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ORIGINAL ARTICLE

Low-impact exercise during pregnancy – a study of safety

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Background. Exercise is an important part of many women's lives. Women are often advised to refrain from physical exercise during pregnancy. The reason given is mainly safety, i.e. fear of maternal hyperthermia, which is known to be related to neural tube defects. However, exercise during pregnancy has not been shown to be related to hyperthermia.
Objective. To study temperature and oxygen saturation responses to low-impact exercise in healthy pregnant women.
Methods. Forty pregnant women and 11 controls participating in low-impact aerobic exercise were monitored before exercise, at maximum-exercise level, and after exercise with regard to core temperature, heart rate, and oxygen saturation level.
Results. The core temperature among the pregnant women did not increase significantly at maximum exercise or after exercise (36.5 versus 36.7 or 36.5 °C, $P = 0.1$, $P = 0.5$). None of the pregnant women were even close to approaching a dangerous body temperature at an intensity level of 69% of their maximum heart rate. As compared with pre-exercise values, oxygen saturation among pregnant women was significantly reduced at both maximum-exercise and postexercise measurements, but no measurement was below 95% in oxygen saturation.
Conclusion. Low-impact aerobics at about 70% of one's maximum heart rate appears to be safe in terms of risk of maternal hyperthermia.

Key words: core temperature; exercise; low-impact aerobics; oxygen saturation; pregnancy

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Most people agree that exercise is healthy. Positive effects on personal fitness have made exercise in various forms an important part of daily life among both men and women. However, many women change their exercising patterns when they become pregnant. Some of them no longer have the energy to work out, whereas others have concerns for the well-being of the fetus. Positive effects of exercising during pregnancy include a greater sense of well-being, increased energy, improved sleep, decreased backaches, better weight control, and enhanced strength and endurance (1). Shorter labor and fewer obstetric interventions have also been reported (1). Epidemiological data have shown that exercise may improve glycemic control in gestational diabetes, especially in obese women (2).

Formerly, it was recommended that pregnant women not exceed a heart rate of 140 bpm during exercise, nor exercise for longer than 15 min at a time (3). However, moderate exercise was allowed (i.e. 50 to 80% of one's predicted maximum heart rate) (4–6). New Canadian recommendations state that all pregnant women should exercise during pregnancy, barring the presence of complicating factors. These new recommendations have also increased the goal for exercise intensity to at least the moderate level, i.e. 60 to 90% of one's age-predicted maximum heart rate (2).

The main safety concern expressed is the potential harm from hyperthermia that may be associated with maternal exercise (7). It has been shown in animal studies that heat stress during early pregnancy is related to an increased risk of neural tube defects (8). A temperature of 39.2 °C or higher has been proposed as presenting a risk for the fetus (1). During exercise, non-pregnant humans are known to reach a core temperature up to 40 °C under normal environmental conditions (or 41–42 °C if conditions are extremely hot) (8). This indicates that during exercise pregnant women may drive their body temperatures up to levels that are potentially dangerous to the fetus. In contrast, there are no reports indicating that hyperthermia occurs during exercise among pregnant women, nor have any teratogenic effects been linked to exercise in humans (2).

The objective was to study temperature and oxygen saturation responses to low-impact exercise of healthy pregnant women.

Materials and methods

Forty-two pregnant women were asked to participate in the study. Volunteers were obtained from pregnant women attending selected aerobic exercise programs. After being given oral information about the study, one potential subject withdrew for practical reasons. During the course of the study, one participant was excluded because of problems in getting reliable oxygen saturation values, leaving 40 women in the program.

Thirty-seven of the pregnant women participated in low-impact aerobic exercise that was especially modified for pregnant women, two did low-impact exercise modified for those with back problems, and one did regular low-impact exercise. Measurements of the women took place in Sweden during October 2002 at Gerdahallen, Lund ($n = 11$), and Friskis & Svettis centers in Stockholm, Malmö, and Lund ($n = 30$). A reference group of 11 non-pregnant controls was composed by inviting the participating of healthy, non-smoking women who usually exercised at the workout center where measurements were made (Gerdahallen). To obtain the same intensity level of exercise, the non-pregnant controls agreed to work out with the class that had been modified for pregnant women ('expectancy class') when measured. The measurements of non-pregnant women were made in October and November 2002. All measurements were done by LL.

Each exercise program consisted of both conditioning and weight-bearing activities, with stretching afterward. To adapt the aerobic program to pregnant women, the instructors excluded jumps and running, and exercises from a supine position. At the end of the program, relaxation practice was added to the sessions.

A pulse oximeter with a probe attached to one of the right fingers was used for measuring heart rate and saturation (Nellcor Symphony N-3000 Pulse Oximeter; Nellcor Inc.; Pleasanton, California). Heart rate was measured instantaneously, and steady-state digital pulse oximetry was recorded after about 20 seconds.

Maternal body core temperature was measured with a tympanic ear meter (ThermoScan, type 6012; Braun; Kronberg, Germany). Each temperature reading was taken three times in the right ear, and the highest temperature regarded as the correct one, as suggested in the instructions from the thermometer manufacturer.

Three measurements were made on each individual during the exercise program. The first measurements were taken before the participants began to exercise and denoted as 'pre-exercise value'. The 'maximum-exercise' measurements were taken after 30–45 min of exercising, immediately following a period of pulse-increasing activity. The last set of measurements, termed 'postexercise', was recorded after stretching and relaxation.

Background information such as age and gestational age were recorded for each participant. Individual changes in exercise patterns from prepregnant to pregnant status were recorded.

Statistics

Mean and standard deviations (SD) were calculated. Paired *t*-test was used for the comparison of repeated measures and the χ^2-test for categorical data, as appropriate. Spearman's *Rho* was used for correlation analysis. *P*-values < 0.05 were regarded as significant. Analysis was performed using SPSS software (SPSS Corporation, Chicago, Illinois).

Results

The 40 pregnant women in the study had a mean age of 30.9 years (SD 4.6), a mean body mass of 69.9 kg (SD 7.6), and a mean gestational age of 25.4 weeks (SD 5.5). Thirty-five of them were nulliparas and five had one child only. The mean age in the control group was 25.5 years (SD 4.0) and the mean body mass 63.6 kg (SD 5.3). They were all nulliparous women.

Neither pregnant women nor any controls reached a potentially dangerous body temperature while exercising. The highest recorded temperature during exercise among pregnant women was 38.1 °C. Outcome measurements are presented in Table I. The pregnant women did not display significant core temperature changes from pre-exercise to either maximum-exercise or postexercise levels ($P = 0.1$ or $P = 0.5$, respectively). The non-pregnant controls, on the other hand, showed a significant increase in core temperature when pre-exercise levels were compared to maximum-exercise temperatures ($P = 0.03$) and postexercise levels ($P = 0.03$). The maximum-exercise temperature also turned out to be the peak temperature among pregnant women, while the controls had their peak temperature at the postexercise measurement, as shown in Fig. 1. A significant decrease in pre-exercise and maximum-exercise core temperature with increasing gestational age was revealed when measurements of core temperature were analyzed (*Rho* $= -0.43$, $P = 0.006$ and *Rho* $= -0.41$, $P = 0.008$, respectively) (pre-exercise core temperature shown in Fig. 2).

As compared with the pre-exercise values, there was a significant reduction in oxygen saturation at maximum exercise (98.7 versus 97.4%, $P = 0.03$) among the pregnant women, which

Table I. Temperature and oxygen saturation response to low-impact exercise

	Mean ± SD			
	Core temperature (°C)	Oxygen saturation (%)	Heart rate (bpm)	Percent of maximum*
Pregnant cases ($n = 40$)				
Before exercise	36.5 ± 0.5	98.7 ± 1.2	87.9 ± 14.4	46.5 ± 7.3
Maximum exercise	36.7 ± 0.6	97.4 ± 1.0†	130.2 ± 20.2	68.8 ± 10.4
After exercise	36.5 ± 0.5	97.6 ± 1.4†	98.9 ± 11.2	52.3 ± 6.1
Non-pregnant controls ($n = 11$)				
Before exercise	36.0 ± 0.8	98.4 ± 1.4	85.0 ± 7.6	43.7 ± 4.3
Maximum exercise	36.4 ± 0.8†	97.9 ± 1.0	146.0 ± 22.1	75.1 ± 11.6
After exercise	36.4 ± 0.6†	98.4 ± 1.0	88.6 ± 10.6	45.5 ± 5.6

SD = Standard deviation.
*Percent of age-predicted maximum heart rate.
†$P < 0.05$ in comparison with pre-exercise value.

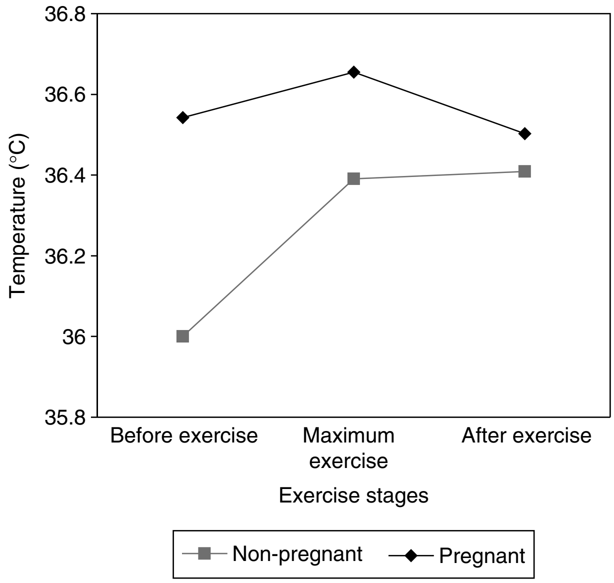

Fig. 1. Core temperature in relation to exercise.

was not found among the controls (Table I). In addition, the postexercise values among pregnant women were also significantly reduced as compared with the pre-exercise values (98.7 versus 97.6%, $P = 0.03$). No values were found below 95% in oxygen saturation. The percentages of age-predicted maximum heart rates at different levels of exercise were calculated (Table I). Pregnant women were exercising at a slightly lower percentage of maximum heart rate ($P = 0.09$) and their postexercise heart rate remained at a higher level ($P = 0.02$), as compared with controls.

Since the onset of their pregnancies, 51% of the women reduced the frequency of exercising, 37% exercised just as much as before, and 12% had increased their exercising habits. As compared with training intensity before pregnancy, 71% of the pregnant women stated that the exercise program during which the measurements were made was less intense than the exercise they used to participate in before pregnancy. Twenty-two percent found the program to be at about the same intensity level, and the remaining 7% stated they exercised at a more intense level than before. All women in the control group found the 'expectancy class' to be less intense than the exercise programs they had usually participated in.

Discussion

We showed that pregnant women participating in regular low-impact aerobics did not reach

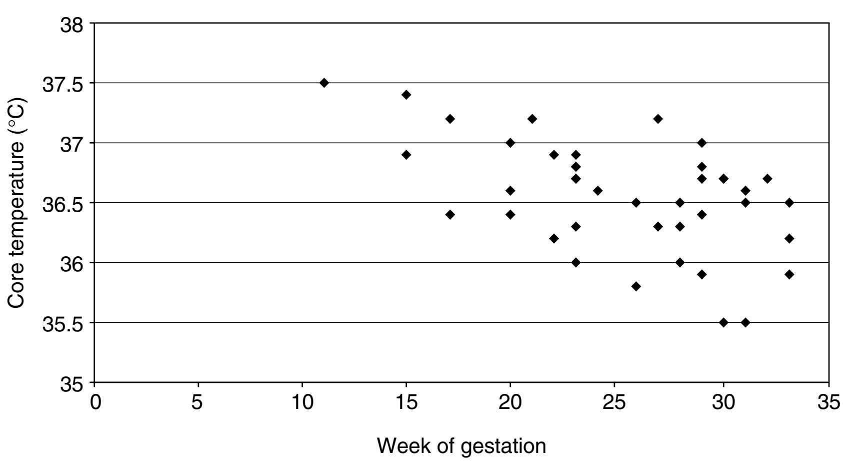

Fig. 2. Pre-exercise core temperature and gestational age.

potentially harmful body temperatures when they remained at an intensity level of 69% of their maximum heart rate, i.e. moderate intensity. There was a large margin of safety up to submaximum intensity, i.e. 80 to 90% of maximum heart rate, a level which is recognized as safe in terms of rise in temperature and oxygen saturation (9,10).

The core temperatures of pregnant women declined with increasing gestational age (Fig. 2). This is in accordance with previous studies (7,9) and can be partly explained by the minute increases in ventilation and in skin blood flow and changes in central temperature regulation that occur during pregnancy (1). The clinical notion that pregnant women feel warm, but in reality become cooler and cooler, may seem paradoxical. However, it has been shown that the initiation of sweating occurs at a continuously lower body temperature with increasing gestational age (7).

It is noteworthy that temperatures of the pregnant women remained similar in postexercise measurements, as compared with their pre-exercise temperatures (Fig. 1; Table I); however, in the reference group, body temperature tended to increase throughout the whole exercise program, with maximum temperature being achieved upon resting (Fig. 1). In an earlier study, we found that, through the entire period of their pregnancy, pregnant women had less of a temperature increase upon exercising than they did before or after pregnancy (9). In mid-pregnancy, pre-exercise temperature equaled maximum-exercise temperature, i.e. there were no increase in core temperature as a result of submaximum exercise (9). Existing data indicate that a more rapid and effective compensation of core temperature occurs during pregnancy, as compared with the non-pregnant state. This may be interpreted as a physiological protection against hyperthermia in pregnancy.

Body temperatures recorded in this study were generally lower than those shown in earlier studies (9,11). Several reasons may be proposed to account for this. A weakness of the present study may be that this is due to calibration variations of the instrument used. However, the main results, i.e. temperature change in response to exercise, would remain unaffected. The thermoregulation systems of the exercise halls used in this study maintained a constant temperature of 19 °C, but in previous studies the temperature was above 22 °C (9,11). In addition, the women differed in what they wore during exercise, resulting in uneven conditions under which they were measured. This can be regarded as a weakness of the study, although because it reflects the actual conditions under which these women usually exercise, it may be a positive aspect of this observational study.

We have no explanation for the decrease in oxygen saturation among the pregnant women. In our prior study, pre-exercise and maximum-exercise values were similar at submaximal level. In this study, the duration of exercise at a moderate intensity level (30–45 min) was longer. This finding indicates the need for new studies of longer duration exercise during pregnancy.

Fifty-one percent of the pregnant women in this study stated that they had reduced the frequency of training during pregnancy. This is in agreement with a study reporting a tendency toward decreased activity with increasing maternal age and parity (13). Women who temporary halt exercise during pregnancy tend not to resume their exercise habits postpartum to the same extent as women who choose to continue exercising during pregnancy (8). Is discouraging a woman from exercising during her pregnancy for reasons of safety really. safe advice?

Several previous restrictions on exercise during pregnancy have been based on hypothetical dangers that have not been demonstrated. Clearly, pregnant women should refrain from engaging in contact sports involving the risk of blows to the abdomen. They should also avoid scuba diving, due to the increased risk it presents for the fetus (12). Women with complications of pregnancy or other significant diseases should contact their obstetrician before initiating an exercise program. Among the warning signs that every pregnant women who chooses to exercise should be aware of, so she may terminate her exercise if any of them appear are, vaginal bleeding, dyspnea prior to exertion, dizziness, headache, chest pain, muscle weakness, calf pain or swelling (thrombophlebitis should be ruled out), preterm labor, decreased fetal movement, or amniotic fluid leakage (2).

Our results support the new American and Canadian recommendations that, in the absence of complicating factors, all pregnant women should be encouraged to do physical exercise. Because, in the course of regular low-impact training, pregnant women did not reach body temperatures even close to the potentially dangerous level of 39.2 °C, we therefore conclude that low-impact aerobics at about 70% of one's maximum heart rate appear to be safe in terms of risk of maternal hyperthermia.

References

1. Wang TW, Apgar BS. Exercise during pregnancy. Am Fam Physician 1998; 57: 1857.

2. American College of Obstetricians and Gynecologists. Exercise During Pregnancy and the Postnatal Period. Washington: American College of Obstetricians and Gynecologists, 2002. Committee Opinion no. 267.
3. American College of Obstetricians and Gynecologists. Exercise in Pregnancy. Washington: American College of Obstetricians and Gynecologists, 1985. Technical bulletin no. 58.
4. Khanna N. Effects of exercise on pregnancy. Am Fam Physician 1998; 57: 1770–2.
5. Huch R, Erkkola R. Pregnancy and exercise – exercise and pregnancy. A short review. Br J Obstet Gynaecol 1990; 97: 208–14.
6. American College of Obstetricians and Gynecologists. Exercise during pregnancy and the postpartum period. ACOG Technical Bulletin no. 189. Int J Gynaecol Obstet 1994; 45: 65–70.
7. Clapp JFD. The changing thermal response to endurance exercise during pregnancy. Am J Obstet Gynecol 1991; 165: 1684–9.
8. Ezmerli NM. Exercise in pregnancy. Prim Care Update Ob Gyns 2000; 7: 260–5.
9. Lindqvist PG, Marsal K, Merlo J, Pirhonen JP. Thermal response to submaximal exercise before, during and after pregnancy: a longitudinal study. J Matern Fetal Neonatal Med 2003; 13: 152–6.
10. Pirhonen JP, Lindqvist PG, Marsal K. A longitudinal study of maternal oxygen saturation during short-term submaximal exercise. Clin Physiol Funct Imaging 2003; 23: 37–41.
11. Jones RL, Botti JJ, Anderson WM, Bennett NL. Thermoregulation during aerobic exercise in pregnancy. Obstet Gynecol 1985; 65: 340–5.
12. Camporesi EM. Diving and pregnancy. Semin Perinatol 1996; 20: 292–302.
13. Zhang J, Savitz DA. Exercise during pregnancy among US women. Ann Epidemiol 1996; 6: 53–9.

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