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LETTER TO THE EDITOR

Aerobic exercise training during pregnancy increases antioxidant status in nulliparous women: Secondary analysis of a controlled clinical trial

El ejercicio físico aeróbico durante el embarazo incrementa la capacidad antioxidante en mujeres nulíparas. Análisis secundario de un ensayo clínico controlado

Dear Editor:

Several hypotheses invoke oxidative stress as a cellular process contributing to endothelial dysfunction in preeclampsia and a plausible convergence point for interaction of the fetoplacental unit and maternal predisposing factors involved in this disorder.¹ A recent summary from the National Heart, Lung, and Blood Institute Working Group on Research on Hypertension during Pregnancy² recommended clinical trials to assess whether exercise training could prevent preeclampsia by reducing oxidative stress and enhancing antioxidant defense systems^{3,4}; it is not known if exercise produces this effect during pregnancy. Therefore, the research question for this study was: does a 12-week supervised aerobic exercise program enhance antioxidant status in pregnant women, which reduces oxidative stress and in turn the incidence of preeclampsia?⁵

This study involved a subset of subjects enrolled in a factorial randomized controlled trial to evaluate the effect of regular aerobic exercise on maternal endothelium-dependent vasodilatation and oxidative stress of the newborn. A detailed account of the methods used in this study has been published elsewhere⁶ (Trial registration NCT00741312), and other results are being published. From March 2010 to January 2011, at three prenatal care outpatient clinics in Cali, Colombia, we included 20 nulliparous women, aged 16–30 years, with a gestational age of 16–20 weeks. The study was approved by the ethics committee of the University of Valle and all subjects gave written informed consent before participation in the study. After confirmation of eligibility, the women were randomly allocated to one of two groups: aerobic exercise plus usual prenatal care, or usual prenatal care only. Participants in the exercise group commenced the program when each block was completed, allowing supervised group exercise sessions

comprising three to five women. The investigator responsible for randomly assigning participants to treatment groups did not know in advance which treatment the next person would receive (concealed allocation) and did not participate in administering the intervention or measuring outcomes. The investigators responsible for assessing eligibility and baseline measures were blinded to group allocation. Participants and therapists administering the intervention were not blinded. The investigators responsible for outcome assessment were blinded to group allocation. All investigators received training before the trial and reminders during the trial regarding the protocol, measurement procedures, and methods and importance of maintaining blinding. Maternal and fetal characteristics are presented in Table 1.

Participants in the experimental group were invited to participate in three 60-min exercise classes per week, starting between week 16 and 20 of gestation and continuing for 3 months. All subjects wore a heart-rate monitor during the training sessions to ensure that exercise intensity was moderate to vigorous.^{5,6} Sessions consisted of walking (10 min), aerobic exercise (30 min), stretching (10 min), and relaxation (10 min). Aerobic activities were prescribed at moderate to vigorous intensity, aiming for 55–75% of maximal heart rate and adjusted according to ratings on the Borg scale. Adherence to the exercise program was encouraged by the physiotherapist who supervised the exercise sessions. In order to maximize adherence to the training program, all sessions were: supervised by a physiotherapist and a physician, conducted in groups of 3–5 women, accompanied by music, and performed in a spacious, air-conditioned room. The control group received no exercise intervention, did not attend the exercise classes and did not take part in a home exercise program. Both groups continued with their normal prenatal care (1 session per week for 3 months) and physical activity.

Antioxidant status was measured using the antioxidant assay kit (Cayman chemical company, Ann Arbor, USA, 2010) in samples of the maternal peripheral blood serum at baseline, at the end of the three-month intervention period and cord blood at 15 min of delivery, according to previously validated methods.^{2,3}

There were no differences in the initial measurements in the basal antioxidant status between the groups ($p=0.16$). At 3 months, the supervised aerobic exercise program, showed slightly higher values for antioxidant status in maternal peripheral blood serum in the experimental group compared to the control group (0.58 ± 0.24 mM) vs.

Table 1 Characteristics of the population: maternal age, body mass index, gestational age at birth, fetal and placental weight and fetal gender in pregnancies.

Characteristics	Control group	Exercise group
Maternal age (years)	19.5 ± 3.4	19.2 ± 2.6
Body mass index (kg/m ²)	24.1 ± 4.5	22.9 ± 3.8
Gestational age at birth (years)	39.8 ± 2.0	38.7 ± 1.0
Fetal weight (g)	3013.2 ± 493.8	3133.3 ± 406.5
Placental weight (g)	430.4 ± 28.9	390.0 ± 20.4
Fetal gender (female/male)	6/4	5/5

Data reported are mean ± standard deviation.

(0.28 ± 0.06 mM), respectively ($p=0.25$). Two-way ANOVA analysis revealed that umbilical cord blood antioxidant status was significantly higher in the exercise group at the end of the intervention ($p<0.001$, $F=8.09$) (Fig. 1).

Preeclampsia is characterized by the duo of increased levels of oxidative stress and decreased levels of antioxidant enzyme systems. This study showed that 12 weeks of aerobic exercise increased antioxidant status in nulliparous women. It has been suggested that regular exercise is associated with beneficial effects on the incidence of preeclampsia because of its antioxidant effects.^{8,9} However, results of epidemiological studies are conflicting. On one hand, vigorous to moderate intensity exercises before and during pregnancy reduced the risk of preeclampsia.¹ On the other hand, a more recent report showed that vigorous exercise for pregnant women actually increased the risk.¹⁰

In general, exercising in such situations can result in increased oxidant generation by several pathways such as the electron transport chain and xanthine oxidase and also due to the depletion of antioxidants. More studies are needed to explore the effects of moderate-intensity exercises of laboratory and clinical trial studies such as this report. Because of a small sample size, the interpretation of the results warrants caution. First, these results may offer a plausible explanation of others' studies previously

published showing a decreased incidence of preeclampsia among exercise group.⁷ We are cautious to make further interpretations, because, to clarify the role of physical inactivity and obesity on oxidative stress mechanisms, a larger sample size is required. Perhaps, a large multicenter trial will allow us to have enough tissue samples to control these confounding factors. These results are consistent with findings from previous studies in other tissues.⁴ It is however yet to be determined whether the improvement in total antioxidant capacity induced by exercise during pregnancy observed in the present study, has a beneficial effect in the prevention of disorders such as preeclampsia.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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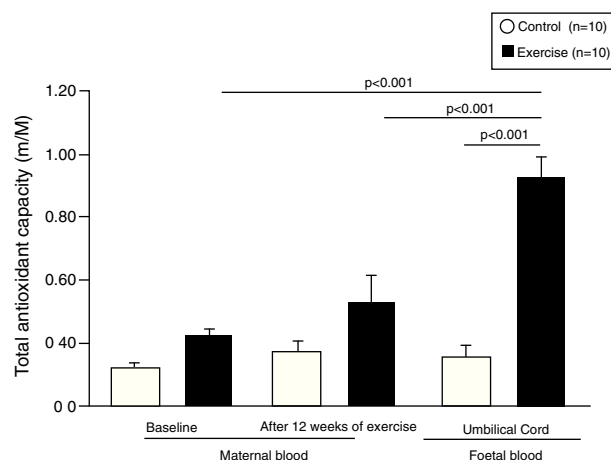


Figure 1 Effects of training on antioxidant status in maternal and umbilical cord blood in nulliparous women. *Note:* Data are means ± standard error of the mean and were compared by two-way ANOVA.

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