

Increasing fitness is associated with fewer depressive symptoms during successful smoking abstinence among women

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Abstract. Exercise has been hypothesized to curb increases in depressive symptoms often associated with smoking cessation. The relationship between increased fitness and changes in depressive symptoms was examined among 40 women who were abstinent at the end of an 8-week randomized controlled trial. Participants received group-based, cognitive-behavioral smoking cessation treatment plus either exercise or contact control. All participants completed maximal fitness tests and questionnaires, including the Centers for Epidemiological Studies Depression Scale at baseline and at post-treatment. Regardless of treatment assignment, women who increased fitness over the 8-week treatment period were more likely to have decreases in depressive symptoms. Results indicate that increased fitness may benefit women by attenuating the depressive symptoms often associated with nicotine withdrawal.

Keywords: Smoking cessation, Mood, Exercise

Introduction

Cigarette smoking continues to be one of the leading preventable causes of morbidity and mortality in the United States (CDC, 2002; USDHHS, 2004). Despite the health consequences of smoking, 21% of women continued to smoke cigarettes in 2001 (CDC, 2003). Improving smoking cessation rates is a priority among health professionals (USDHHS, 2000). One obstacle to maintaining smoking cessation among women is the depressed mood that frequently occurs following initial quit attempts (Kenford et. al., 2002). Changes in mood may be especially important for women, as women are more likely than men to report that they smoke to reduce negative affect and stress (Cepeda-Benito & Reig-Ferrer, 2000), and negative mood is more likely to lead to relapse in women than men (Borland, 1990). Exercise has been found to improve mood in the general population (Lawlor & Hopker, 2001; Morgan, 1997) and exercise at a moderate intensity level may be beneficial for the prevention of depressive symptoms (Brown et. al., 2005). Thus, exercise has been hypothesized as a potential enhancement to smoking cessation treatment (Abrams et.al., 1987).

In testing this hypothesis, Marcus and colleagues (1999) conducted a randomized controlled trial and found that women who performed vigorous intensity exercise in addition to a group-based cognitive behavioral smoking cessation treatment program (CBT) were more likely to quit smoking than women who received CBT plus contact control (1999). Among a subset of

women in the exercise condition, Bock and colleagues (1999) found acute decreases in negative affect following exercise sessions during most weeks of the 12-week intervention, but did not find chronic decreases in negative affect over the course of the program. Similarly, Ussher and colleagues (2001), found that negative mood decreased during, and for 10 minutes following, a single 10-minute bout of moderate intensity exercise among men and women who had not smoked since the previous evening. While these studies have shown that acute bouts of exercise can exert short-term effects on mood among smokers, a longer-term relationship between exercise and mood has not been established. Additionally, previous research has not examined the relationship between fitness changes resulting from exercise and corresponding mood changes.

The current study examines the relationship between fitness changes and depressed mood among participants who had completed a randomized controlled trial for women comparing CBT plus moderate intensity exercise versus CBT plus an equal contact control (Marcus et. al., 2003; Marcus et. al., 2005). The purpose of the present study was to examine the relationship between fitness change and depressive symptoms among women enrolled in the larger smoking cessation trial. Unlike previous research that assessed acute mood changes in response to a single bout of exercise (Bock et. al., 1999; Ussher et. al., 2001), we assessed changes in depressive symptoms over the course of the 8-week treatment protocol. Moreover, participants underwent fitness testing at baseline and post-treatment to determine change in fitness. We hypothesized that women who increased their fitness during the treatment would be less likely to exhibit the increases in depressed mood often associated with smoking cessation and nicotine withdrawal.

Material and Methods

Participants: Participants enrolled in the clinical trial were 217 healthy, sedentary (less than 60 minutes of moderate or vigorous intensity exercise per week), women smokers (at least 5 cigarettes per day), ages 18-65, who responded to newspaper advertisements for a quit-smoking program. The institutional review board from the Miriam Hospital in Providence, RI approved the study and participants completed written consent forms prior to participating in the research program.

Procedures: Participants were randomly assigned to: (1) a cognitive-behavioral smoking cessation treatment designed for women (CBT) plus supervised group and home-based moderate-intensity exercise; or (2) CBT plus equal contact time with staff (for more details see Marcus et. al., 2003). Both conditions participated in the 8-week, group-based CBT program for one hour per week. The program included topics related to cognitive-behavior theory such as stimulus control, as well as topics relevant to women, such as weight management and balancing family and work. The program began with a nicotine fading protocol, with quit day scheduled for session 2. Manuals for the therapists and written materials for the participants were used to ensure standard delivery of the intervention. Participants completed the Centers for Epidemiological Studies Depression Scale (CESD) at baseline and the end of treatment to assess depressed mood. Additionally, we assessed physical fitness among all participants using a treadmill exercise test at baseline and the end of treatment (see measures section for more details).

Participants in the exercise condition received an exercise intervention in addition to the smoking cessation treatment. The exercise prescription involved participating in exercise that

produced 50-69% of maximum heart (e.g., brisk walking) five days per week for a total of 165 minutes each week (USDHHS, 1996). This included exercise at our gym for a minimum of one session per week lasting approximately one hour, which occurred on the same night as the smoking cessation intervention. For the remainder of the week, participants had the option to either participate in exercise at our gym or at home. They were instructed to participate in four days of exercise of at least 30 minutes per occasion in addition to the 45-minute exercise session (the overall session lasted one hour to include 15 minutes of stretching) that occurred following the smoking cessation session. The first exercise session occurred immediately following the first CBT session. Therefore, participants began exercising one week before quit day.

Participants in the contact control condition attended an 8-week wellness program (films, lectures, discussions, and handouts on lifestyle and health issues) lasting one hour each week, in addition to the smoking cessation program. This design has been used in previous studies to control for contact time with the study staff and to reduce the risk of differential attrition between groups (Marcus et. al., 1999).

Measures : The main outcome measure for the study was 7-day Point Prevalence Abstinence (PPA). Seven day point-prevalence is a categorical variable indicating whether at the end of treatment the participant was quit and had been quit for at least seven days. It is referred to as seven day point prevalence because it is measuring whether a person is quit at a particular point in time with quit defined as not having smoked for at least seven days. We used carbon monoxide (using the Bedfont carbon monoxide analyzer) and saliva cotinine levels to verify quit status. Criteria for 7-day point prevalence abstinence was a cotinine level less than 57 nmol/L (10ng/ml; Etzel, 1990) and a carbon monoxide level less than 8 ppm (Ossip-Klein et. al., 1986).

The Centers for Epidemiological Studies Depression Scale (CESD) was used as an indicator of depressive symptomatology. The CESD is a 20-item scale that has been extensively validated (Weissman, Sholomskas, Pottenger, Prusoff, & Locke, 1977) and is commonly used in smoking cessation trials (e.g., Anda et. al., 1990). Scores on each item range from 0-3, with a total score range of 0-60. CESD scores were obtained at baseline and post-treatment and are expressed as change-scores (i.e., post-treatment - baseline).

Graded maximal exercise tests were performed using a modified Balke protocol at baseline and at post-assessment (for more detail see Marcus et. al., 2003). Thus, change in fitness is expressed as percent change in estimated peak oxygen consumption (peak VO_2).

Statistical Analyses: Of the 217 women originally enrolled, 93 were excluded from these analyses because they did not return for the post-treatment assessment, and 4 were excluded because their estimated fitness change was a statistical outlier. Of the remaining 120, 40 were abstinent at post-assessment. Because women who were not quit at post-treatment would not be expected to be experiencing withdrawal symptoms (i.e., depressed mood) at that time, analyses included only women who were abstinent at post-treatment ($n = 40$).

We originally intended to use treatment condition as our independent variable; however, a manipulation check revealed no differences in fitness change between the two conditions. Therefore, we decided to use change in fitness from baseline to post-treatment as our independent variable, regardless of group assignment. Specifically, we regressed change in mood, as measured by the CESD, on change in fitness, as indicated by percent change in estimated peak VO_2 .

Results

The sub-sample of women who were quit at post-assessment ($n = 40$) were predominantly Caucasian (77.5%), and had an average age of 42.45 years ($SD = 9.45$). Descriptive statistics for depressive symptoms and fitness are depicted in Table 1. Although mean changes in peak VO_2 (1.47%) and CESD scores (-0.27) were small, there was considerable inter-subject variability ($SD = 13.15\%$ and 9.62, respectively). Analyses revealed a significant negative relationship between fitness change and change in depressive symptoms ($t = -2.14$, $p < .05$). Specifically, a 10% increase in peak VO_2 (or .76 standard units) corresponded to a decrease of 2.49 units on the CESD.

Table 1. Descriptive statistics ($N = 40$).

	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Baseline estimated peak VO_2	30.12	5.05	18.9	44.1
Post-assessment estimated peak VO_2	30.37	5.51	18.9	40.6
Percent change in estimated peak VO_2	1.47	13.15	-32.63	23.53
Baseline CESD	10.79	8.70	0	36
Post CESD	10.70	8.33	0	38
Change in CESD	-0.27	9.62	-24	25

Note. CESD = Center for Epidemiological Studies Depression Scale.

Discussion

This study showed a significant inverse association between increased fitness and decreases in depressive symptoms among women enrolled in an 8-week smoking cessation program who were successfully abstinent at the end of treatment. The findings indicate that increasing fitness through exercise may help attenuate the depressed mood women often experience when attempting to quit smoking (Kenford et. al., 2002). Results of the present analysis are consistent with previous studies showing acute improvements in mood following single bouts of exercise among women and men who had recently quit smoking (Bock et. al., 1999; Ussher et. al., 2001). However, the current findings extend previous results by showing that the relationship between exercise and mood can exist over the course of an 8-week smoking cessation treatment, and by using an objective indicator of fitness. In addition, the women who increased their fitness not only benefited from improved mood during their smoking cessation treatment, but began a successful exercise program that if maintained, will likely yield numerous additional health benefits (USDHHS, 2000). Indeed, regular participation in moderate intensity exercise is recommended by the CDC, ACSM, the Surgeon General, and the American Heart Association (Fletcher et. al., 1995; Pate et. al., 1995; USDHHS, 1996). This form of exercise can be safely performed by most women and has high potential for disseminability.

Strengths of the present study include the longitudinal design and objective indicator of fitness. However, the lack of a randomized design precludes any causal assertions. Additionally, of the 217 enrolled in the clinical trial, only 40 (18%) were included in this secondary analysis, as we sought to examine the relationship between fitness and depressive withdrawal symptoms only among participants who were quit at the end of the smoking program. This rate of successful

smoking cessation is consistent with rates from other clinical trials (Fiore et. al., 2000) and highlights how difficult it can be to change smoking behavior. The significance of the results, despite the relatively small sample size, speaks to the strength of the relationship. The results suggest that women attempting to quit smoking should be encouraged to exercise not only for the health benefits of improved fitness, but also to attenuate the depressive symptoms that often accompany cessation attempts.

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