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Smoking status and exercise in relation to PTSD symptoms: A test among trauma-exposed adults

Anka A. Vujanovic [a,*], Samantha G. Farris [b], Christopher B. Harte [c], Jasper A.J. Smits [d], Michael J. Zvolensky [b]

[a] University of Texas Health Science Center at Houston, Medical School – Department of Psychiatry and Behavioral Sciences, 2800 South MacGregor Way, Houston, TX 77021, USA
[b] University of Houston, Department of Psychology, 126 Heyne Building, Houston, TX 77204-5502, USA
[c] VA Boston Healthcare System, 150 South Huntington Avenue, Boston, MA 02130, USA
[d] Southern Methodist University, Department of Psychology, 6116 N. Central Expressway, Suite 1100, Dallas, TX 75206, USA

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ABSTRACT

The present investigation examined the interactive effect of cigarette smoking status (i.e., regular smoking vs. non-smoking) and weekly exercise (i.e., weekly metabolic equivalent) in terms of posttraumatic stress (PTSD) symptom severity among a community sample of trauma-exposed adults. Participants included 86 trauma-exposed adults (58.1% female; M_{age} = 24.3). Approximately 59.7% of participants reported regular (≥10 cigarettes per day) daily smoking over the past year. The interactive effect of smoking status by weekly exercise was significantly associated with hyperarousal and avoidance symptom cluster severity ($p \leq .05$). These effects were evident above and beyond number of trauma types and gender, as well as the respective main effects of smoking status and weekly exercise. Follow-up tests indicated support for the moderating role of exercise on the association between smoking and PTSD symptoms, such that the highest levels of PTSD symptoms were observed among regular smokers reporting low weekly exercise levels. Theoretical and clinical implications of the findings are discussed.
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The relations among tobacco use, traumatic event exposure, and posttraumatic stress disorder (PTSD[1]) symptoms have been well-established (Feldner, Babson, & Zvolensky, 2007; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). For example, across populations, trauma-exposed individuals are more likely to be current smokers (e.g., Acierno, Kilpatrick, Resnick, & Saunders, 1996), smoke at higher rates (Beckham et al., 1995), and evidence greater levels of nicotine dependence (McClernon et al., 2005), as compared to individuals without clinical *or* subclinical PTSD. Likewise, higher smoking rates and greater levels of nicotine dependence are related to an increased risk for PTSD symptoms among trauma-exposed persons (e.g., Beckham, Feldman, Kirby, Hertzberg, & Moore, 1997). Although smoking and PTSD symptoms commonly co-occur and appear to influence one another, there has been little work focused on factors that may moderate these relations. Elucidating potential protective factors with respect to smoking-PTSD relations has important clinical implications for prevention and intervention efforts.

One such possible moderator of smoking-PTSD associations is exercise. There is a large and diverse empirical literature demonstrating the positive effects of exercise among the general population and many chronic medical populations (e.g., chronic fatigue syndrome, chronic obstructive pulmonary disease, cardiovascular disease, cancer) in regard to improving physical symptoms of fatigue, pain, and dyspnea (e.g., Mostert & Kesselring, 2002). Other work has found that increased exercise can decrease depression and anxiety symptoms, as well as improve positive affect among the general population and many chronic medical populations (Emery, Schein, Hauck, & MacIntyre, 1998; Ströhle et al., 2007). Indeed, population-based studies and well-controlled clinical trials have provided consistent evidence that exercise improves well-being, decreases depression, anxiety, and hostility, as well as offers greater feelings of social connectedness (Otto & Smits, 2011). For example, in controlled clinical trials, programmed exercise can provide depression relief that rivals that provided by antidepressant medication (Stathopoulou, Powers, Berry, Smits, & Otto, 2006).

* Corresponding author. Tel.: +1 713 741 3858; fax: +1 713 486 2530.
E-mail addresses: anka.vujanovic@gmail.com, Anka.A.Vujanovic@uth.tmc.edu (A.A. Vujanovic), samantha.g.farris@gmail.com (S.G. Farris), c.b.harte@gmail.com (C.B. Harte), jsmits@mail.smu.edu (J.A.J. Smits), mjzvolen@central.uh.edu (M.J. Zvolensky).

[1] For purposes of brevity, the term "PTSD" in this article should be interpreted as referring to all levels of posttraumatic stress (clinical and subclinical). In the present sample, "PTSD" refers to subclinical symptoms.

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In regard to smoking, there is growing scientific literature suggesting that exercise may influence several aspects of tobacco use. For instance, among smokers in the general population, exercise has significant salutary effects on craving and withdrawal symptoms (Ussher, Taylor, & Faulkner, 2012); and offers promising effect sizes for short-term abstinence (Williams et al., 2010), although some mixed findings have been reported (Ussher, West, McEwen, Taylor, & Steptoe, 2003).

Notably, there is limited research on exercise among trauma-exposed populations. Available data suggest there are low rates of exercise among PTSD populations (e.g., de Assis et al., 2008; Zen, Whooley, Zhao, & Cohen, 2012). Furthermore, exercise has been found to mediate the association between PTSD and physical and functional health in a trauma-exposed sample of undergraduate students, with PTSD – Hyperarousal symptoms emerging with particularly salient inverse relations with exercise (Rutter, Weatherill, Krill, Orazem, & Taft, 2011). Furthermore, several small-scale, uncontrolled intervention studies (n's = 9–15), based on trauma-exposed adult (Manger & Motta, 2005; Otter & Currie, 2004) and adolescent (Diaz & Motta, 2008; Newman & Motta, 2007) samples reporting varying levels of PTSD symptoms, have documented significant reductions in PTSD symptoms following aerobic exercise interventions. Although the literature is scant and most studies are methodologically limited (e.g., small sample sizes, lack of control groups), extant work suggests a possible clinically significant role for exercise in terms of both smoking and PTSD and other negative mood symptoms.

Several explanations for the anxiolytic effects of exercise have been proposed (Stathopoulou et al., 2006), a few of which may be particularly relevant for understanding how exercise might influence the smoking-PTSD association. First, it is possible that engagement in exercise modifies traditional emotional action tendencies (e.g., approach vs. avoidance), which in turn serves to attenuate both smoking behavior and PTSD symptoms (Foa, Hembree, & Rothbaum, 2007; Zvolensky & Bernstein, 2005). More specifically, exercise may serve as interoceptive exposure to trauma- and smoking-relevant bodily sensations (e.g., rapid heart palpitations, shortness of breath) in trauma-exposed smokers with PTSD symptoms, which over time, may serve to decrease PTSD symptoms (Smits et al., 2008) and relieve the addictive properties of tobacco (Zvolensky et al., 2008). Second, exercise also appears to reduce reactivity to stress (Puterman et al., 2010, 2011), broadly, and thus may confer protective effects in terms of the development or expression of post-traumatic psychopathology through a stress-buffering pathway. For example, with respect to anxiety-related outcomes, a number of studies have now shown that exercise reduces fear reactivity to established laboratory stressors (e.g., inhalation of carbon dioxide-enriched air; Smits, Meuret, Zvolensky, Rosenfeld, & Seidel, 2009; cholecystokinin tetrapeptide challenge; Ströhle et al., 2005). Third, given the commonality of sleep disturbances to tobacco use (e.g., Okun, Levine, Houck, Perkins, & Marcus, 2011) and PTSD (American Psychiatric Association [APA], 2000; see review by Lamarche & De Konick, 2007), exercise may exert concurrent effects on smoking and PTSD symptoms by improving sleep (Driver & Taylor, 2000). Finally, regular exercise may intensify individuals' present-centered attention and awareness and increase levels of distress tolerance (i.e., ability to withstand negative emotional or physical states; Simons & Gaher, 2005), which may serve to ameliorate both PTSD symptoms and smoking behavior over time (e.g., Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Vujanovic, Bernstein, & Litz, 2011).

Despite the emerging empirical literature in this domain, and the theoretical relevance of exercise for the smoking-PTSD co-occurrence, few studies have addressed this topic directly. Furthermore, no published studies to date have examined the interplay of smoking behavior and exercise among trauma-exposed smokers. Thus, the current investigation is the first empirical study of the relations of smoking status and exercise with regard to PTSD symptom severity and PTSD symptom cluster severity. It was hypothesized that, among trauma-exposed persons, the interactive effect of regular smoking status (i.e., $>=10$ cigarettes per day; cf., non-smoking status) and low weekly exercise levels would yield the highest levels of PTSD symptoms, generally, and PTSD – Hyperarousal symptoms, specifically (e.g., Rutter et al., 2011). Weekly exercise was expected to moderate the association between smoking status and PTSD symptoms, such that the highest levels of PTSD symptoms were expected among regular smokers reporting low levels of exercise. These effects were expected above and beyond the variance contributed by theoretically-relevant covariates (i.e., gender, number of trauma exposure types) and the main effects of smoking status and exercise output. Participants were screened out for current (past month) *DSM-IV-TR* (APA, 2000) Axis I psychopathology so as to ascertain that any observed effects were not due to co-occurring Axis I disorders (e.g., Marshall et al., 2008).

1. Method

1.1. Participants

Participants (n = 86, 58.1% female) reported a mean age of 24.3 years (SD = 10.54). The ethnic/racial distribution of the study sample reflected that of the local recruitment environment (State of Vermont Department of Health, 2010): 89.5% (n = 77) identified as White/Caucasian; 4.7% (n = 4) as Black/African-American; 1.2% (n = 1) as Hispanic/Latino; 1.2% (n = 1) as Asian; and 3.5% (n = 3) did not specify race/ethnicity. The majority of the sample was never married (90.7%) and had completed at least high school (61.6%) or some college (25.6%) education.

Participants were selected from a large pooled database that consisted of data from adults ages 18 to 65, who participated in one of three studies on emotional vulnerability. Inclusion criteria for the current study were: (1) exposure to a *DSM-IV-TR* PTSD Criterion A traumatic life event (APA, 2000); (2) available PTSD symptom data; (3) PTSD symptom severity score $\geq$ 1 on the Posttraumatic Diagnostic Scale (PDS; Foa, 1995); and (4) available physical exercise self-report data. Exclusionary criteria were comprised of: (a) limited mental competency and/or the inability to provide informed, written consent; (b) current suicidal/homicidal ideation; (c) current Axis I psychopathology[2]; (d) self-reported smoking as between 1 and 9 cigarettes per day over the past year; (e) current or past serious medical illness (e.g., chronic cardiopulmonary illness, seizure disorder); and (f) pregnancy. Participants were excluded for medical illness and pregnancy due to the experimental nature of a portion of the study protocol not presented here. Of the 86 subjects, 9 were excluded for infrequent tobacco use (cigarettes per day/past year $\leq$ 9), thus 77 participants were included in the final analyses.

2. Measures

2.1. Structured clinical interview for DSM-IV disorders/non-patient version (SCID-I/NP; First, Spitzer, Gibbon, & Williams, 1995)

The SCID-I/NP is a structured-clinical interview used to assess for Axis I psychiatric diagnoses. The SCID-I/NP has been found to have good reliability (Zanarini et al., 2000) and excellent validity

[2] The same pattern of results was found when including individuals with Axis I psychiatric disorders.

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