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## The effects of acute exercise on tobacco cravings and withdrawal symptoms in temporary abstinent pregnant smokers<sup>★</sup>

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### Abstract

**Introduction**—Smoking during pregnancy is common, and quitting at any point during pregnancy can yield benefits to both the fetus and mother. Smoking cessation is typically followed by withdrawal symptoms and a strong desire to smoke, both of which are likely to contribute to relapse. Research has shown that a bout of exercise minimizes cravings and tobacco withdrawal symptoms (TWS) after temporary abstinence in smokers, but these findings have not been replicated in pregnant smokers. This study examined the effect of 20 min of exercise on cravings (primary outcome) and TWS (secondary outcomes) among temporary abstinent, inactive pregnant smokers.

**Methods**—Thirty female smokers (Mean(M) age = 25.7 years, Standard Deviation(SD) = 5.5; M weeks pregnant = 18.2, SD = 5.3; Fagerstrom Test for Cigarette Dependence = 3.3, SD = 2.2; M 9.3 cigarettes/day, SD = 4.7; M hours abstained = 17.2, SD = 2.8) were randomized to 20 min of mild-to-moderate intensity exercise (EC;  $n = 14$ ) or passive (PC;  $n = 16$ ) condition. Cravings and TWS were assessed immediately before, during (at 10 min), immediately post, and at 10, 20, and 30 min post-condition.

**Results**—A 2 (condition)  $\times$  6 (time) repeated measures ANOVA revealed that the EC significantly ( $p < 0.05$ ) reduced cravings ( $\eta^2 = 0.46$ ) compared with the PC, across time. Non-significant, but nevertheless, large effects were evident favouring the EC over time for TWS

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#### Contributors

HP, GF, PS, MM, and MU conceived the study. SDJ, AC, TH and LF recruited participants and conducted the study in London, ON. MU recruited participants and collected the study in London, England. HP and SDJ ran the statistical analyses and prepared the first draft of the manuscript, which were jointly interpreted and edited by the authors, respectively. All authors contributed to and approved the final version of the manuscript.

#### Conflict of interest

My coauthors and I do not have any personal or financial conflicts of interest related to the research, nor do the authors have other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, this work.

restlessness ( $r^2 = 0.34$ ), stress ( $r^2 = 0.24$ ), irritability ( $r^2 = 0.21$ ), tension ( $r^2 = 0.15$ ), and depression ( $r^2 = 0.14$ ).

**Conclusions**—Consistent with previous research, this study reveals that in pregnant smokers, a bout of exercise is associated with a reduction in cravings and similar patterns exist for TWS. Therefore, exercise may have the potential to assist in the initial stages of smoking cessation attempts during pregnancy.

### Keywords

Smoking cessation; Pregnancy; Withdrawal symptoms; Cravings

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## 1. Introduction

According to recent statistics, 19% of young Canadian women of child-bearing age (20–24 years) reported smoking during their most recent pregnancy (CTUMS, 2011). There is compelling evidence that prenatal tobacco exposure results in lower birth weight, prenatal death, and behavioural problems among offspring (Castles, Adams, Melvin, Kelsch, & Boulton, 1999; Fergusson, 2002; Fried, 2002). Although abstinence early in pregnancy will produce the greatest benefits to the fetus and expectant mother, quitting at any point during pregnancy can yield benefits (McBride, 2003; McCowan et al., 2009). In the general population, smoking cessation is typically followed by withdrawal symptoms and a strong desire to smoke, both of which contribute to relapse (Piasecki et al., 2000; West, Hajek, & Belcher, 1989). These symptoms are also apparent in pregnant smokers (Heil, Higgins, Mongeon, Badger, & Bernstein, 2006; Ussher, Etter, Giatras, & Coleman, 2012), who also frequently report tobacco withdrawal as a barrier to quitting (Grangé et al., 2006; Ripley-Moffitt et al., 2008; Tong, England, Dietz, & Asare, 2008). Two recently published meta-analyses provide consistent support for the tenet that a single bout of mild-to-moderate intensity exercise reduces tobacco withdrawal symptoms and cravings during a temporary period of abstinence (Hassova et al., 2012; Roberts, Maddison, Simpson, Bullen, & Prapavessis, 2012). These findings, however, are not generalized beyond middle-aged men and women. There is a need, therefore, to replicate these findings with other populations, such as pregnant smokers.

Previous evidence for the robust effect of an acute bout of exercise on cravings and tobacco withdrawal symptoms cannot be generalized to pregnant women due to intensified tobacco withdrawal symptoms. Altered mood state (i.e. depression) is common (Gaynes et al., 2005) and cravings intensify, as a result of increased nicotine and cotinine metabolism, during pregnancy (Dempsey, Jacob, & Benowitz, 2002). Ussher, Aveyard, et al. (2012), Ussher, Etter, et al. (2012), however, reported that pregnant women are likely to report less severe tobacco withdrawal than non-pregnant women. They attribute these findings to several limitations including that only half of participants complied with the 24-h abstinence period, biasing the sample towards participants who found abstinence to be less challenging.

This population is often reluctant to use nicotine replacement therapy (Ussher & West, 2003) and for which there is no evidence of benefit (Coleman, Chamberlain, Davey, Cooper, & Leonardi-Bee, 2012), but has expressed high levels of interest in using exercise to aid

smoking cessation (Ussher, West, & Hibbs, 2004). Pregnancy is often considered an ideal opportunity for behavioural change because women are more likely to stop smoking during pregnancy than at any other time in their lives (McBride, 2003). In practice, performing short, intermittent and daily bouts of mild-to-moderate intensity exercise is achievable for most pregnant women (Davies, Wolfe, Mottola, & MacKinnon, 2003). An exercise intervention has been shown to reduce the desire to smoke among pregnant smokers on the first day of an attempt to quit (Ussher et al., 2008); however, the dose of exercise was not standardised and a control group was not included.

The purpose of the present study was to examine the effect of 20 min of mild-to-moderate intensity exercise on the strength of desire to smoke (primary outcome) and withdrawal symptoms (secondary outcomes) among inactive pregnant smokers, undergoing a temporary period of abstinence. It was hypothesized that participants in the mild-to-moderate intensity exercise group would report less desire to smoke and withdrawal symptoms compared with their passive control counterparts.

## 2. Methods

### 2.1. Participants

Participants consisted of 30 pregnant women who were recruited from London, Ontario ( $N=23$ ) and St. George's Hospital, South West London, England. There were no significant differences between the samples in the two locations in demographic or smoking characteristics. Individuals were eligible to participate if they were between 20 and 40 years of age, in their second trimester of pregnancy (13–24 weeks), smoked more than five cigarettes per day and at least 10 cigarettes per day prior to gravidity, were not receiving psychiatric treatment, did not present contraindications to exercise, and did not meet the physical activity guidelines for pregnancy (i.e., exercising less than three times per week for 30 minutes at a moderate intensity; Davies et al., 2003). Participants were also screened with the Physical Activity Readiness Medical Examination (Wolfe & Mottola, 2002) for pregnancy for contra-indications to exercise.

### 2.2. Sample size

In a recent meta-analysis (Roberts et al., 2012), the average weighted reduction in desire to smoke was 1.9 points. Therefore, the authors selected a study (Janse Van Rensburg, Taylor, Hodgson, & Benattayallah, 2012) that reflected this change. Using calculated means and standard deviations for exercise ( $M=3.6$ ;  $SD=1.0$ ) and control ( $M=5.3$ ;  $SD=1.0$ ) post-condition for desire to smoke from Janse van Rensburg et al., it was estimated that for a between-group design, with a power of 0.99 and alpha at 0.05, a sample of 15 participants per group was needed to detect differences on this primary outcome variable (SamplePower Version 3, SPSS).

### 2.3. Primary outcome measure

Cigarette cravings were assessed using a seven-point scale (1 = not at all, 4 = somewhat, 7 = extremely) for the statement 'How strong is your desire to smoke right now?' (West et al., 1989).

## 2.4. Secondary outcome measures

Six tobacco withdrawal symptoms (irritability, depression, tension, restlessness, difficulty concentrating, and stress), which have previously been shown to be sensitive to the effects of exercise (Taylor, Ussher, & Faulkner, 2007), were evaluated using the Mood and Physical Symptoms Scale (MPSS; West et al., 1989; West & Hajek, 2004; West & Russell, 1985). Each symptom was measured in the present state using a seven-point scale (1 = not at all, 4 = somewhat, 7 = extremely).

## 2.5. Exercise condition

The exercise condition entailed a single bout of treadmill walking at a mild-to-moderate intensity (25–55% of heart-rate reserve; Davenport, Mottola, McManus, & Gratton, 2008) for 20 min, which commenced upon reaching the lower limit of the heart-rate prescription. Approximately 2 min and 5 min were allocated for warm-up and cool down, respectively.

## 2.6. Passive control condition

The passive control condition required participants to view a neutral DVD (27 min in duration) about home gardening, in a quiet, isolated room in the laboratory. This control condition has been shown to be acceptable in previous studies (e.g., Ussher, Nunziata, Cropley, & West, 2001).

## 2.7. Design and procedure

Participants were assigned, according to a computer-generated randomization scheme, to a (i) mild-to-moderate exercise ( $n = 14$ ) or (ii) passive control ( $n = 16$ ) condition. Group allocation was concealed from participants, but not researchers. Prior to study involvement, participants were informed that the study was interested in measuring cravings and withdrawal symptoms following a temporary period of abstinence. Since all participants, irrespective of randomization, received this level of detail concerning the purpose of the study, the impact of blinding on the findings would be equivalent between groups and across time. This investigation received ethics approval from both institutions. The conduct of the trial followed the principles outlined in the Declaration of Helsinki and the World Health Organization 2002 Good Clinical Research Practice. All participants provided informed written consent. Study procedures, described below, were identical between sites.

Participants were required to attend a screening session (pre-abstinence) to complete questionnaires and confirm smoking status with an expired breath carbon monoxide level (CO; Micro Smokerlyzer®; Bedfont Scientific) greater than 10 ppm. Participants returned to the laboratory two days later after being asked to abstain from smoking for 18 h. Abstinence was confirmed by a reduction in expired CO levels (<10 ppm). Irrespective of condition, cigarette cravings and tobacco withdrawal symptoms were assessed immediately before the condition, during (at 10 min), immediately post-condition, and at 10, 20, and 30 min post-condition. For those in the exercise condition, heart rate (Polar RS100 Heart Rate monitor) was monitored to ensure adherence to the exercise prescription intensity. Interaction between all study participants and investigator was minimized.

## 2.8. Statistical analyses

To verify equivalence between the exercise and passive sitting conditions at baseline, independent-samples *t*-tests were used. If group differences at baseline were found for any variable, then a repeated measure analysis of covariance (ANCOVA) was conducted. However, ANCOVA assumes that the relationship between the dependent variable and each covariate is linear (Tabachnick & Fidell, 2001). Thus, if unequivalent variables at baseline are found not to be linearly correlated to either primary or secondary outcomes, then the assumption of linearity is being violated and ANCOVA is not recommended, as to do so would likely reduce the power (sensitivity) of the repeated measure ANOVA tests (Stevens, 1996). Statistical analyses were conducted using SPSS (Version 20). The level of significance was accepted at  $p < 0.05$  for all statistical tests.

## 3. Results

### 3.1. Group equivalency

Participants' demographic information and smoking characteristics (e.g., FTCD, Fagerstrom & Schneider, 1989) are presented in Table 1. Group equivalency was achieved between exercise and control conditions, with the exception of marital status, number of previous quit attempts, and hours abstained from smoking (Table 1). Controlling for the number of previous quit attempts and hours abstained from smoking for the main analysis was deemed unnecessary (see Section 2.8) as these variables were found to be unrelated to the primary outcome ( $r = 0.05$ ,  $p = .927$  and  $r = 0.01$ ,  $p = .809$ , respectively) and either unrelated or mildly related to the secondary outcomes ( $r$  range =  $-0.00$  to  $-0.32$ ;  $p$  values range = .981 to .087). Group equivalency was evident for primary and second outcome measures pre-abstinence and post-abstinence (Table 1).

### 3.2. Fidelity inspection

Repeated-measures analysis of variance (ANOVA) showed a significant group (exercise vs. control) by time (immediately pre-treatment exercise  $Mean = 88.79$ ,  $SD = 19.10$  vs. control  $Mean = 82.80$ ,  $SD = 12.41$ ) and mid-condition 10 min (exercise  $Mean = 101.36$ ,  $SD = 18.47$  vs. control  $Mean = 82.13$ ,  $SD = 12.77$ ) interaction effect in the expected direction for heart rate ( $F[1, 27] = 14.54$ ,  $p = 0.001$ ,  $\eta^2 = 0.35$ ). Nine participants adhered to the prescribed mild-to-moderate intensity prescription for 20 min at 25–55% of their heart-rate reserve, while an additional participant was shy of this realization and exercised between 20 and 25% of their heart-rate reserve. The remainder of participants ( $N = 4$ ) exercised below 20% of their heart-rate reserve.

### 3.3. Cravings and tobacco withdrawal symptoms

Cigarette cravings and tobacco withdrawal symptoms data were analyzed using a 2 (condition; exercise vs. control)  $\times$  6 (time) repeated-measures ANOVA (see Fig. 1). The Mauchly's test for sphericity was significant ( $p < .001$ ) indicating the assumption of sphericity was violated. Hence the multivariate statistic is reported. For cravings, there was a substantial group by time interaction effect (Wilks' Lambda = .540, ( $F[5, 24] = 4.094$ ,  $p = 0.008$ ,  $\eta^2 = 0.46$ ). Planned post-hoc *t*-tests showed cravings were significantly lower

following baseline in the exercise compared with the control condition immediately after exercise ( $p = 0.044$ ,  $\eta^2 = 0.12$ ) and 10 min post exercise ( $p = 0.018$ ,  $\eta^2 = 0.16$ ). Although in the expected direction, only a trend effect was seen during exercise ( $p = 0.061$ ,  $\eta^2 = 0.10$ ) and no significant differences were found 20 ( $p = 0.128$ ,  $\eta^2 = 0.07$ ) and 30 min ( $p = 0.128$ ,  $\eta^2 = 0.01$ ) post exercise (see Fig. 1).

For tobacco withdrawal symptoms, a group by time interaction trend effect was evident for restlessness (Wilks' Lambda = .661, ( $F[5, 23] = 2.363$ ,  $p = 0.072$ ,  $\eta^2 = 0.34$ ). Differences between groups over time for stress (Wilks' Lambda = .753, ( $F[5, 24] = 1.576$ ,  $p = 0.205$ ,  $\eta^2 = 0.24$ ), irritability (Wilks' Lambda = .790, ( $F[5, 24] = 1.274$ ,  $p = 0.307$ ,  $\eta^2 = 0.21$ ), tension (Wilks' Lambda = .860, ( $F[5, 24] = 0.861$ ,  $p = 0.521$ ,  $\eta^2 = 0.15$ ), depression (Wilks' Lambda = .860, ( $F[5, 24] = 0.778$ ,  $p = 0.575$ ,  $\eta^2 = 0.14$ ), and difficulty concentrating (Wilks' Lambda = .961, ( $F[5, 24] = 0.194$ ,  $p = 0.962$ ,  $\eta^2 = 0.04$ ), did not reach significance. All effect sizes, with the exception of difficulty concentrating, were large, favoring the exercise condition (see Fig. 2).

#### 4. Discussion

Systematic reviews (Hassova et al., 2012; Roberts et al., 2012; Taylor et al., 2007) have clearly shown that a single brief bout of exercise reduces tobacco cravings and withdrawal symptoms after a temporary period of abstinence in male and female smokers, relative to a control condition. This study replicates these findings in temporarily abstaining pregnant smokers.

Insofar as cravings are concerned, there was an average reduction of 1.71 points (i.e., 24%) in strength of desire to smoke from pre-abstinence to mid-exercise. This is in line with other studies, which have reported an average reduction of 1.4 to 4.1 points in strength of desire to smoke from pre-abstinence to during moderate intensity exercise (Daniel, Cropley, & Fife-Schaw, 2007; Everson, Daley, & Ussher, 2008; Janse Van Rensburg et al., 2012; Taylor, Katomeri, & Ussher, 2005). The effect of exercise on average reductions of strength of desire from pre-abstinence to immediately post-condition and from pre-abstinence to 10, 20, and 30 min post-condition was 2.07 (i.e., 29%), 2.14 (i.e., 31%), 1.43 (i.e., 20%), and 1.21 (i.e., 17%), respectively. This, again, is in line with other research (Roberts et al., 2012; Taylor et al., 2007) which has revealed reductions in cravings up to 30 min postcondition in non-pregnant populations.

With respect to tobacco withdrawal symptoms, large non-significant effects (effect sizes ranging from 0.14 to 0.34) were evident during and following exercise for all withdrawal symptoms (except concentration disruption), in contrast to the passive control condition in our pregnant participants. Tobacco withdrawal symptoms, including irritability, depression, tension, restlessness, difficulty concentrating, and stress, have been shown to be attenuated by exercise (Roberts et al., 2012; Taylor et al., 2007). Namely, the following average reductions have been illustrated in the literature (Daniel et al., 2007; Everson et al., 2008; Taylor & Katomeri, 2007): 0.5-point in irritability; 0.26 to 0.4-point in depression; 0.6-point in tension; 0.5 to 0.87-point in restlessness; 0.2 to 0.8-point in difficulty concentrating; and 0.45 to 0.81-point reductions in stress. Our findings showed larger average reductions in



TWS (except concentration disruption) during and following exercise than those reported previously. The range of average reductions for each symptom was as follows: irritability 1.64 to 2 (i.e., 23% to 29%); depression .78 to .92 (i.e., 11% to 13%); tension 1.5 to 1.85 (21% to 26%); restlessness 1 to 1.78 (i.e., 14% to 25%); difficulty concentrating .15 to .43 (i.e., 2% to 6%) and stress 1.5 to 2.07 (i.e., 21% to 30%).

Although our fidelity check showed differences in heart rate between those who exercised and those who did not, it also showed that 5 out of our 14 exercisers failed to reach their prescribed intensity (25–55% of heart rate reserve). The finding raises two questions: Why did we not achieve a higher adherence rate to the exercise prescription? And, what level of exercise intensity is needed to attenuate cravings and withdrawal symptoms? With respect to the first question, this study recruited pregnant smokers who did not meet the physical activity guidelines for pregnancy. For some sedentary pregnant smokers, exercising at 25–55% of heart rate reserve for 20 continuous minutes may be challenging, uncomfortable, or produce adverse symptoms that participants would rather avoid. Considering that it is unethical to ask a compromised population to exercise beyond their perceived limits, exercising below 25% of heart rate reserve may be more tolerable and sustainable for some sedentary pregnant smokers, as revealed by the adherence rate to the exercise prescription.

With respect to the second question, this study demonstrates that low-to-moderate intensity movement significantly reduces cravings, compared to passive sitting. This is comparable to similar research studies in non-pregnant smokers that evaluated exercise of very low intensity. Specifically, significant reductions in cravings have been shown in light-intensity yoga (Elibero, Janse Van Rensburg, & Drobles, 2011) and isometric exercise (Ussher, Cropley, Playle, Mohidin, & West, 2009), when compared with a passive control group. The latter study showed an average reduction of 1.79 points in strength of desire to smoke from baseline to post-isometric exercise, which is equivalent to the results in this pregnant population. Nevertheless, the small sample size made it impossible to explore whether the intensity of exercise moderates craving reductions—an important issue to pursue in future work. It should be pointed out that the American College of Sports Medicine suggests that the minimum intensity of exercise required to achieve aerobic benefit in previously sedentary women is equivalent to 20–39%  $\text{VO}_2$  reserve, which corresponds to approximately 13–33% heart rate reserve (Davenport, Sopper, Charlesworth, Vanderspank, & Mottola, 2008). Hence, all pregnant smokers were exercising at an appropriate intensity to achieve potential health benefits.

The present study is not without limitations. Specifically, recruitment of participants that were interested in participating and met inclusion criteria (e.g. adequate cigarette consumption) was challenging. The complexity surrounding recruitment of pregnant smokers and recommendations has been documented (Pollak et al., 2006). Despite showing significant differences in cravings, the study was underpowered for the secondary outcome TWS variables. Although participants endured a temporary period of smoking abstinence, cravings and withdrawal symptoms may not be as severe as engaging in an actual quit attempt. In addition, as women progress with pregnancy, physical limitations and fatigue might prevent adherence to exercise as a means to cope with cravings. Similarly, requesting that pregnant smokers abstain from smoking and any nicotine products for 18 h seemed to

be a challenging task for some participants (i.e., the mean period of abstinence was 15.5 h for the exercise group, compared to 18.9 h for the passive control group). Although mean hours abstained was significantly different between groups, this variable was completely unrelated to cravings the primary outcome variable ( $r = 0.01$ ,  $p = .809$ ). Furthermore, pre-treatment cravings scores were comparable between groups (see Fig. 1). Taken together, this suggests that lower abstinence periods should be considered in future work that allows all participants to meet study protocol requirements without jeopardizing craving scores. Finally, findings cannot be generalized to pregnant smokers younger and older than the current sample.

This study provides preliminary evidence that exercise moderates cravings, and to a lesser extent, tobacco withdrawal symptoms, in temporarily abstinent pregnant smokers. Considering that high relapse rates are due to cravings and withdrawal symptoms, our findings support the role of a brief bout of exercise in initial cessation attempts and symptom management. With respect to cessation, there is insufficient evidence regarding the safety and effectiveness of nicotine replacement therapy for pregnant smokers (Coleman, Chamberlain, Davey, Cooper, & Leonardi-Bee, 2012) and behavioural interventions alone have had limited success (Lumley, Oliver, Chamberlain, & Oakley, 2009). Hence, large randomised trials of exercise as an aid to smoking cessation during pregnancy are now needed and one such trial is ongoing (Ussher, Aveyard, et al., 2012; Ussher, Etter, et al., 2012). In the meantime, the benefits of exercise outweigh the risks and should be recommended to pregnant smokers who want to improve their general health and increase their ability to manage cravings and withdrawal.

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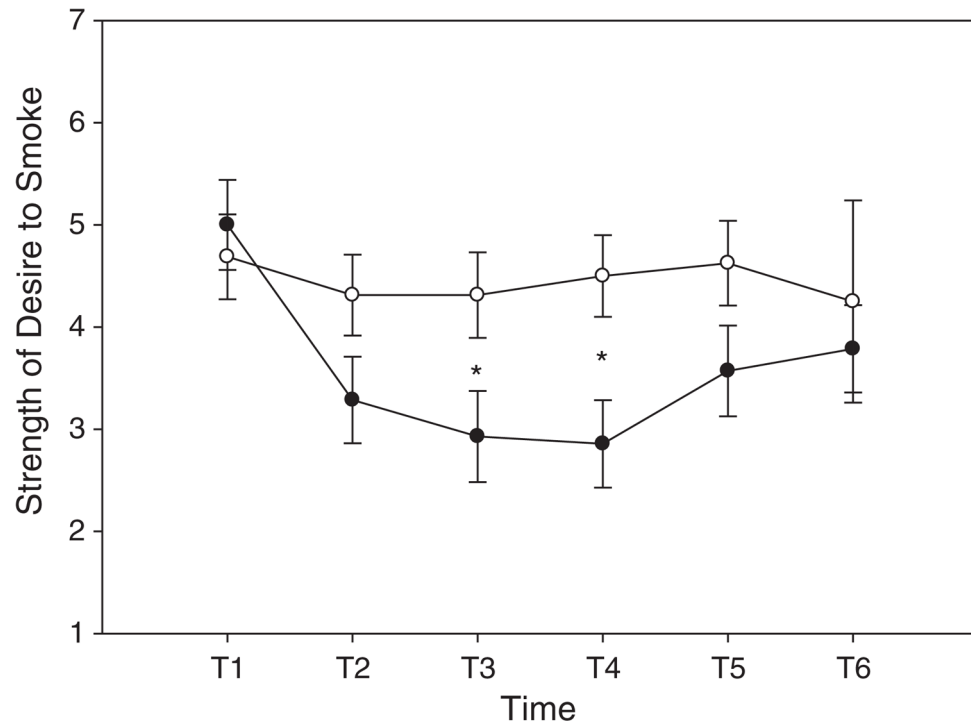
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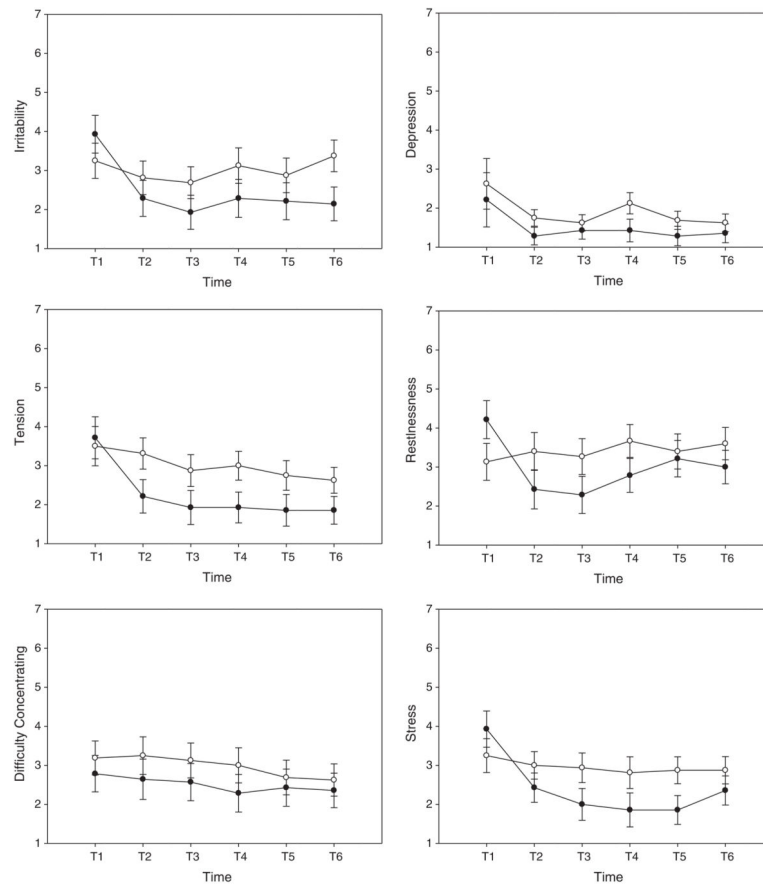
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### HIGHLIGHTS

- Exercise reduces cravings in temporary abstinent pregnant smokers.
- A similar reduction pattern exists for tobacco withdrawal symptoms.
- Exercise is recommended during initial smoking cessation attempts during pregnancy.



**Fig. 1.** Mean (SE) strength of desire to smoke over time (T1 Before, T2 During, T3 After, T4 10 min After, T5 20 min After, T6 30 min After) for exercise (closed circles) and passive control (empty circles) conditions. Descriptive statistics can be obtained from the corresponding author upon request. \*  $p < 0.05$ .



**Fig. 2.** Mean (SE) of tobacco withdrawal symptoms over time (T1 Before, T2 During, T3 After, T4 10 min After, T5 20 min After, T6 30 min After) for exercise (closed circles) and passive control (empty circles) conditions. Descriptive statistics can be obtained from the corresponding author upon request.



Table 1

Characteristics of study participants by condition.

N	Exercise condition		Passive control condition		Significance (p)
	14	SD	16	SD	
<i>Pre-abstinence</i>					
Age (years)	24.80	5.12	26.88	5.85	0.303
Weight (kg)	70.67	16.70	73.51	12.06	0.601
Weeks pregnant	17.80	4.83	19.25	6.13	0.472
Marital status					
Single	43.8%		46.7%		
Married	37.5%		0.0%		0.018*
Common law	12.5%		40.0%		
Separated	6.2%		13.3%		
Occupation					
Full-time work	31.2%		20.0%		0.496
Unemployed	12.5%		26.7%		
Keeping house	25.0%		33.2%		
Ethnicity					
Caucasian	87.5%		64.3%		0.251
Native	6.2%		28.6%		
Education level					
Less than high school	12.5		6.7		0.980
High school diploma	31.2		33.3		
College or higher	37.4		33.4		
Yearly household income					
Below \$5000	18.8		0.0		0.152
Between \$5000–16,000	31.2		60.0		
Don't know	18.8		0.0		
Percentage of family and friends that smoke					
Below 20%	31.6		23.6		0.121

N	Exercise condition		Passive control condition		Significance (p)
	14	16	Mean	SD	
Between 20 and 50%	36.8	23.5			
Above 50%	31.6	52.9			
FTCD	3.83	1.80	2.80	2.51	0.242
Years smoked	9.38	4.79	12.07	5.91	0.173
Cigarettes smoked per day	10.33	4.23	8.62	5.95	0.418
Carbon monoxide (ppm)	12.58	8.43	11.13	6.54	0.610
Number of previous quit attempts	1.77	1.17	4.14	2.11	0.005*
<i>Post-abstinence</i>					
Carbon monoxide (ppm)	2.43	3.03	4.06	2.41	0.111
Hours abstained	15.51	1.60	18.59	2.82	0.001*
Strength of desire to smoke	5.00	1.62	4.69	1.70	0.610
Irritability	3.93	1.94	3.25	1.69	0.315
Depression	2.21	1.58	2.63	3.22	0.668
Tension	3.71	2.05	3.50	1.97	0.773
Restlessness	4.21	1.58	3.06	1.98	0.092
Difficulty concentrating	2.79	1.67	3.19	1.90	0.531
Stress	3.93	1.90	3.25	1.57	0.293

Abbreviations: kg, kilograms; ppm, parts per million; FTCD, Fagerstrom Test for Cigarette Dependence.

\*  $p < 0.05$ .