP-DV, coded dichotomously (yes/no), were indexed via a series of 8 questions about situations in which the individual had been pushed, choked, beaten up, had objects thrown at them, or were threatened with a weapon by an intimate partner within the last 12 months. Questions regarding smoking status were not reported. Here, victims of IPP-DV were approximately twice as likely to report current smoking compared to nonvictims (32% versus 17%, respectively).

Finally, Anda and colleagues (1999) examined the relation between retrospectively reported childhood trauma and smoking in adulthood. Childhood traumatic events measured included verbal, physical, and sexual abuse as well as the presence of a battered mother. Four indices of smoking were created: (1) early smoking initiation (regularly smoking by age 14), (2) ever smoked (having smoked at least 100 cigarettes), (3) current smoker (smoking at the time) and (4) heavy smokers (currently smoking 20 or more cigarettes a day). Overall, smoking rates were approximately 14% among those exposed to childhood trauma. All childhood trauma types were associated with a greater likelihood of early smoking initiation as well as lifetime, current, and heavy smoking, the likelihood of which was further increased by repeated traumatization.

Summary—Most notable in studies of the relation between trauma exposure and smoking is the relatively consistent finding that being exposed to a traumatic event is associated with increased smoking behavior, including smoking status, smoking level, and nicotine dependence. Among adults, current smoking rates among traumatic event-exposed adults range between 32% (IPP-DV) to 58% (severe battering), and among adolescents these rates vary from 13% (boys witnessing violence) to 36% (physical abuse). Elevated smoking behavior has been observed across exposure to several different traumatic event types, including combat, interpersonal violence (e.g., physical and sexual assault, domestic violence), and child abuse (e.g., verbal, physical, and sexual). Interestingly, traumatic events that are more “severe,” as indexed by their greater relation with PTSD (see Kessler et al., 1995; e.g., rape, severe battering, and sexual abuse), appear associated with the greatest likelihood of smoking.

Prevalence of Traumatic Event Exposure and PTSD among Smokers

Few studies have measured the prevalence of traumatic event exposure among smokers. Vest, Catlin, and Brownson (2002) investigated the relation between IPV and smoking among a random sample of 18,415 adult women. While the operational definition of smoker versus

nonsmoker was not specified, Vest and colleagues (2002) examined a portion of the Behavioral Risk Factor Surveillance System data, which Lemon and associates (2002; described above) also studied. In Lemon and associates' study, current smoking was defined as smoking 100 cigarettes in their lifetime and smoking at the time of the interview. Although descriptive information was not provided to estimate the prevalence of IPV among smokers, Vest et al. (2002) reported that smokers were more than twice as likely to report IPV histories compared to nonsmokers.

In the second and only other study in this domain, Ganz (2000) examined a random, stratified probability sample of 695 adults from Central Harlem, New York. Traumatic event exposure was indexed with a self-report questionnaire of 20 specific event types and an "other" category. Current smokers were defined as persons who reported smoking at least 100 cigarettes in their lifetime and who endorsed smoking cigarettes "now." Significantly greater traumatic event exposure was observed among smokers, who reported smoking approximately 12 cigarettes per day, compared to nonsmokers. The following traumatic events were more commonly reported by smokers: serious accident; physical assault or abuse by a partner; physical assault as an adult by someone other than a partner; life-threatening mugging; and childhood sexual assault or rape. Also, lifetime traumatic event exposure was significantly related to an increased likelihood of current smoking after adjusting for sociodemographic factors. However, lifetime traumatic event exposure was not significantly related to number of cigarettes smoked per day.

Summary—Overall, there is limited research on the prevalence of trauma and PTSD among smokers. Indeed, research does not allow for general estimates of the rate of either traumatic event exposure or PTSD among smokers. This limitation is unfortunate, as it hinders predictions regarding the likelihood of this problem in smoking-focused research and treatment settings. However, research does suggest smokers are significantly more likely to report higher levels of traumatic event exposure, which generally coalesces with research reviewed above in that it further highlights frequent co-occurrence between traumatic event exposure and smoking.

Covariation between Severity of Posttraumatic Response and Smoking Behavior

Several tests have been conducted to examine the relation between levels of smoking behavior and the degree to which individuals respond symptomatically to traumatic event exposure. The vast majority of these studies compare smoking behavior between traumatic event-exposed individuals with, versus without, PTSD, which in this section, are critically analyzed first. We then review studies adopting other approaches to examining the covariation between smoking and indices of response to trauma (e.g., traumatic event-related PTSD symptom levels).

In one of the earliest investigations in this area, smoking among combat-exposed Lebanon war veterans was examined (Shalev, Bleich, & Ursano, 1990). Significantly more of the veterans who met, versus did not meet, criteria for PTSD smoked (66% versus 37%, respectively). Of these smokers, those with versus without PTSD smoked significantly more cigarettes per day.

Op den Velde and colleagues (2002) compared cigarette use between male veterans of the Dutch Civilian Resistance against the Nazi occupation of The Netherlands with, versus without, PTSD. Cigarette use was indexed via a self-report question regarding number of cigarettes smoked per day during the previous year. Smoking rates were higher among veterans with than without PTSD (56% and 34%, respectively). After controlling for state anxiety and depressive symptoms, higher smoking levels and trait anxiety were associated with PTSD. An interaction between these factors also emerged, which was suggested to reflect a stronger association between trait anxiety and PTSD among non-smokers than smokers.

Beckham and colleagues (1997) compared smoking level among Vietnam veterans as a function of PTSD. A list of Likert-type scales was administered to measure current smoking status, cigarettes smoked per day, and years smoking. Point prevalence smoking rates did not significantly differ between those with and without PTSD (53% and 45%, respectively). However, veterans with PTSD reported smoking more cigarettes per day and were significantly more likely to be heavy smokers (i.e., ≥ 25 cigarettes per day) than veterans without PTSD (48% versus 28%, respectively). Also, among veterans with PTSD, heavy smoking status was significantly related to increased total PTSD symptoms as well as avoidance and hyperarousal symptom clusters.

Koenen and colleagues (2003) reported relations among smoking, combat exposure, and PTSD using the VET registry, which consists of monozygotic male-male twin pairs who served in the military during the Vietnam War era. Combat exposure was indexed via an interview inquiring about exposure to 18 combat activities (e.g., flying in an attack helicopter, being wounded). Twins exposed to combat, compared to their twin brothers, were significantly more likely to meet criteria for nicotine dependence unadjusted for PTSD, with PTSD unadjusted for combat, and with PTSD adjusted for combat. Tobacco dependence levels did not differ after adjusting for PTSD.

Similarly, Koenen and colleagues (2005) found that compared to veterans not exposed to a traumatic event, significantly more of those exposed, with or without PTSD, met criteria for nicotine dependence (40%, 71%, and 52%, respectively). These associations remained after adjusting for other risk factors, including comorbid psychiatric and substance use disorders.

Acierno and others (1996; described above) examined the relative contributions of PTSD compared to assault and depression in predicting smoking behavior among adult women. In analyses of lifetime psychological characteristics, significant predictors entered stepwise regression analyses for each outcome in the following order: lifetime smoking: assault, PTSD, and depression; current smoking: depression, assault, and PTSD. In analyses with current PTSD and depression and recent assault, assault entered first followed by current PTSD. Regression analyses also were conducted with both current and lifetime histories of trauma-related variables and depression entered as predictors. In order of entry into the model, significant predictors of current smoking were: lifetime depression, lifetime assault, and lifetime PTSD. In terms of current smoking among only smokers, lifetime depression and lifetime assault were significant predictors. In terms of number of cigarettes smoked per day among smokers, significant predictors in descending order of magnitude of effect size were lifetime PTSD, current depression, education, and race. Finally, the effects of psychopathology in addition to assault on current smoking rates were investigated. Of women with positive assault histories, 30% smoked, which was significantly greater among (1) those with assault and depressive histories, (2) assault and PTSD histories, and (3) assault and both depressive and PTSD histories (43%, 45%, and 54%, respectively). Smoking rates did not differ between groups with PTSD, depression, or both.

Lipschitz et al. (2003) examined smoking and traumatic event-related symptoms among 104 inner-city adolescent girls. Among traumatic event-exposed girls, significantly greater proportions of those with, compared to without, PTSD smoked (86% and 31%, respectively). Differences were nonsignificant when comparing a partial PTSD group (63%) with the PTSD and no PTSD groups. Analyses predicting smoking level (none, 1–10 cigarettes a day, or greater than 10) suggested both high, relative to low, levels of PTSD symptoms and traumatic event exposure versus no exposure predicted higher smoking levels.

In a study of physical health outcomes and PTSD, Boscarino (2006) examined Vietnam era Army veterans (i.e., served in the United States but not in Vietnam during the Vietnam War

period) and Vietnam theater veterans (i.e., served in Vietnam and therefore more likely combat exposed) in terms of smoking level. Smoking level was indexed by pack years, which were calculated as a function of the average number of cigarette packs smoked per day and the number of years smoked. Participants were coded according to the following categories in terms of pack years: none, 1–9, 10–18, 19–29, or 30+. A greater proportion of Vietnam theater veterans were heavy smokers, as defined by 19+ pack years, than Vietnam era veterans and those with PTSD were heavier smokers than those without PTSD.

In contrast to comparing smoking levels between traumatic event-exposed persons with versus without PTSD, Beckham and colleagues' (1995; described above) examined, several variables, including marital status, race, combat exposure, state and trait anxiety, PTSD and depressive symptoms, and smoking rates among 124 treatment-seeking male combat-exposed Vietnam veterans with PTSD. Smokers, compared to nonsmokers, reported significantly higher levels of PTSD symptoms despite no mean difference in combat exposure. Smokers also reported higher levels of depression and trait anxiety.

Finally, Schnurr and Spiro (1999) examined a mail-based survey of older-adult male combat veterans that measured physical health with the SF-36 (Ware et al., 1993). Smoking was significantly associated with greater combat exposure and PTSD symptom levels. Mediation analyses suggested smoking did not account for a significant amount of variance in the observed significant relation between PTSD symptoms and physical health.

Summary—One general conclusion that can be drawn from the above studies is it appears that traumatic event-related psychopathology positively covaries with smoking levels. For instance, the presence of PTSD is related to current smoking above and beyond the effects of traumatic event exposure alone. Traumatic event-exposed smokers who develop PTSD also tend to smoke at greater levels than those who do not develop PTSD. This association appears consistent across ages (adolescents, adults, and older adults) and multiple trauma types (combat, participating in a trauma-relevant resistance movement, and exposure to violence as a child). These associations also have remained after methodologically and/or statistically controlling for several relevant factors, including heritability, level of traumatic event exposure, state anxiety, depressive symptoms, and other psychiatric and substance use disorders. Thus, it is not likely that the observed associations are attributable to these other relevant variables. Finally, limited research on the association between smoking and PTSD-related symptom clusters suggests the hyperarousal symptoms of PTSD are positively related to smoking and there is inconsistent evidence of a relation between smoking and both avoidance and reexperiencing symptoms.

Time Course/Temporal Patterning

Other research has examined onset patterns between smoking behaviors and PTSD-related factors to explicate the temporal nature of relations among smoking and PTSD-related factors. We have organized this section of the review according to the three methodological approaches used to examine this issue. First, studies that examine retrospectively-reported change in smoking behaviors among communities and individuals exposed to a traumatic event are reviewed. Second, examinations of retrospectively-reported age of onset patterns are reviewed. Finally, we conclude with a review of the only prospective test in this domain.

Retrospectively-Reported Changes in Smoking Behavior after Traumatic Event-Exposure

Gleser and others (1981) assessed the psychological effects of disaster on survivors of the Buffalo Creek, West Virginia flood of 1972 when a dam collapsed flooding the valley of Buffalo Creek. The Checklist for Family Disruption Indicators and the Psychosocial Disruption Checklist were created to, in part, measure smoking before (retrospectively) and after the flood.

Of 143 responding families, 44% reported increased smoking levels after the flood to the time of the follow-up interview (2 years after the flood).

In a similar study, family members of homicide victims were surveyed (Mezey, Evans, & Hobdell, 2002). The specific question used to index change in smoking behavior was not reported and the relation between post-traumatic response and smoking was not examined. However, 94% of smokers reported increased smoking subsequent to the homicide.

Pawlak and DeFronzo (1993) examined the relations among social bonds and childhood traumatic event exposure in terms of adult smoking behavior. In a broad-based survey, smoking was indexed dichotomously via the question "Do you smoke?" Two questions addressed childhood traumatic event exposure. First, having ever been beaten or punched was indexed, and if yes, follow-up questions included: was this the first time and did this occur in childhood or as an adult. The second question inquired about living situation at age 16 and family instability (i.e., with mother and father or in any other family situation). After statistically controlling for religious beliefs, commitment, attachment, involvement, and moral conformity, exposure to a traumatic event in childhood predicted adult smoking status.

Recently, three studies have assessed smoking-related reactions to the September 11th, 2001 terrorist attacks on the World Trade Center in New York City. First, Vlahov and colleagues (2002) completed a survey wherein lifetime (i.e., "Have you ever smoked cigarettes?"), prior to the attack ("How many cigarettes did you smoke during the week before September 11th?"), and post-attack ("How many cigarettes did you smoke during the week prior to the interview?") smoking rates were measured. Multiple aspects of traumatic event exposure were measured, including exposure to eight potentially traumatic events (e.g., death of a spouse) during the year prior to the attacks, exposure to the attacks (e.g., directly witnessing, knowing someone killed or injured, being in the rescue efforts, having a job impacted by the attacks), and type and amount of exposure to media coverage of the attacks and associated aftermath. Participants were partitioned into four groups that differed as a function of the proximity of their residence to the attacks. Of note, symptoms of PTSD were required to be related to the attacks as opposed to related to another traumatic event. Of the total sample, 22% smoked cigarettes before, and 23% reported smoking after the attacks, and 9% reported increased smoking after the attacks. Of those reporting an increase, 8% reported increasing by approximately 20 cigarettes per week. Diagnoses of PTSD were significantly more common among those increasing than not increasing cigarette use (24% versus 5%, respectively). Variables associated with increased cigarette use post-attacks included the following: closer proximity to the attack; potentially traumatic events during the year prior to the attack; fear of injury or death during the attacks; peri-event panic (as indexed via structured clinical interview); post-attack job loss; and high levels of media exposure.

Second, Nandi, Galea, Ahern, and Vlahov (2005) utilized similar methodology to examine a random sample of residents from the entire New York City metropolitan area four months after the World Trade Center attacks. Overall, 36% of the sample reported an increase in cigarette use and 10% of the sample (41% of smokers) was nicotine dependent. Nicotine dependent persons were more likely to meet criteria for PTSD (18%) than non-dependent persons (5%). Among both nicotine dependent and non-dependent persons, those reporting increased cigarette use were more likely to meet criteria for PTSD (23% and 15%, respectively) than not (6% and 5%, respectively). The following factors were associated with increased likelihood of nicotine dependence: higher levels of life stressors prior to attacks, high levels of attack-related media exposure, and being directly affected by the attacks.

Third, Vlahov and colleagues (2004) used methodology comparable to their previous study (Vlahov et al., 2002) to survey residents of the entire New York City metropolitan area. They

again observed an overall increase in smoking rates (22% one month prior to the attacks versus 24% post-attacks). Among the 320 smokers prior to the attacks, 7% reported no recent smoking and 9% reported increased smoking (2% were new smokers and 7% increased frequency) after the attacks. Of those who increased smoking, 57% increased by at least 20 cigarettes per week. There were significantly more cases of current PTSD among those increasing, versus not increasing, smoking (4% compared to 1%, respectively). The following factors were related to increased smoking: male gender; high social support; potentially traumatic events during the year prior to the attacks; and job loss. Also of note, in descriptive comparisons of the current sample and the sample assessed 5 to 8 weeks post-attacks (Vlahov et al., 2002), psychopathology appeared to substantially remit whereas increases in substance use remained relatively stable.

Similar to research on the World Trade Center attacks, two studies examined smoking-related responses to the 1995 Oklahoma City bombing. First, Smith, Christiansen, Vincent, and Hann (1999) surveyed the Oklahoma City metropolitan area and compared them to residents of the Indianapolis metropolitan (control) area. Interview questions asked participants if they were smokers and, if so, if they had started or increased smoking since the bombing (specific questions were not described). Traumatic event exposure was indexed via self-report of eight possible consequences of the bombing (e.g., personal injury, death of a family member) and post-traumatic response was measured via six self-report items of PTSD-like symptoms (e.g., loss of interest, emotional numbing, feeling easily startled), four questions about intrusive thoughts or avoidance of reminders of the bombing, and general distress since the bombing. While inferential statistics were not reported, Oklahoma City residents reported higher rates of traumatic event exposure, PTSD symptoms, smoking, increased smoking, and smoking initiation than the control area.

In the second study, individuals seeking crisis intervention after the Oklahoma City bombing were studied (Pfefferbaum et al., 2002). A questionnaire was used to measure traumatic event exposure. Participants were asked if they heard or felt the explosion, were injured, or knew someone killed or injured in the explosion. Smoking was measured via a self-report item asking participants to indicate if they were either (1) nonsmokers, (2) smokers who did not increase use since the bombing, or (3) smokers who increased use since the bombing (decreased smoking was not included). Smokers who increased use, compared to those who did not and nonsmokers, reported higher levels of posttraumatic stress symptoms. Also, participants who reported an increase in either smoking or drinking, compared to all others, endorsed higher levels of peritraumatic reactions, grief, posttraumatic stress symptoms, worry about their own safety, and functional impairment.

In a separate investigation, retrospectively reported changes in smoking level were assessed among survivors of a ferry accident in Belgium, which killed over 30% of the passengers (Joseph, Yule, Williams, & Hodgkinson, 1993). Change in smoking level was assessed with two self-report questions mailed to survivors approximately two years after the accident. Participants rated if, relative to prior to the accident, they had used cigarettes (1) no more than usual, (2) a little more than usual, or (3) a lot more than usual, in the six months immediately following the accident (Time 1) and during the six months prior to the assessment (approximately 18 months post-accident; Time 2). At Time 1, 34% endorsed increasing use a lot and 10% a little, whereas at Time 2, 23% endorsed a lot of increased use and 16% a little. Those reporting at least a little increased use reported higher levels of intrusion and avoidance posttraumatic stress symptoms (hyperarousal symptoms were not measured) than those not increasing use.

Retrospectively-Reported Age of Onset Patterns—Secondary examinations of large data sets also have been utilized to understand temporal patterns among smoking, nicotine

dependence, traumatic event exposure, and PTSD. Here, temporal associations among retrospectively reported age of onset for each of these factors are examined. These studies are organized according to sample representativeness, with the most generalizable reviewed first.

Breslau, Novak, and Kessler (2004) examined self-reported age of onset patterns for PTSD and smoking behavior using data from the NCS (Kessler et al., 1994). Here, onset of daily smoking was defined as the age at which smoking first occurred for at least one month. Analyses examined (1) the association of preexisting PTSD (first onset at least one year prior to daily smoking) with the age of onset of daily smoking and progression to nicotine dependence and (2) the relation between PTSD and smoking persistence, defined as 12-month prevalence among lifetime smokers who began to smoke daily at least 2 years prior the interview. After statistically controlling for race, gender, education, and age, those with a lifetime history of PTSD, regardless of whether the diagnosis was “active” at the time of the interview or past, were more likely than those without PTSD to report later onset of daily smoking. Similarly, active smokers with a lifetime history of PTSD were more likely than those without this diagnosis to transition to nicotine dependence, although this pattern was only observed for active, but not past, diagnoses. No anxiety or mood disorder predicted smoking persistence among daily smokers.

Perkonig, Kessler, Storz, and Wittchen (2000) used a similar approach with 3,021 adolescents and young adults (aged 14 to 24 years) in metropolitan Munich to examine age of onset patterns among nicotine dependence, traumatic event exposure, and PTSD. Nicotine dependence preceded traumatic event exposure among 60% and PTSD among 72% of comorbid cases. Traumatic event exposure and PTSD preceded nicotine dependence among relatively fewer cases (27% and 21%, respectively) with onset of nicotine dependence occurring in the same year as traumatic event exposure among 12% of participants and among 6% of comorbid cases. After adjusting for age, gender, and social class, the presence of previous nicotine dependence increased the likelihood of subsequent traumatic event exposure, but not PTSD among the entire sample or among only traumatic event-exposed participants. Prior exposure to a traumatic event, PTSD, and PTSD in the traumatic event-exposed subsample, even after also controlling for traumatic event-related characteristics (e.g., type, repeated exposure), all significantly increased the likelihood of later age of onset of nicotine dependence.

Using the VET registry described above, Koenen and colleagues (2005) also examined the directionality of the PTSD–nicotine dependence association via retrospectively-reported age of onset patterns. Among the 6% of the sample meeting criteria for both nicotine dependence and PTSD, nicotine dependence onset preceded PTSD onset in 46% of cases, while the opposite was observed in 47% of cases. Nicotine dependence occurred after traumatic event exposure, but before PTSD onset, for 6% of participants. Among nicotine dependent, traumatic event-exposed participants without PTSD (18%), trauma preceded nicotine dependence among 57% and nicotine dependence was primary for 43% of cases. Also, regression analyses suggest three other patterns. First, among persons not nicotine dependent, pre-traumatic event exposure, exposure without PTSD, did not increase the likelihood of later nicotine dependence onset. Second, among traumatic event-exposed persons without nicotine dependence prior to PTSD onset, PTSD increased the likelihood of subsequent nicotine dependence. Finally, among those not exposed to a traumatic event prior to nicotine dependence, such dependence did not increase the likelihood of traumatic event exposure, whereas nicotine dependent individuals were twice as likely to meet criteria for PTSD after traumatic event exposure. These patterns remained after controlling for other substance use disorders, major depression, and conduct disorder.

Prospective Test—In the only prospective investigation in this domain, Breslau, Davis, and Schultz (2003) examined the relation between traumatic event exposure, PTSD, and the onset of new cases of nicotine dependence. These factors were monitored across a 10-year follow-

up period. Follow-up assessments conducted at 3, 5, and 10 years were collapsed to create an overall index of new cases of nicotine dependence. There were 108 new cases of nicotine dependence during the follow-up. After adjusting for sex, race, educational level, and preexisting alcohol or other drug abuse and dependence, compared to persons with no traumatic event history at baseline (10%), persons with PTSD at baseline were approximately 4 times more likely, and those with traumatic event exposure only at baseline were twice as likely, to become nicotine dependent (31% and 19%, respectively). The traumatic event-exposed and PTSD groups also significantly differed. Lifetime age-of-onset data collected at baseline suggested PTSD significantly increased the likelihood of later nicotine dependence onset, whereas traumatic event exposure alone did not.

Summary—Studies examining the temporal associations among traumatic event exposure, PTSD, and smoking suggest exposure to a traumatic event, and particularly PTSD, increase smoking behavior. Indices of smoking that appear to increase include smoking level, smoking onset, nicotine dependence, and transition from smoking to nicotine dependence. Greater “severity” of traumatic event exposure appears related to these increases, as indexed by factors such as proximity to event, repeated traumatization, and personal effects of the event.

Several inconsistent findings within this portion of the smoking-traumatic stress literature are in need of further study. For instance, mixed findings include the role of (1) traumatic event exposure alone in later smoking onset, (2) smoking in increasing risk of traumatic event exposure, and (3) nicotine dependence in PTSD subsequent to traumatic event exposure. It is conceivable that these relations are bidirectional, as has been suggested in other smoking-anxiety comorbidity research (Zvolensky, Bernstein, Marshall, & Feldner, in press), which may account for the current discrepancies in the extant database. For instance, nicotine withdrawal may maintain physiological hyperarousal symptoms of PTSD, and posttraumatic stress may increase nicotine dependence due to the belief that smoking will aid in regulating negative affect. Prospective tests will likely be necessary for understanding these patterns as reliance on retrospective reports may be systematically biased. For example, retrospectively-reported age of onset patterns for smoking and PTSD may be affected by increased negative affect secondary to PTSD. Specifically, negative affect could bias recall of smoking onset such that persons with PTSD are more likely than traumatic event-exposed persons without PTSD to attribute smoking onset to traumatic event exposure. Prospective tests are also needed to support conclusions regarding the role of PTSD in other aspects of smoking behavior, such as smoking *initiation*. Finally, the interesting observation that increased smoking (and other substance use) does not appear to remit along with the natural course of recovery from a traumatic event (Vlahov et al., 2004) warrants further exploration.

Other Research related to the Relation between Smoking and PTSD

In addition to work on the co-occurrence of smoking, PTSD, and traumatic event exposure, several areas of work are beginning to address other factors implicated in this relation. In this next section, we review evidence in these domains, organized according to amount of research conducted, beginning with the most well-researched.

PTSD-Related Smoking Motivational Processes—Drawing from affect-regulation perspectives, researchers have begun to theorize that persons who respond symptomatically to trauma exposure are characterized by distinct smoking motivations relative to persons without such symptoms (Acierno et al., 1996; Beckham et al., 1995; Weaver & Etzel, 2003). This work importantly begins to explicate motivational processes that may underlie smoking-PTSD/traumatic event relations. Two areas of research fall within this domain: examination of the roles of traumatic event cues and smoking to reduce negative affect.

Trauma-Related Stimuli as Cues for Smoking: Researchers have tested the hypothesis that trauma-related stimuli function as cues for increased smoking behavior to manage reactions to such cues. Three studies have examined this hypothesis. In the first, Beckham and associates (1996) used a within-subjects design to examine the relation between exposure to trauma-relevant cues and smoking withdrawal symptoms among combat veteran smokers with PTSD. Trauma-relevant cues were presented via word (e.g., medevac, firefight, hate, death) presentation in a Stroop task, which included presentation of 3 neutral and 3 trauma-relevant cards with 100 words on each card. Withdrawal symptoms were assessed prior to the Stroop task and after completion of each word card. Anxiety-relevant word cards were rated as more stressful upon completion of the Stroop task and they took longer to name. Results suggested greater levels of craving, affect, somatic, and lack of alertness withdrawal symptoms following naming of traumatic event-relevant than neutral word cards, suggesting traumatic event cues may increase smoking withdrawal-relevant symptoms.

Second, McClernon and colleagues (2005) examined the effects of recalling traumatic event-related experiences on smoking topography as a function of PTSD. An individualized script-driven imagery procedure (Pitman et al., 1990) was used to expose participants to traumatic event cues. Prior to smoking administration, two scripts were created: one traumatic event-relevant and one neutral. After developing the scripts, participants smoked a cigarette via a smoke-delivery apparatus (Levin, Rose, & Behm, 1989), which was used to measure puff volume, number of puffs, and puff onset intervals. Results suggested a main effect of group; persons with PTSD inhaled significantly larger amounts of smoke than the non-PTSD group. Also, in regards to puff onset, a script by group interaction suggested the non-PTSD group smoked more quickly following the trauma-relevant than neutral script, whereas among the PTSD group, there were no differences. There were no differences in terms of number of puffs.

Finally, using a similar methodology, Beckham and colleagues (2005) examined the relation between situational cues and smoking behavior as a function of PTSD. The study consisted of an initial interview followed by one day of ambulatory monitoring, which involved wearing a monitor that recorded heart rate and blood pressure. Participants were instructed to make paper diary entries every time the machine recorded a reading and when they prepared to smoke. Diary entries included the following: the time, location, social situation, activity, physical activity, if smoking was allowed at the time, and if others were smoking. Participants also reported on their mood and PTSD symptoms that may be expected to vary across short time periods (e.g., intrusive thoughts, difficulty concentrating) in the 10-minutes prior to making diary ratings. Other measures of situational antecedents included single-item ratings of craving and if caffeine, food, alcohol, or medication was used in the 30 minutes prior to completing the diary entry. Smokers with PTSD were more likely to smoke in the presence of the following cues: total, reexperiencing, and hyperarousal symptoms of PTSD, negative affect, positive affect, restlessness, and while interacting with others. In contrast, no affect-related factors were associated with smoking among those without PTSD. Here, higher levels of craving and the presence of certain situational factors (e.g., drinking coffee, being alone, being around other smokers) were related to smoking.

Smoking to Reduce Negative Affect: The second area of research in this domain has focused on understanding smoking motivational processes among persons with PTSD. The hypothesis that persons with, versus without, PTSD are more likely to smoke because they smoke to reduce negative affect has been examined. In Beckham and colleagues' (1995) study of combat-exposed veterans with PTSD described above, the relations between PTSD-related factors and reasons for smoking were examined. Seven different reasons were examined: stimulation, indulgent, psychosocial, sensorimotor, addictive, automatic, and negative affect reduction motives. Negative affect reduction motives were indexed via a combination of relevant items from both the Reasons for Smoking questionnaire (Ikard, Green, & Horn, 1969) and the

Motives for Smoking Scale (Russell et al., 1974). Depressive symptoms emerged as the only predictor of automatic smoking motives and there were no other predictors of other motives.

In a second study, Beckham et al. (1997; described above) compared veterans with versus without PTSD in terms of smoking motives. As above (Beckham et al., 1995), an abbreviated version of the Motives for Smoking Scale (Russell et al., 1974) was utilized and results were reported for six subscales: stimulation, indulgent, tension reduction, addictive, automatic, and psychosocial. After statistically controlling for age, socioeconomic status, and combat exposure, the presence of PTSD predicted greater indulgent, addictive, automatic, and tension reduction motives. Smoking status [heavy (≥ 25 cigarettes per day) versus light-moderate (< 25 cigarettes per day)], which significantly predicted all smoking motives except for indulgent, did not moderate the association between PTSD and smoking motives despite persons with PTSD being more likely to be heavy smokers.

A third study was conducted among traumatic event-exposed daily (at least 5 cigarettes per day) smokers (Feldner et al., in press). After controlling for number of cigarettes smoked per day and gender, higher levels of posttraumatic stress symptoms were associated with smoking to reduce negative affect (but not other smoking motives). In comparisons of those likely meeting criteria for PTSD as indexed via self-report (37% of the sample) and those not meeting criteria, persons with PTSD endorsed significantly higher levels of smoking to reduce negative affect.

Summary: These studies suggest persons with PTSD are motivated to smoke, at least in part, by PTSD-related factors. Specifically, it appears persons with PTSD increase smoking in response to trauma cues, and there is evidence, albeit mixed, to suggest they smoke to reduce negative affective states. However, these tentative conclusions need to be qualified by noting there currently is little research in the area and these findings require replication. Furthermore, there are several other motivational processes that need to be examined, such as smoking expectancies (e.g., smoking will result in physical illness).

Quitting Smoking—A limited body of research also has begun to examine smoking quit rates among persons with PTSD relative to those without mental illness. These studies have explored the hypothesis that persons with PTSD are relatively unable to quit smoking. In Lasser and colleagues' (2000) examination of the NCS (Kessler et al., 1994) data described above, smoking quit rates also were examined. The smoking quit rate, defined as the proportion of lifetime smokers who were not current smokers, was significantly lower for participants with lifetime diagnoses of PTSD than for participants without mental illness. Similarly, those with past-month diagnoses of PTSD evidenced a significantly lower quit rate than those without mental illness in the past month.

In a second study along these lines, Hapke and colleagues (2005) utilized a similar approach to examining quit rates. Compared to those who had not been exposed to trauma, the smoking quit rates were significantly lower among those with PTSD, but not trauma-exposed persons without PTSD (37%, 19%, and 38%, respectively). The presence of PTSD, but not trauma exposure alone, also predicted significantly lower rates of remitted nicotine dependence compared to those not exposed to trauma (13%, 46%, and 46%, respectively).

Summary: The data are consistent with the hypothesis that with PTSD experience difficulty quitting smoking. Indeed, smoking cessation rates for this group can be compared to rates among groups with other psychiatric disorders. For example, although no direct statistical comparisons were reported, smoking cessation rates for persons with lifetime PTSD were lower than those observed among other groups with lifetime histories of several types of psychiatric problems that have been linked to smoking [e.g., lifetime histories of major depressive disorder

and panic disorder (38% and 41%, respectively); Lasser et al., 2000]. It does not appear that trauma exposure alone marks difficulty quitting, which may suggest trauma-related *psychopathology* per se is interfering with quitting. However, little is known about *why* persons with PTSD are not quitting, and perhaps more importantly, no controlled, prospective tests have thus far been completed, thereby highlighting an important and timely next step for this area.

Heritability—Shared genetic/familial factors were examined in Koenen and colleagues' (2005) examination of the VET registry (described above). Specifically, a twin design was utilized to estimate the variance in nicotine dependence accounted for by shared familial vulnerability and non-shared environmental factors. The best-fitting model included significant genetic and individual-specific environmental factors. It was estimated that approximately 62% of the association between PTSD and nicotine dependence was accounted for by shared genetic/familial factors and the remaining 38% by individual-specific environmental factors.

Summary: There is a notable paucity of research examining the role of heritability in smoking – PTSD/traumatic event exposure comorbidity, particularly given the relatively large estimate of the role of this factor. Several potentially interesting future directions in this domain are highlighted by the only extant study. For instance, research aimed at elucidating the specific mechanisms by which the documented genetic/familial vulnerability is conferred, such as common genetic and/or neurobiological factors, is now needed.

Depression—One study examined the role of histories of depression as a potential variable underlying the link between smoking and posttraumatic symptoms. Thorndike, Wernicke, Pearlman, and Haaga (2006) examined the relations between nicotine dependence levels, PTSD symptoms, and gender among daily smokers. Participants were excluded on the basis of current depressive episodes and moderate levels of depressive symptoms (Beck Depression Inventory scores ≥ 16 ; Beck, Rush, Shaw, & Emery, 1979). The Structured Clinical Interview for DSM-IV (First et al., 1995) was used to identify histories of depressive episodes and the Depression Proneness Inventory (Alloy, Hartlage, Metalsky, & Abramson, 1987) indexed vulnerability to depression in response to stressful life events. Nicotine dependence levels were positively associated with total PTSD symptoms as well as the hyperarousal, avoidance, and reexperiencing symptoms, even after statistically controlling for depression proneness and past history of major depressive episodes among men. However, these relations were not apparent among women.

Summary: This study suggests, albeit preliminarily, that PTSD symptom-smoking linkages are not solely attributable to associated differences in depressive symptoms, diagnoses, or vulnerability. This is one of the only studies to systematically examine the possibility that other types of psychopathology that commonly co-occur with PTSD account for the relation between smoking and PTSD. Additional work is needed in this domain to more fully understand why persons with PTSD smoke at high rates, which is discussed in greater detail below.

Cardiovascular Functioning—The only other factor related to PTSD and smoking to receive empirical examination is cardiovascular functioning among groups characterized by one or both of these problems. This work aims to ultimately understand the health risks and poor outcomes in terms of morbidity and mortality observed among persons with PTSD (Friedman & Schnurr, 1995). Beckham and associates (2004) examined the relations between smoking status and cardiovascular functioning in terms of PTSD diagnostic status among combat-exposed Vietnam veterans. Participants recorded 11 affect ratings on 21 occasions during 1 day, which were condensed into the following three factors by collapsing across rating

period and via a principal component analysis: anger/hostility, anxiety/depression, and positive affect. Smokers also recorded if they had smoked a cigarette in the last 30 minutes each time they made affect ratings. Cardiovascular parameters monitored included the following: heart rate and blood pressure measured 3 times in the clinic and across 12 to 14 hours of continuous monitoring. Participants self-reported smoking level and were categorized in two ways: (1) smokers versus nonsmokers and (2) nonsmokers, light smokers (1 – 19 cigarettes per day), and heavy smokers (≥ 20 cigarettes per day). There were diagnostic status by smoking *status* interactions in predicting diastolic blood pressure (DBP), mean arterial pressure (MAP), and positive affect ratings. Among those with PTSD, DBP was higher for smokers versus nonsmokers, whereas for those without PTSD, smokers had lower DBP levels than nonsmokers. In terms of MAP, among those with PTSD, smokers had higher MAP levels than nonsmokers, whereas for those without PTSD, smokers had lower levels than nonsmokers. In terms of positive affect, among those with PTSD, smokers reported greater positive affect than nonsmokers, whereas among those without PTSD smoking status was not related to positive affect. A similar pattern of findings emerged when smoking *level* was examined rather than smoking status. Also, smokers with, versus without, PTSD, had higher DBP, MAP, and anger/hostility ratings as well as lower positive affect ratings. Finally, among those without PTSD, smoking within the past 30 minutes was associated with lower anxiety/depression ratings compared to not smoking within the past 30 minutes. However, this pattern did not emerge among smokers with PTSD.

Summary: This study represents an interesting first step in understanding how smoking may interact with PTSD to affect cardiovascular functioning. However, given multiple unexpected findings in this study (e.g., among those with PTSD, smokers reported higher levels of positive affect than nonsmokers), replication and extension is needed. Nonetheless, this research may prove beneficial to understanding poor health outcomes among persons with PTSD. We now review the final area studied in this literature: treatment targeting this comorbid condition.

Treatment

Based on high comorbidity rates between PTSD and alcohol and other drug use problems (e.g., cocaine; Ouimette, Brown, & Najavits, 1998), treatments have been developed that simultaneously target PTSD and drug use problems (e.g., Back et al., 2001). These treatments are demonstrating promising results (e.g., Najavits et al., 1998) suggesting integrated treatments may improve traditional models of targeting each problem individually. Despite these advances, little research has examined the efficacy of interventions targeting PTSD, smoking, or both, among persons with this dual diagnosis. Indeed, no trials have targeted PTSD specifically among smokers, although clinical trials of PTSD treatments likely have studied samples with high smoking rates given the common overlap highlighted thus far. Only two investigations have examined the effects of targeting smoking among persons with PTSD.

First, McFall and colleagues (2005) examined incorporation of smoking-focused interventions into mental health treatment among veterans with chronic PTSD with moderate to severe levels of PTSD symptoms. This integrated treatment was compared to standard care. Both conditions consisted of (1) psychopharmacological treatment of PTSD and smoking (e.g., bupropion, transdermal nicotine patch), (2) behavioral counseling to quit smoking (e.g., advice to quit, relaxation training, setting a quit date), and (3) non-standardized psychotherapy for PTSD. Conditions differed in that those receiving integrated care received all treatment components from mental health specialists, whereas standard care included mental health care from specialists in mental health and smoking cessation-focused elements delivered by VA smoking cessation specialists. Participants in the integrated care treatment reported higher levels of treatment satisfaction than those in the standard care treatment. After controlling for nicotine dependence and depressive symptoms, the integrated treatment improved smoking point

prevalence levels relative to standard care at the 2, 4, 6, and 9 month follow-up assessments. At the 9-month follow-up, approximately 19% of those receiving integrated care were abstinent versus 8% of those receiving standard care. However, differences in (more stringent) repeated 7-day point prevalence abstinence rates between the integrated and usual care groups were not significant (12% versus 3%, respectively). Changes in PTSD symptom levels were nonsignificant among both groups.

In a second trial (Hertzberg, Moore, Feldman, & Beckham, 2001), the effects of bupropion sustained-release (SR) on smoking status was examined among 15 veterans with chronic PTSD. In this 12-week double blind comparison, participants were randomly assigned using a 2 to 1 ratio to receive either bupropion SR ($N = 10$), which was initiated at 150mg daily for 3 to 4 days and increased to 300mg daily, or a placebo control ($N = 5$). All participants in the bupropion SR condition were also receiving (nonstandardized) psychopharmacological treatment for PTSD, depression, and/or anxiety (e.g., paroxetine, trazodone, clonazepam). Eight (80%) participants in the bupropion condition quit smoking by week 2, 6 (60%) remained abstinent at the 12-week comparison, and 4 (40%) were abstinent at the 6-month follow-up. One participant (20%) in the placebo control group quit by week 2 and remained abstinent through the 6-month follow-up period. There were no changes in PTSD symptoms, depression, or state anxiety.²

Summary—Overall, specialized treatments for targeting comorbid smoking-PTSD have not been developed and smoking-focused interventions among persons with PTSD do not improve PTSD symptom levels. However, evidence regarding the effects of these interventions on smoking is more promising, with abstinence rates comparable to those observed in smoking cessation trials with alcoholics and schizophrenia (McFall et al., 2005). The fact that persons with PTSD in the control conditions of these studies evidence lower abstinence rates than those reported in no-intervention conditions with the general population (which often screen for psychopathology; 3% versus 8%, respectively; Fiore et al., 2000) supports evidence suggesting persons with PTSD are vulnerable to unsuccessful quit attempts. Together, these patterns highlight the need to improve treatments for comorbid smoking and PTSD.

This gap in existing treatments is striking and clinically important in light of the theoretical and empirical evidence suggesting PTSD and associated characteristics may be central to smoking cessation problems. For example, persons with PTSD are characterized by, in part, elevated anxiety sensitivity (Taylor, 2003), defined as the fear of anxiety-related sensations (Reiss & McNally, 1985), and this factor has been linked to problems with smoking cessation (Zvolensky, Bernstein, Cardenas et al., in press). An important consideration in developing these types of specialized treatments is the degree to which they would be implemented upon establishing their efficacy. Indeed, despite continued efforts at developing, testing, and disseminating empirically-supported treatments for PTSD (e.g., Bradley, Greene, Russ, Dutra, & Westen, 2005), treatments without this type of support continue to be administered (Lohr, Hooke, Gist, & Tolin, 2003). Given this likely challenge, treatments for comorbid smoking-PTSD should be developed and refined with a focus on, at least in part, feasibility. Additionally,

²Two other studies that speak to treatment feasibility warrant brief consideration. First, Acceptance and Commitment Therapy (Hayes, Strosahl, & Wilson, 1999) that primarily targeted cognitive and affective (experiential) avoidance was delivered to a young woman with PTSD and comorbid substance use problems, including smoking (Batten & Hayes, 2005). It was theorized that experiential avoidance was a process underlying both functional problems associated with PTSD and substance use. The young woman was smoking 10–20 cigarettes per day at treatment initiation and she was using amphetamines, marijuana, alcohol, and cocaine. Although she quit smoking upon learning she was pregnant during treatment, she relapsed after giving birth. After 96 sessions and treatment discontinuation due to reduction in PTSD-associated problems and substance use, she relapsed to smoking. Second, based on the work of Vlahov and colleagues (2002, 2004), Ruggiero and colleagues (2006) recently examined the efficacy of delivering an evidence-based intervention to disaster victims via the internet. This intervention included modules for PTSD, panic, depression and several types of substance use, including smoking. Preliminary results suggest this type of approach may be relatively sensitive and specific in identifying smokers and participants generally endorsed high levels of satisfaction with the intervention.

researchers in the general substance use – PTSD domain may benefit from developing and examining treatments applicable to cases of PTSD with different types of substance use problems by, for instance, targeting factors (e.g., elevated anxiety sensitivity) that may underlie these different comorbidity types.

General Conclusions and Future Directions

While we have provided brief summaries pertinent to individual areas of the smoking – PTSD/traumatic event exposure literature, we will now consider more general overarching conclusions and general directions for future research in this area.

Methodological Limitations

While this literature is generally characterized by relatively strong methodology in terms of sampling and posttraumatic event-related assessment, two general limitations warrant consideration. First, studies typically have relied exclusively on self-report measures. Although helpful for developing an initial foundation for this research area, its limitations are noteworthy and researchers are now well-positioned to move beyond this approach. Specifically, reliance on self-report measures can result in shared method variance, thereby confounding results. Increased use of additional methods, perhaps in the context of laboratory-based investigations, will strengthen confidence in conclusions drawn regarding smoking-PTSD overlap. For instance, script-driven imagery procedures used in laboratory studies of PTSD (e.g., Pitman et al., 1990) could now be integrated to examine, for example, how nicotine dependence levels relate to PTSD-related psychophysiological reactivity above and beyond general levels of stress-related psychophysiological reactivity.

Second, future investigations may benefit from use of more sophisticated methods for measuring smoking behavior. For instance, few studies have incorporated measures of smoking other than self-report and assessments of frequently smoking rely on one to two global questions (e.g., “Have you increased smoking?”). Supplementing these strategies with biochemical verification, such as cotinine analyses, time-line follow-back interview methods, and more specific smoking-focused assessments would enhance understanding of the parameters of smoking behavior that are linked to posttraumatic stress. For example, assessments can measure number of quit attempts, duration of quit attempts, and withdrawal symptoms experienced during quit attempts, in addition to smoking status and nicotine dependence. Several well-developed research designs that incorporate these types of sophisticated approaches used in studies of the comorbidity between smoking and other types of psychopathology (e.g., Humfleet et al., 2005; Niaura, Britt, Borrelli, Shadel, Abrams, & Goldstein, 1999) could serve as models for this area.

Specificity of the Smoking–Traumatic Event Exposure/PTSD Relations

While it appears clear that smoking commonly occurs with histories of traumatic event exposure and PTSD, there is little evidence speaking to the specificity of this association. Specifically, it is relatively unclear if it is factors specific to PTSD and/or smoking that result in high comorbidity rates. For instance, reactions to the World Trade Center attacks included increases in not only smoking levels, but also other substances (e.g., marijuana use), and these effects were related to depressive episodes as well as PTSD (Vlahov et al., 2002, 2004). This example illustrates the challenge of teasing apart the specificity of the PTSD-smoking association. It may be that persons who develop PTSD are characterized by generally elevated levels of negative affect, and therefore several types of substances are used in attempts to regulate this affect. Alternatively, there may be some aspect of smoking per se that accounts for the association. While a review of the literature on the relation between PTSD and other substance types is beyond the scope of the current discussion, to the best of our knowledge

there has not been a direct test of the specificity of PTSD to smoking and no model has been posited to guide specificity-oriented hypotheses. Similarly, comorbid psychopathology among persons with PTSD may be accounting for PTSD – smoking comorbidity. To date, only limited evidence speaks to the role of comorbid problems, and this is relegated to comorbid depression. While these studies suggest the smoking – PTSD relation may not be entirely attributed to comorbid depression, no other comorbid psychopathology has been examined. For instance, high rates of comorbidity between PTSD and panic disorder (Kessler, Chiu, Demler, & Walters, 2005), which has been linked to smoking (Zvolensky & Bernstein, 2005), necessitate examination of panic as potentially accounting for the smoking-PTSD overlap.

Theory

Additional systematic investigation is now needed to understand factors that affect (i.e., mediators and moderators) the well documented association between PTSD and smoking. While there is limited, mixed data regarding how smoking motives relate to PTSD-relevant factors, there are several other possible factors that need to be explored. For instance, examining how PTSD relates to other smoking motivational processes, such as smoking-related outcome expectancies, will advance this research area. Existing theory regarding substance use-PTSD comorbidity (Stewart & Conrod, 2003) and empirical findings related to smoking-PTSD relations suggest PTSD symptoms and the cognitive, emotional, and behavioral features of PTSD may prevent smokers with PTSD from quitting smoking. Several different characteristics will likely be fruitful foci of study. For instance, research on anxiety sensitivity and PTSD (Taylor, 2003) suggests individuals with PTSD may be highly vigilant for, and sensitive to, interoceptive and exteroceptive cues of anxiety and negative affect and this factor has been linked to problems quitting smoking (Zvolensky, Bonn-Miller, Bernstein, & Marshall, in press). Outside of continued elucidation of specific mediators and moderators, the development of accounts that integrate specific characteristics of PTSD (e.g., high anxiety sensitivity) into models of the processes (e.g., difficulty sustaining smoking quit attempts) that likely underlie high smoking - PTSD/traumatic event exposure comorbidity rates are now needed to guide future research in this area.

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Table 1

Methodological overview of examinations (listed alphabetically) of the relations between smoking and posttraumatic stress disorder.

AUTHOR(S) / YEAR	SAMPLE	MEASURES OF PRIMARY VARIABLES		
		Smoking	Trauma	PTSD
Acierno, Kilpatrick, Resnick, Saunders, & Best, 1996	National household probability sample of adult ($M_{age} = 48.1$ years) women collected in the NWS ($N = 4,008$)	Smoking history: - study specific interview questions	Lifetime and recent assault: - computer-assisted interview	Current and lifetime DSM-III-R PTSD diagnoses: - NWS PTSD and depression modules
Acierno and colleagues, 2000	National household probability sample of adolescents between 12 and 17 years old ($N = 4,023$)	Smoking history: - study specific interview questions	Lifetime experienced or witnessed assault: - study specific questions	Current and lifetime DSM-IV PTSD diagnoses: - Modified NWS PTSD and depression modules N/A
Anda and colleagues, 1999	Adult ($M_{age} =$ approximately 56 years) members of an HMO in southern California ($N = 9,215$)	Early smoking initiation, ever smoked, current and heavy smoking: - Study specific questions	Childhood trauma: - CTS - Wyatt	
Beckham and colleagues, 1995	Male treatment-seeking combat-exposed Vietnam veterans with PTSD ($M_{age} = 45$ years; $N = 124$)	Cigarettes per day and nicotine dependence: - FTQ Reasons for smoking: - Combination of Motives for Smoking Scale and RFS	N/A	PTSD: - SCID-III-R - The Mississippi Scale
Beckham and colleagues, 1996	Treatment-seeking male Vietnam combat veteran ($M_{age} = 46$ years) smokers ($M_{cigarettes\ per\ day} = 31$; $N = 25$)	Smoking withdrawal symptoms: -modified Smoking Withdrawal Questionnaire	N/A	PTSD diagnoses: - Either SCID-III-R or CAPS PTSD Symptoms: - Mississippi Scale
Beckham and colleagues, 1997	Vietnam combat-exposed Veterans with ($N = 381$) and without ($N = 64$) PTSD (total $N = 445$)	Smoking status and levels: - Study specific questions on Likert-type scales Reasons for smoking: - Motives for Smoking Scale	N/A	PTSD diagnoses and symptom levels: -Combinations of the following: SCID for DSM-III-R, CAPS, clinical interview, Mississippi Scale, Combat Exposure Scale
Beckham and colleagues, 2004	Adult ($M_{age} = 49$ years) male combatexposed Vietnam veterans with ($N = 61$) and without ($N = 56$) PTSD (total $N = 117$)	Smoking status, levels, and timing: - Study specific questions	Combat exposure: - Combat Exposure Scale	PTSD diagnoses: - SCID for DSM-III-R PTSD symptoms: - Mississippi Scale
Beckham and colleagues, 2005	Adult ($M_{age} = 44$ years) smokers ($M_{cigarettes\ per\ day} =$ approximately 21) with ($N = 63$) and without ($N = 32$) PTSD recruited from the community (total $N = 95$)	Nicotine dependence: - Smoking histories questionnaire - FTQ	N/A	PTSD diagnoses and symptoms: - CAPS - Davidson Trauma Scale
Boscarino, 2006	15,288 Vietnam era U.S. Army veterans from the Vietnam Era Survey who contacted via telephone between 1985 and 2000	- Study specific structured telephone interview administered by the Research Triangle Institute	N/A	- Validated study-specific structured telephone interview administered by the Research Triangle Institute
Breslau, Davis, & Schultz, 2003	Epidemiologically defined sample of young adults (age 21 to 30 at baseline) followed across a 10-year follow-up period from 1989 to 1999 ($N = 899$)	Nicotine dependence: - DIS for DSM-III-R	Trauma exposure: - DIS for DSM-III-R	PTSD: - DIS for DSM-III-R
Breslau, Novak, & Kessler, 2004	Adults who participated in the NCS ($N = 4,411$)	Onset of daily smoking and nicotine dependence: - DIS for DSM-III-R	N/A	Lifetime and current PTSD diagnoses: - DIS for DSM-III-R
Buckley, Susannah, Bedard, Dewulf, & Greif, 2004	Review of medical records from 1996 – 2002 in VA PTSD clinic ($N = 826$)	Smoking status: - HRA	N/A	PTSD: - CAPS or SCID-IV

AUTHOR(S) / YEAR	SAMPLE	MEASURES OF PRIMARY VARIABLES		PTSD
		Smoking	Trauma	
Dobie and colleagues (2004)	Adult women ($M_{age} = 45$ years) receiving outpatient services at a VA facility in the Northwestern United States ($N = 1,206$)	Smoking status: - Study specific survey question	N/A	Past month PTSD screen: - PCL-C (diagnostic cutpoint ≥ 50)
Feldner and colleagues, in press	Daily smokers (at least 5 cigarettes per day) with exposure to at least one traumatic event that met criterion A for PTSD defined by DSM-IV-TR ($N = 100$)	Smoking status and level: - FTQ Reasons for Smoking: - RFS	Trauma exposure: - PDS	Past month PTSD symptoms: - PDS Likely diagnoses of PTSD: - PDS
Ganz, 2000	Random, stratified probability sample of adults in Central Harlem, New York from between 1992 and 1994 ($N = 695$)	Smoking status: - Study specific question	Trauma exposure: - Study specific questionnaire	N/A
Gleser, Green, & Winget, 1981	Survivors of the Buffalo Creek flood of 1972, occurring in West Virginia, who filed law suits for psychological distress and responding to a questionnaire survey ($N = 143$)	Smoking status: - Checklist for Family Disruption Indicators - Psychosocial Disruption Checklist	Trauma: - Living in the Buffalo Creek valley during the time of the flood.	N/A
Hapke and colleagues, 2005	Random sample of adults aged 18–64 in northern German cities ($N = 4,075$)	Nicotine dependence: - Munich CIDI Smoking quit rate: - Percentage of “ever smokers” not smoking in most recent 4 weeks	Trauma: - Munich CIDI - Trauma checklist	PTSD diagnoses: - Munich CIDI
Hertzberg, Moore, Feldman, & Beckham, 2001	Smoking-focused treatment-seeking adult ($M_{age} = 50$ years) daily smoking ($M_{cigarettes\ per\ day} = 33$) male Vietnam veterans ($N = 15$)	Smoking status: - Self-report and expired carbon monoxide analysis	N/A	PTSD diagnoses: - CAPS PTSD symptoms: - Davidson Trauma Scale
Joseph, Yule, Williams, & Hodgkinson, 1993	Adult ($M_{age} = 35$ years) survivors of a 1987 ferry accident that killed 193 of approximately 600 people on board	Change in smoking level: - Study specific question		PTSD avoidance and intrusive symptoms: - IES
Kaplan and colleagues, 1998	Caucasian adolescents (age range = 12 – 18 years) from Long Island, NY, who had ($N = 99$; Median age = 16) or had not ($N = 99$; Median age = 15) been physically abused. Abused youth drawn from the NY State Department of Social Services Register for Child Abuse between 1989 and 1991	Smoking status: - Measure not identified	Abuse histories: - CTS	PTSD diagnoses: - SCID for DSM-III-R
Koenen and colleagues, 2003	Monozygotic male-male twin pairs who served in the military during Vietnam war era from the VET Registry ($N = 1,874$ pairs)	Lifetime dependence: - DIS-III-R	Combat exposure: - Study specific interview	Lifetime PTSD: - DIS-III-R
Koenen and colleagues, 2005	VET Registry described above	Lifetime tobacco dependence onset: - DIS-III-R	Combat exposure: - Study specific interview	Lifetime PTSD onset: - DIS-III-R
Lasser and colleagues, 2000	Adults ranging in age between 15 and 54 years who participated in the NCS ($N = 4,411$)	Smoking status: - CIDI Smoking quit rate: - Proportion of lifetime smokers not currently smoking	N/A	Current or lifetime PTSD diagnoses: - CIDI
Lemon, Verhoek-Oftedahl, & Donnelly, 2002	Random sample of adult (18 – 54 years) women from Rhode Island ($N = 1,561$)	Smoking status: - Study specific questions	IPV: - Study specific questions	N/A

AUTHOR(S) / YEAR	SAMPLE	MEASURES OF PRIMARY VARIABLES		
		Smoking	Trauma	PTSD
Lipschitz and colleagues, 2003	Inner-city adolescent ($M_{\text{age}} = 17.2$) trauma-exposed girls consecutively recruited from medical clinics after routine appointments ($N = 104$)	Smoking status and level: - Personal Experience Screening Questionnaire	DSM-IV-defined trauma exposure: - Child Exposure to Violence Checklist	PTSD Diagnoses: - K-SADS-PL Past month DSM-IV-defined PTSD Symptoms: - Child and Adolescent PTSD Checklist PTSD: - CAPS PTSD Symptoms: - Davidson Trauma Scale
McCleron and colleagues, 2005	Adult ($M_{\text{age}} = 44$) trauma-exposed smokers ($M_{\text{cigarettes per day}} = 22$) with current ($N = 74$), or no lifetime history of ($N = 36$), PTSD (total $N = 110$)	Nicotine dependence: - FTND Anticipated pleasure from smoking: - Questionnaire on Smoking Urges	N/A	DSM-IV defined PTSD diagnoses: - measure not specified PTSD symptoms: - PTSD Checklist
McFall and colleagues, 2005	Treatment-seeking adult ($M_{\text{age}} = 52$ years) primarily male (92%) veteran daily smokers (≥ 10 cigarettes per day) who had been smoking for about 31 years with chronic PTSD ($N = 66$) recruited from a PTSD clinic who expressed willingness to participate in smoking cessation treatment	Nicotine dependence: - FTND Smoking abstinence: - Self-report and expired carbon monoxide analysis	N/A	DSM-IV defined PTSD diagnoses: - measure not specified PTSD symptoms: - PTSD Checklist
Mezey, Evans, & Hobbell, 2002	Primarily female (89%) adult ($M_{\text{age}} = 45$ years) family members ($N = 35$) of homicide victims who had received help from a national charity for crime victims in England	Change in smoking level: - Unidentified study specific question	Identified as trauma victims via receipt of charity from a charity for crime victims	N/A
Nandi, Galea, Ahern, & Vlahov, 2005	Random sample of adults ($M_{\text{age}} = 42.6$ years) living in New York city interviewed four months after the September, 2001 attacks on the World Trade Center ($N = 2,001$)	DSM-IV-defined nicotine dependence: - National Survey on Drug Use and Health Interview Smoking status and level: - Study specific questions	Trauma exposure: - Study specific interview questions	DSM-IV-defined PTSD: - NWS PTSD module
Op den Velde and colleagues, 2002	Older adult (ages 60 to 65 years) male veterans of the Dutch Civilian Resistance against the Nazi occupation of The Netherlands with ($N = 72$) and without PTSD ($N = 53$; total $N = 125$)	Smoking status: - Study specific question	N/A	PTSD: - Dutch version of the PTSD portion of the SCID for DSMIII-R
Pawlak & DeFronzo, 1993	Adults ($M_{\text{age}} = 43.1$) who participated in the national 1988 General Social Survey ($N = 595$)	Smoking status: - Study specific question	Trauma exposure: - Study specific questions	N/A
Perkonig, Kessler, Storz, & Wittchen, 2000	Adolescent and young adults (aged 14 to 24 years) in metropolitan Munich ($N = 3,021$)	DSM-IV-defined nicotine dependence onset: - Munich CIDI	DSM-IV-defined trauma exposure: - Munich CIDI	Onset of DSM-IV-defined PTSD: - Munich CIDI
Pfefferbaum and colleagues, 2002	Support-seeking persons after the 1995 Oklahoma City bombing were examined approximately 6 months after the bombing ($N = 84$)	Smoking status and change in smoking: - Study specific question	Trauma exposure: - Study specific questions	PTSD symptoms: - IES-R
Schnurr and Spiro, 1999	Older-adult ($M_{\text{age}} = 65$ years) male combat veterans ($N = 921$) from the Boston VA Normative Aging Study	Smoking status: - Self-reported yes/no question	Trauma exposure: - Combat Exposure Scale	PTSD: - The Mississippi Scale
Shalev, Bleich, & Ursano, 1990	Lebanon War Combat exposed adult veterans with ($N = 50$) and without ($N = 48$) PTSD (total $N = 98$)	Smoking status: - Unidentified medical symptoms questionnaire	N/A	PTSD: - Unidentified clinical interview

AUTHOR(S) / YEAR	SAMPLE	MEASURES OF PRIMARY VARIABLES		
		Smoking	Trauma	PTSD
Smith, Christiansen, Vincent, & Hann, 1999	Random sample of adults (overall $M_{age} =$ approximately 43 years) interviewed between 1995 and 1996. Participants were residents of the Oklahoma City metropolitan area ($N = 2,030$) after the bombing of the Murrah Federal Building in Oklahoma City in 1995 and residents of the Indianapolis metropolitan area ($N = 1,152$)	Smoking status, initiation, and change in level: - Study specific questions	Trauma exposure: - Study specific questions	PTSD symptoms: - Study specific questions
Thorndike, Wernicke, Pearlman, & Haaga, 2006	Relations between nicotine dependence levels, PTSD symptoms, and gender among daily (at least 10 cigarettes per day; $M = 17$) smokers recruited from the community ($M_{age} = 41$ years; $N = 157$)	Nicotine dependence: -FTND	N/A	PTSD diagnoses: - SCID for DSM-IV PTSD Symptoms: - PDS
Vest, Catlin, & Brownson, 2002	Random sample of adult (≥ 18 years old) women from Connecticut, Massachusetts, Montana, New York, Ohio, Pennsylvania, and Washington ($N = 18,415$) collected between 1995 and 1999 in the BRFSS	Smoking status: - Study specific question	Trauma exposure: - Study specific questions	N/A
Vlahov and colleagues, 2002	Random sample of adult ($M_{age} = 42$) residents of Manhattan, near the terrorist attacks on the World Trade Center ($N = 988$), interviewed 5 to 8 weeks after attack	Smoking status and level: - Computer-assisted study specific interview questions	Trauma exposure: - Computer-assisted study-specific interview questions	DSM-IV-defined PTSD diagnoses and symptoms: - Computer-assisted modified DIS
Vlahov and colleagues, 2004	Random sample of adult ($M_{age} = 42$) residents of entire New York City metropolitan area interviewed 6 to 9 months after attack on the World Trade Center ($N = 1570$)	Smoking status and level: - Study specific interview questions	Trauma exposure: - Study-specific interview questions	DSM-IV-defined PTSD diagnoses and symptoms: - Computer-assisted modified DIS
Weaver & Etzel, 2003	Adult ($M_{age} = 34$ years) victims of severe battering ($N = 62$) recruited from social service agencies (e.g., domestic violence shelters, advocacy agencies)	Nicotine dependence: - FTND	IPV: - Revised CTS - Psychological Maltreatment of Women Inventory	PTSD symptom levels: - PDS
Weinbaum and colleagues, 2001	Random sample of females in California ($N = 3,408$) from the 1998 California Women's Health Survey	Smoking status: - Computer assisted interview	Intimate partner physical domestic violence: - Modified CTS	N/A

Note: PTSD = Posttraumatic Stress Disorder, ND = Nicotine Dependence, IPV = Interpersonal Violence, IPP-DV = intimate partner physical domestic violence, DSM = Diagnostic and Statistical Manual (APA, 1980, 1987, 1994). **Datasets** VA = Veterans Affairs, NCS = National Comorbidity Survey (NCS; Kessler et al., 1994), BRFSS = Behavioral Risk Factor Surveillance System (Remington et al., 1988), VET Registry = Vietnam Era Twin Registry (Eisen et al., 1987), Boston Veterans Affairs Normative Aging Study (Bosse et al., 1984), NWS = National Women's Study (Resnick et al., 1993).

Smoking, PTSD, and Trauma Measures HRA = Health Risk Appraisal (HRA; University of Michigan, 1996), FTND = Fagerstrom Test for Nicotine Dependence (FTND; Heatherton et al., 1991), FTQ = Fagerstrom Tolerance Questionnaire (Fagerstrom, 1978), K-SADS- PL = Schedule for Affective Disorders and Schizophrenia for School Aged Children – Present and Lifetime version (Kaufman et al., 1997), DIS = Diagnostic Interview Schedule (DIS; Robins et al., 1981), Personal Experience Screening Questionnaire (Winters, 1991), CIDI = Composite International Diagnostic Interview (CIDI; World Health Organization Version 1.0), modified Smoking Withdrawal Questionnaire (Shiffman & Jarvik, 1976), RFS = Reasons for Smoking questionnaire (Ikard et al., 1969), SCID = Structured Clinical Interview (Spitzer & Williams, 1989), ADIS = Anxiety Disorders Interview Schedule (DiNardo et al., 1983), ADIS-IV = Anxiety Disorders Interview Schedule (Brown et al., 1994), CAPS = Clinician Administered PTSD scale (Blake et al., 1995), PCL-C = PTSD Checklist Civilian Version (Weathers & Ford, 1996), PDS = Posttraumatic Diagnostic Scale (Foa, 1995), CTS = Conflict Tactics Scale (Straus,

1979), Maltreatment of women inventory (Tolman, 1999), Mississippi Scale = The Mississippi Scale for Combat-Related PTSD (Keane et al., 1988), Davidson Trauma Scale (Davidson et al., 1997), IES-R = Impact of Events Scale – Revised (Weiss & Marmar, 1997), CES = Combat Exposure Scale (Keane et al., 1989).

Table 2

Synopsis of Results from Studies of Smoking and PTSD (Listed Alphabetically)

Author(s)/ Year	Analytic Approach	Results
Acierno et al., 1996	Logistic Regression	Those with lifetime PTSD (OR = 2.25) or assault (OR = 2.12) were more likely to smoke compared to those without history of PTSD or assault.
Acierno et al., 2000	Univariate Analyses Stepwise Regression	Witnessing violence, assault, depression, PTSD increased likelihood of current smoking (OR ranging between 2.10 and 4.52). For boys, physical assault (OR = 2.07) and witnessing violence (OR=2.45) increased risk for smoking. For girls, physical (OR = 2.71) and sexual abuse (OR = 2.28) as well as witnessing violence (OR = 2.53) increased likelihood of smoking.
Anda et al., 1999	Logistic Regression	Point prevalence of smoking was 14% among those exposed to childhood trauma. All types of adverse childhood experiences increased risk for smoking (OR range = 1.3 – 3.9).
Beckham et al., 1995	Descriptive Stepwise Logistic Regression Stepwise Regression	Prevalence of smoking was 60% with the following breakdown: 26% smoke < 20 cigs/day; 34% smoke 21–25 cigs/day; 40% smoke > 25 cigs/day. Smokers reported more PTSD symptoms than non-smokers after controlling for combat exposure. Depressive symptom level was the only significant predictor of automatic smoking motives and there were no other significant predictors for other smoking motives.
Beckham et al., 1996	Analysis of Variance	Analyses suggested greater levels of craving, affect, somatic, and lack of alertness withdrawal symptoms followed naming of trauma-relevant word cards than neutral word cards.
Beckham et al., 1997	Chi Square Hierarchical Regression	Those with, versus without, PTSD were more likely to be heavy smokers (48% versus 28%, respectively). Heavy smoking (≥ 25 cigarettes per day) was associated with increased total, avoidance, and hyperarousal symptoms of PTSD. PTSD predicted greater indulgent, addictive, automatic, and tension reduction motives. Smoking status [heavy versus light-moderate (< 25 cigarettes per day)], which significantly predicted all smoking motives except for indulgent, did not moderate the association between PTSD and smoking motives.
Beckham et al., 2005	Generalized Estimating Equations	After controlling for psychiatric and cardiac medications and lifetime histories of major depression, smokers with PTSD were more likely to smoke in the presence of the following cues: negative affect (OR = 1.42), positive affect (OR = 1.58), total PTSD symptoms (OR = 1.48), reexperiencing symptoms (OR = 1.71), hyperarousal symptoms (OR = 1.45), while interacting with others (OR = 1.53), and restlessness (OR = 1.69). No affect-related factors were associated with smoking among those without PTSD.
Beckham et al., 2004	Mixed Regression Generalized Estimating Equations	Among those with PTSD, DBP was higher for smokers ($M = 81$) versus nonsmokers ($M = 76$), whereas for those without PTSD, smokers ($M = 78$) had lower DBP levels than nonsmokers ($M = 83$). In terms of MAP, among those with PTSD, smokers ($M = 98$) had higher MAP levels than nonsmokers ($M = 93$), whereas for those without PTSD, smokers ($M = 93$) had lower levels than nonsmokers ($M = 96$). In terms of positive affect, among those with PTSD, smokers reported greater positive affect ($M = 2.09$) than nonsmokers ($M = 1.97$), whereas among those without PTSD smoking status was not related to positive affect. A similar pattern of findings emerged when smoking level was examined rather than smoking status. Also, smokers with, versus without, PTSD, had higher DBP, MAP, and anger/hostility ratings as well as lower positive affect ratings. Among those without PTSD, smoking within the past 30 minutes was associated with lower anxiety/depression ratings compared to not smoking within the past 30 minutes. However, this pattern did not emerge among smokers with PTSD.
Boscarino, 2006	Chi Square	Vietnam theater veterans were significantly heavier smokers, as defined by 19+ pack years, than Vietnam era veterans (34% versus 31%, respectively). Vietnam veterans with PTSD were heavier smokers than those without PTSD (38% versus 32%, respectively).
Breslau et al., 2003	Logistic Regression Cox Proportional Hazards Modeling	Compared to persons with no trauma history (10%), persons with PTSD (31%) were approximately four times more likely (OR = 3.30), and those with trauma exposure only were twice as likely (OR = 1.81) to become nicotine dependent. The difference in risk between the trauma exposed and PTSD groups also was statistically significant. Lifetime data collected at the baseline interview suggested PTSD was associated with a significantly increased likelihood of nicotine dependence onset [adjusted hazards ratio (AHR) = 1.83], whereas trauma exposure alone was associated with increased risk.
Breslau et al., 2004	Logistic Regression	Those with a lifetime history of PTSD (OR = 2.1), regardless of whether the diagnosis was “active” at the time of the interview (OR = 2.0) or past (OR = 2.5) were significantly more likely than those without PTSD to begin daily smoking. Similarly, active smokers with a lifetime history of PTSD (OR = 1.7) were significantly more likely than those without this diagnosis to

Author(s)/ Year	Analytic Approach	Results
Buckley et al., 2004	Chi Square	transition to nicotine dependence, although this pattern was only observed for active diagnoses (OR = 2.1). No anxiety or mood disorder predicted smoking persistence.
	Descriptive	Higher rates of smoking among those with PTSD (45%) than the general population (22%).
Dobie et al., 2004	Logistic Regression	Smokers with PTSD were heavy smokers, 73% smoke one or more packs a day.
Feldner et al., in press	Hierarchical Regression	After controlling for age, women screening positive for PTSD were (OR = 2.0) more likely to endorse smoking during the past year (39%) than those screening negative (22%).
	Analysis of Variance	After controlling for daily smoking level and gender, higher levels of posttraumatic stress symptoms were associated with smoking to reduce negative and smoking for stimulation, but not other smoking motives.
Ganz, 2000	Logistic Regression	Persons who likely met PTSD criteria endorsed significantly higher levels of smoking to reduce negative affect than those not meeting criteria.
	Chi Square	Lifetime trauma was significantly related to increased likelihood of current smoking, but not number of cigarettes smoked/day.
Gleser et al., 1981	Descriptive	Higher levels of trauma exposure were observed among smokers ($M = 1.6$ events) than nonsmokers ($M = 1.1$ events). Persons endorsing exposure to the following traumas were significantly more likely to be current smokers: accident, physical abuse, serious mugging.
Hapke et al., 2005	Logistic Regression	44% increased smoking by 2 years post-disaster. Compared to those without trauma exposure (58% ever-smokers; 36% current-smokers; 19% ever nicotine dependent; 10% currently nicotine dependent; 46% remitted nicotine dependent), significantly higher rates of ever-smoking, current smoking, ever being nicotine dependent, and current nicotine dependence were observed among trauma-exposed individuals both with (75%, 60%, 39%, and 33%, respectively) and without (64%, 39%, 26%, and 14%, respectively) PTSD (ORs ranging from 1.20 to 4.52). When these analyses were conducted as a function of gender, the pattern of results was comparable for women, but among men trauma exposure with or without PTSD only predicted current nicotine dependence (ORs = 4.26, 1.39, respectively) and trauma exposure predicted lifetime nicotine dependence (OR = 1.39). Regarding specificity to trauma type, results demonstrated the highest likelihood for smoking ($OR_{\text{ever}} = 3.52$; $OR_{\text{current}} = 3.4$) and nicotine dependence ($OR_{\text{current}} = 5.10$) was among rape victims, with similar odds ratios emerging for those sexually abused. Compared to persons not exposed to a traumatic event, those who witnessed a traumatic event or who had a "terrible experience" during a war were not significantly more likely to smoke or be nicotine dependent. Compared to those who had not been exposed to trauma (37%), the smoking quit rates were significantly (OR = .38) lower among those with PTSD (19%), but not trauma exposed without PTSD (38%). The presence of PTSD (13%), but not trauma exposure alone (46%), also predicted significantly lower rates of remitted nicotine dependence (OR = .18) compared to those not exposed to trauma (46%).
Hertzberg et al., 2001	Descriptive	80% of participants in the bupropion condition quit smoking by week 2, 6 (60%) remained abstinent at the 12-week comparison, and 4 (40%) were abstinent at the 6-month follow-up. One participant (20%) in the placebo control group quit by week 2 and remained abstinent through the 6-month follow-up period.
	Repeated Measures Analysis of Variance	There were no significant changes in PTSD symptoms, depression, or state anxiety.
Joseph et al., 1993	Descriptive	By 6-months post-disaster (Time 1), 34% increased cigarette consumption a lot, 10% a little, and 56% endorsed no change. By 18-months post-disaster (Time 2), 23% increased smoking a lot, 16% a little, and 61% reported no change.
	Correlation Analysis of Variance	Neither gender nor age was related to these reported changes in cigarette use. Significantly less of an increase reported at Time 2 ($M = 1.61$) relative to Time 1 ($M = 1.75$). Those bereaved in the accident were more likely to use cigarettes at Time 2. Those reporting (a little to a lot of) increased use endorsed higher intrusion ($M = 22.8$) and avoidance ($M = 20.9$) symptoms than those not increasing cigarette use (16.3 and 13.3, respectively).
Kaplan et al., 1998	Chi Square	Significantly more of the abused group reported lifetime ($N = 42$; 42%) and current ($N = 36$; 36%) smoking than the non-abused group [$N = 13$ and 13 (13%), respectively].
	Logistic Regression	After controlling for other risk factors (e.g., one biological parent in the home, female gender, greater age), physical abuse was associated with a significantly greater likelihood of both lifetime (OR = 3.84) and current (OR = 3.27) smoking relative to non-abuse.
Koenen et al., 2005	Logistic Regression	Compared to veterans not exposed to trauma (40%), more of those exposed to trauma with (71%; OR = 2.34) or without (52%; OR = 1.31) PTSD were nicotine dependent. Among 6% ($n = 416$) of sample who were both nicotine dependent and had PTSD, nicotine dependence onset ($M_{\text{age}} = 24.0$) preceded

Author(s)/ Year	Analytic Approach	Results
		PTSD onset ($M_{age} = 24.2$) in 46.2% of the sample, while the opposite was true in 47.1%. Nicotine dependence occurred after trauma exposure but before PTSD for 6% of participants. Among nicotine dependent persons exposed to trauma without developing PTSD (18%; $N = 1,255$), trauma preceded nicotine dependence among 57% and nicotine dependence was primary for 43%. Among those not nicotine dependent pre-trauma, trauma exposure without PTSD did not increase likelihood of later nicotine dependence.
	Cox Proportional Hazards Modeling	Among trauma-exposed persons without nicotine dependence prior to PTSD onset, PTSD increased the likelihood of later nicotine dependence ($OR = 1.73$). Among those not exposed to trauma prior to nicotine dependence, such dependence did not increase the likelihood of trauma exposure ($OR = .94$), whereas nicotine dependent individuals were twice as likely ($OR = 2.24$) to meet criteria for PTSD after trauma exposure.
	Bivariate Twin Modeling/ Tetrachoric Correlations	Significant genetic and individual-specific environmental factors ($X^2_{14} = 5.57$; $P = .98$). Approximately 62% of association between PTSD and nicotine dependence was accounted for by shared genetic factors and the remaining 38% by individual-specific environmental factors.
Koenen et al., 2003	Logistic Regression	Among those not nicotine dependent pre-trauma, trauma exposure without PTSD did not increase the likelihood of later nicotine dependence onset. Among trauma-exposed persons without nicotine dependence prior to PTSD onset, PTSD increased the likelihood of subsequent nicotine dependence ($OR = 1.73$). Among those not exposed to trauma prior to nicotine dependence, such dependence did not increase the likelihood of trauma exposure ($OR = .94$), whereas nicotine dependent individuals were twice as likely ($OR = 2.24$) to meet criteria for PTSD after trauma exposure.
Lasser et al., 2000	Chi Square	Of those with a lifetime history of PTSD, more were current smokers (45.3%) and lifetime smokers (63.3%) than those without mental illness (22.5% and 39.1%, respectively). Of those with PTSD within the last month, more were current (44.6%) and lifetime (58.1%) smokers compared to persons without mental illness. The smoking quit rate was significantly lower for participants with lifetime diagnoses of PTSD than for participants without mental illness (28.4% vs. 42.5%). Similarly, those with past-month diagnoses of PTSD evidenced a significantly lower quit rate (23.2%) than those without mental illness in the past month (42.5%).
Lemon et al., 2002	Descriptive Logistic Regression	Current smoking rates among those who had experienced physical or sexual IPV, psychological IPV, and no IPV were 44%, 34%, and 23%, respectively. Physical or sexual IPV, but not psychological IPV, is associated with higher smoking rates relative to those without such histories ($OR = 2.07$).
Lipschitz et al., 2003	Descriptive	Approximately 41% of girls smoked cigarettes and 92% of endorsed experiencing at least one DSM-IV-defined (APA, 1994) traumatic event and 74% reported experiencing two or more events ($M = 3.05$). Of girls reporting traumatic event exposure, 15% met criteria for PTSD, 8% endorsed partial PTSD (defined as at least 1 reexperiencing and avoidance symptom and 2 hyperarousal symptoms), and the most frequent traumas endorsed were sexual abuse or assault (22%), vicarious trauma (i.e., hearing about the homicide of a close friend or relative; 22%), witnessing community violence (21%), and witnessing family violence (18%).
	Chi Square	Of traumatic event-exposed girls, a greater proportion of those with (86%) versus without (31%) PTSD smoked.
	Logistic Regression	High levels of PTSD symptoms ($OR = 1.11$) and trauma exposure ($OR = 1.24$) significantly predicted smoking level.
McClernon et al., 2005	Analysis of Covariance	After controlling for nicotine dependence and current MDD, the PTSD group ($M = 35$ ml) had significantly larger puff volumes than the non-PTSD group ($M = 29$ ml). A script by PTSD group interaction in terms of puff onset suggested the non-PTSD group had significantly shorter intervals for puff onset following the trauma-relevant ($M = 29$) versus neutral ($M = 37$) script, whereas among the PTSD group, there were no differences ($M = 34$ and 35, respectively). There were no differences in terms of number of puffs.
McFall et al., 2005	Generalized Estimating Equations	Controlling for nicotine dependence and depressive symptoms, the integrated treatment significantly ($OR = 5.23$) improved smoking cessation rates at the 2, 4, 6, and 9 month follow-up assessments. At the nine-month follow-up, 19% of those receiving integrated care were abstinent versus 8% of those receiving standard care. Differences in repeated 7-day point prevalence abstinence rate between the integrated care (12%) and usual care (3%) were nonsignificant. Changes in PTSD symptoms levels were nonsignificant among both groups.
Mezey et al., 2002	Descriptive	17 (48%) participants (94% of smokers), reported smoking more than prior to the homicide.
Nandi et al., 2005	Descriptive Chi Square	36% of smokers reported an increase in cigarette use. Nicotine dependent persons were more likely to meet criteria for PTSD (18%) than non-dependent persons (5%). Among both nicotine dependent and non-dependent persons, those reporting increased cigarette use were more likely to meet criteria for PTSD (23% and 15%, respectively) than not

Author(s)/ Year	Analytic Approach	Results
Op den Velde et al., 2002	Logistic Regression	(6% and 5%, respectively). In terms of trauma-related factors, the following were significantly associated with increased likelihood of nicotine dependence: life stressors prior to attacks (OR = 1.7 for 2 or more versus 0); high media exposure (OR = 2.0 relative to low exposure); being directly affected by the attacks (OR = 1.6 relative to no direct effect). High smoking levels and trait anxiety significantly predicted PTSD. A significant interaction suggested a stronger association between trait anxiety and PTSD among non-smokers than smokers.
Pawlak & DeFronzo, 1993	Hierarchical Regression Analysis	Measures of religious beliefs, commitment, attachment, involvement, and moral conformity explained 8% of the variance in adult smoking. When childhood trauma was added, variance explained significantly increased to 9.7%.
Perkonig et al., 2000	Cox Proportional Hazards Modeling	Trauma (27%; $N = 43$) and PTSD (21%; $N = 7$) preceded nicotine dependence among fewer cases with onset of nicotine dependence occurring in the same year as trauma exposure among 12% ($N = 19$) of participants and among 6% ($N = 2$) of comorbid cases. Time-lagged effects in terms of age of onset patterns were examined using Cox proportional hazards models that adjusted for age, gender, and social class. The presence, relative to absence, of previous nicotine dependence increased the likelihood of subsequent trauma exposure (AHR = 1.77), but not PTSD among the entire sample or among a subsample of trauma-exposed participants. Prior trauma (AHR = 1.80), PTSD (AHR = 4.26), and PTSD in the traumaexposed subsample (AHR = 2.84), even after also controlling for trauma-related characteristics (e.g., trauma type, repeated trauma exposure; AHR = 2.50), all increased the likelihood of later age of onset of nicotine dependence.
Pfefferbaum et al., 2002	Multivariate Analysis of Variance	Smokers who increased use after the attack reported higher level of PTSD symptoms ($M = 68.5$) than those who did not increase ($M = 35.5$) and nonsmokers ($M = 50.0$). Smokers who increased smoking also reported significantly greater functional impairment ($M = 1.8$) compared to smokers who did not increase ($M = 0.5$) and nonsmokers ($M = 0.9$), which did not significantly differ. Finally, participants who reported an increase in either smoking or drinking ($N = 21$), compared to all others ($N = 63$), endorsed higher levels of peritraumatic reactions, grief, posttraumatic stress symptoms, worry about safety, and functional impairment.
Schnurr & Spiro, 1999	Regression	Smoking was positively associated with combat exposure and PTSD symptom levels.
Shalev et al., 1990	Chi Square	Persons with PTSD were significantly more likely to be smokers than those without PTSD (66% versus 37%, respectively).
	Analysis of Variance	Smokers with PTSD smoked significantly more than those without PTSD ($M = 32$ versus $M = 20$ cigarettes per day, respectively).
Smith et al., 1999	Descriptive	Oklahoma city residents reported higher rates of (1) trauma exposure, (2) PTSD symptoms, (3) smoking, (4) increased smoking, and (5) smoking initiation compared to Indianapolis residents.
Thorndike et al., 2006	Regression	Among men, nicotine dependence levels were positively associated with total PTSD symptoms as well as the hyperarousal, avoidance, and reexperiencing symptoms, even after statistically controlling for depression proneness and past history of major depressive episodes among men. These relations were not apparent among women.
Vest et al., 2002	Logistic Regression	Smokers were twice as likely to report IPV histories compared to nonsmokers (OR = 2.24).
Vlahov et al., 2002	Chi Square	Diagnoses of PTSD were more common among those who increased cigarette use (24%) compared to those who did not increase use (5%). Of those increasing use, increases were approximately 20 cigarettes per week.
	Logistic Regression	In terms of trauma-related factors, the following were associated with increased cigarette use: closer proximity to attack (OR = 2.3); traumatic event prior to attacks (OR = 2.5 for 1 versus 0 events; OR = 4.0 for more than 2 versus 0 events); fear of injury or death during attack (OR = 1.8 to no fear) peri-event panic (OR = 4.6 relative to no panic); post-attack job loss (OR = 2.5 relative to no job loss); high media exposure (OR = 1.8 relative to low exposure).
Vlahov et al., 2004	Chi Square	There were significantly more cases of PTSD among those who increased (4%) smoking versus those who did not increase (1%).
	Logistic Regression	The following variables were significantly associated with increased cigarette use: male gender (OR = 0.6 for females relative to males); high social support (OR = 0.3 for low relative to high levels of social support); traumatic events during year prior (OR = 2.3 for 2 or more events compared to 0); job loss (OR = 3.9 relative to no job loss).
Weaver et al., 2003	Descriptive	58% were current smokers, 50% smoked < 10 cigs/day; 43% were nicotine dependent.
	Regression	Nicotine dependence was positively related to severity of sexual coercion, trauma dominance/isolation, reexperiencing, and arousal symptoms.
Weinbaum et al., 2001	Logistic Regression	Victims of IPP-DV were more likely current smokers than nonvictims (OR = 2.1).

Note: DBP=Diastolic Blood Pressure MAP=Mean Arterial Pressure MDD=Major Depressive Disorder.

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