



Canadian Guidelines for Exercise in Pregnancy

LARRY A. WOLFE, PhD and GREGORY A. L. DAVIES, MD

School of Physical and Health Education, Departments of Obstetrics and Gynaecology and Physiology, Queen's University, Kingston, Ontario, Canada

The need for guidelines for exercise during pregnancy and the postpartum period was stimulated during the early 1980s when active women of the “baby boom” generation became interested in whether it was safe to continue their active lifestyles during pregnancy. As a result of the strong demand for information, important questions were raised concerning the risk/benefit ratio of such exercise.¹ Postulated risks included the possibility that the fetus may be forced to compete with contracting maternal skeletal muscle for oxygenated blood flow (leading to fetal hypoxia and distress), essential substrates (leading to fetal growth restriction), and heat dissipation (leading to fetal hyperthermia and potential teratogenic effects).^{2–4} Concern was also expressed that exercise may increase the chance of early miscarriage, spontaneous abortion, and pre-

mature labor, as well as chronic fatigue and musculoskeletal injury.⁴ Putative benefits included maintenance of prenatal aerobic and musculoskeletal fitness levels, prevention of excessive maternal weight gain, facilitation of labor and recovery from labor, promotion of good posture, prevention of gestational glucose intolerance and low back pain, and improved psychological adjustment to the changes of pregnancy.⁴

As a result of the conflict between these postulated benefits and risks, the idea that a dose-response relationship existed between the quantity and quality of exercise and maternal/fetal well-being quickly emerged^{4–7} (Fig. 1). The concept that exercise is safe for some pregnant women but not others also led to the need for absolute and relative medical contraindications to exercise and the need for medical screening by a qualified health care provider before engaging in fitness training after becoming pregnant.⁸

As a result of a lack of scientific information, early guidelines for exercise during pregnancy were necessarily conservative and based primarily on common sense and

*Note: A copy of the Physical Activity Readiness Medical Examination for Pregnancy can be obtained from the Internet at: www.csep.ca/forms.asp
Correspondence: Larry A. Wolfe, PhD, School of Physical and Health Education, Queen's University, Kingston, Ontario K7L 3N6, Canada. E-mail: wolfel@post.queensu.ca*

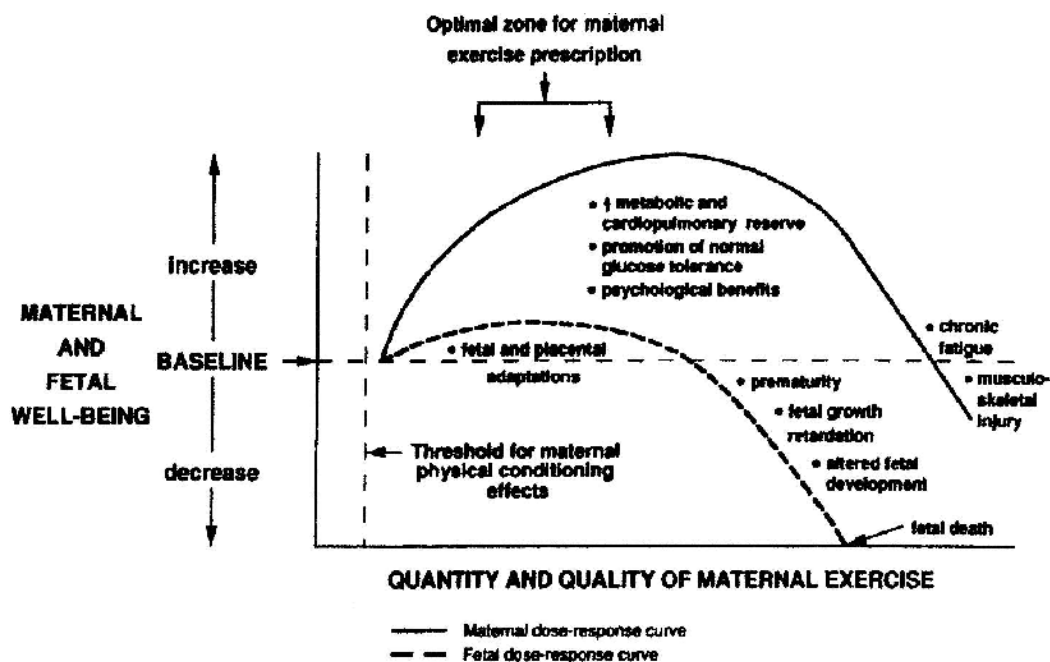


FIG. 1. Postulated dose-response relationship between quantity and quality of prenatal exercise with maternal and fetal well-being. Solid line, maternal dose-response curve; broken line, fetal dose-response curve. (Wolfe LA, Brenner IKM, Mottola MF. Maternal exercise, pregnancy outcome and fetal well-being. *Exerc Sport Sci Rev.* 1994;22:145–194, with permission)

the best guesses of medical authorities and exercise physiologists. In the United States, the original guidelines, “Exercise During Pregnancy and the Postpartum Period,” were published in 1985.⁸ These guidelines were the subject of much controversy because they placed conservative limits on the maximum pulse rate that could be achieved (140 bpm) and the duration of exercise (maximum of 15 minutes) and did not accommodate the idea that previously inactive women could begin an exercise program after becoming pregnant. Subsequent revisions published in 1994⁹ and 2002¹⁰ have become progressively more evidence-based and less restrictive and are widely accepted.

Pre- and postnatal exercise guidelines followed a parallel but different development path in Canada as a result of promotion by national and provincial health/fitness ministries. The first of these, a booklet en-

titled “Fitness and Pregnancy,” was published by Fitness Canada (a federal government ministry) and was made available to the general public in 1982. This publication promoted the idea that pregnancy is a good time to develop healthy lifestyle habits (including regular exercise, good nutrition, smoking cessation, and abstinence from alcohol consumption). Guidelines for aerobic exercise included the idea that pregnant women should exercise 3 to 5 days per week for at least 15 minutes per session using the lower end of conventional pulse rate target zones for apparently healthy adults. The “talk test” was also introduced as a check to avoid overexertion. Muscular conditioning exercises, including calisthenics for general muscular conditioning and improvement of posture, abdominal exercises, Kegel exercises to strengthen the pelvic floor, and warm-up/cool-down exercises, were de-

scribed in detail. Finally, a postnatal exercise routine was also provided. This publication was followed by guidelines for the training of pre- and postnatal fitness instructors published by the Fitness Ontario Leadership Program and the National Fitness Leadership Advisory Committee.

More recently, the Physical Activity Readiness Examination (PARmed-X for Pregnancy)¹¹ was made available for use by physicians and midwives to provide medical clearance for their pregnant patients to initiate prenatal exercise programs. A summary of guidelines for the prescription of aerobic exercise and muscle conditioning was also included to assist health care providers in advising their pregnant patients on safe and effective types, intensities, and durations of exercise and suggested rates of progression. Safety precautions and reasons to stop exercise and consult a physician were also incorporated, along with advice for active living, healthy eating, and maintenance of a positive self-image.

A companion booklet, "Active Living During Pregnancy: Physical Activity Guidelines for Mother and Baby," was also made available to provide more detailed information to pregnant women on the guidelines outlined in the PARmed-X for Pregnancy.¹² The PARmed-X for Pregnancy was first made available to the public in 1996 and revised in 2002. The companion booklet was published in 1999. These materials are co-published by Health Canada and the Canadian Society for Exercise Physiology (CSEP) and are available from CSEP.

Research Background for PARmed-X for Pregnancy

The original prototype version of the PARmed-X for Pregnancy was formulated for use in a series of research studies conducted in the Clinical Exercise Physiology Laboratory at Queen's University in Kingston, Ontario, Canada (L. A. Wolfe, coordi-

nator). These were controlled prospective studies that involved previously sedentary women. Subjects in the experimental group entered the physical conditioning program at the start of the second trimester and continued until term. Procedures for aerobic exercise prescription and muscle conditioning were those described in the current version of the PARmed-X for Pregnancy. All subjects were tested at the start of the second trimester (preconditioning), at the end of both the second and third trimesters (postconditioning), and 3 to 4 months postpartum. Measurements during both steady-state and progressive testing protocols included a wide array of maternal metabolic, cardiovascular, and respiratory variables as well as fetal responses, pregnancy outcome, and labor and delivery data.¹³⁻²⁰ These studies confirmed that the physical conditioning methods used were safe for the mother and fetus and effective to improve maternal fitness.

In 1990, the format of the prototype PARmed-X for Pregnancy was refined after input from the Ontario Fitness Safety Standards Committee (N. L. Gledhill, chairperson) and an Expert Advisory Committee of the Canadian Society for Exercise Physiology and Health Canada. Safety precautions for muscle conditioning were also added in accordance with advice from Michelle F. Mottola, PhD (School of Kinesiology, University of Western Ontario). After an exhaustive review of available literature,^{21,22} use of the PARmed-X for Pregnancy was endorsed by the Canadian Academy of Sports Medicine in their "Position Statement on Pregnancy and Exercise."²³

Finally and most recently, CSEP and the Society of Obstetricians and Gynecologists of Canada (SOGC) have collaborated to formulate Canadian National Guidelines for exercise during pregnancy and postpartum.²⁴ These guidelines endorse the current version of the PARmed-X for pregnancy¹¹ and will be published in the June 2003 issues of the Journals of both societies.²⁴

Medical Screening and Monitoring

An important goal in the design of the PARmed-X for Pregnancy was to establish communication between the pregnant woman, the health care provider monitoring her pregnancy, and her prenatal fitness instructor. To accomplish this, the pregnant woman completes Part A (her own basic contact information and telephone number of her prenatal fitness instructor) and Part B (questions on her general health status, presence or absence of symptoms in her current pregnancy, her current physical activity habits and intentions).

After completion of Parts A and B, the form is given by the pregnant woman to her health care provider, who completes Part C to approve or withhold medical clearance as appropriate. This section consists of a convenient checklist regarding the presence or absence of well-accepted absolute and relative contraindications to exercise in pregnancy, followed by a recommendation that exercise is either approved or contraindicated, based on current information.

A tear-away form is provided to be completed by the health care provider monitoring the woman's pregnancy to inform the individual's prenatal fitness instructor that the screening process had been completed. Finally, both "Safety Considerations" and "Reasons to Consult a Physician" were incorporated to ensure that the pregnant women exercises safely and seeks medical advice if signs appear that her pregnancy is not proceeding normally.

General Advice

The PARmed-X for Pregnancy guidelines carry forward the original philosophy of Fitness Canada that pregnancy is a good time to establish healthy lifestyle habits and that previously inactive women are encouraged to begin exercise programs while pregnant. In view of the discomforts in early pregnancy (nausea, fatigue, etc.), the high gen-

eral rate of early miscarriage, and concerns about possible teratogenic effects of overheating during closure of the fetal neural tube, the start of the second trimester was identified as the best time to begin such a program.

Since the potential for competition between contracting maternal skeletal muscle and the fetus for oxygenated blood flow, glucose availability from the maternal blood glucose pool, and heat dissipation is highest in late gestation, the third trimester was also identified as a poor time to increase the quantity and quality of physical activity. This leaves the second trimester as the best time to progressively increase the amount of physical activity.

Aerobic Exercise

PRESCRIPTION AND MONITORING OF EXERCISE INTENSITY

Historically, the safest and most accurate way to prescribe and monitor the intensity of aerobic exercise in pregnancy has been a subject of considerable controversy. This is based on the fact that resting heart rate increases abruptly during the first trimester, followed by further moderate increases with advancing gestational age. Maximal heart rate has also been reported to be attenuated during maximal exercise testing,²⁵ resulting in a significant reduction in maximal heart rate reserve²⁶ (Fig. 2). Recent studies from this laboratory indicate that the higher resting heart rate and blunted heart rate response to heavy exercise are the result of reduced parasympathetic/vagal and sympathoadrenal modulation, respectively.²⁷

As a result of the reduced maximal heart rate reserve, use of conventional heart rate target ranges for aerobic exercise is less dependable and precise during pregnancy compared with the nonpregnant state. To adjust for this, the modified heart rate target zones were provided as part of the PARmed-X for Pregnancy guidelines. This involved reduction in the heart rate target

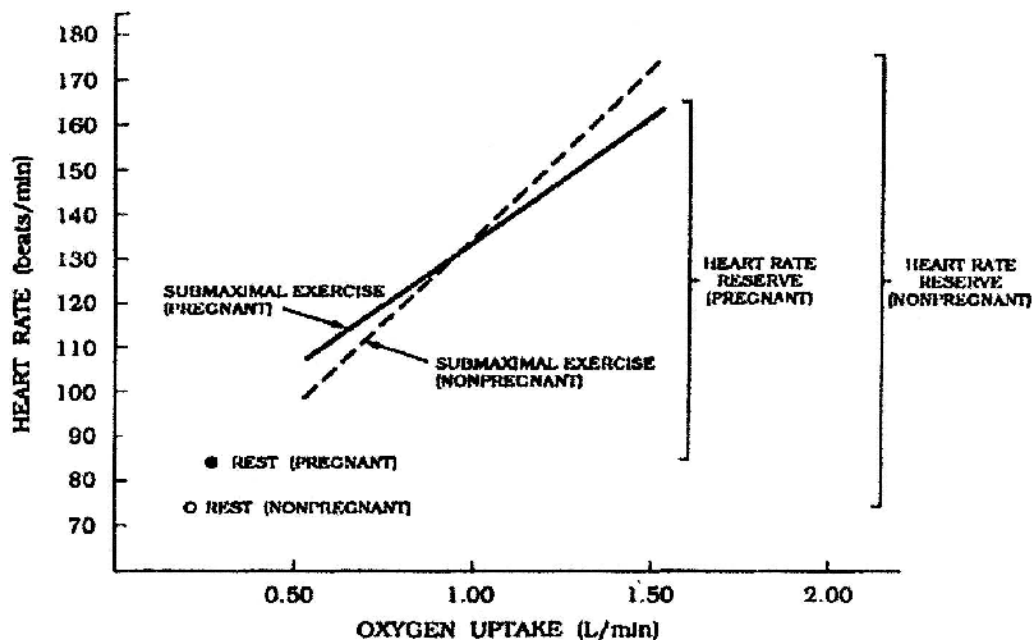


FIG. 2. Pregnancy-induced changes in resting heart rate, heart rate responses to exercise, and maximal heart rate reserve. (Wolfe LA, Mottola MF. Aerobic exercise in pregnancy: an update. *Can J Appl Physiol.* 1993;18:117-147, with permission)

zone for each age decade from approximately 20 to 15 bpm. This was done by lowering the upper end of the zone by 5 bpm. In both the pregnant and nonpregnant states, the heart rate target range represents approximately 60–80% of aerobic capacity.

Since the heart rate method of prescribing exercise intensity is less precise during pregnancy, ratings of perceived exertion (RPE) were recommended for use in addition to heart rate. RPE ratings at any given external work rate are not significantly altered by pregnancy or advancing gestational age.^{13,17} Therefore, Borg's conventional 15-point scale⁶⁻²⁰ was recommended for this purpose, with 12 to 14 (a rating of 13 corresponds to a subjective rating of "somewhat hard") identified as the RPE range to use in pregnancy.

As suggested originally by Fitness Canada, the "talk test" was also retained as a final check to avoid overexertion. This is based on the idea that the exercising pregnant

woman should be able to carry on a verbal conversation; if she cannot, the exercise intensity is too high. Since respiratory chemosensitivity is increased throughout pregnancy,²⁸ this test is more conservative during pregnancy than in the nonpregnant state.

EXERCISE DURATION AND FREQUENCY

Pregnant women should perform aerobic exercise regularly for at least 15 minutes, 3 days per week at the target intensity. Previously inactive women can gradually increase the duration of exercise from 15 to approximately 30 minutes per session over the course of the second trimester. The frequency of aerobic exercise can also be increased from a minimum of 3 days per week to 4 or 5 days per week. Exercise durations of 25 to 30 minutes per session at the target intensity have been shown to be safe and effective to increase maternal physical fitness.¹³⁻²⁰

The recent case-control study by Camp-

bell and Mottola²⁹ indicated that women who participated in structured exercise five or more times per week had an increased chance of delivering a low-birth weight infant compared with women who exercised three or four times per week. Women who exercised 2 days per week or less were also at increased risk for low birth weight.

Muscle Conditioning

TYPES OF EXERCISES

A detailed review of procedures for muscle conditioning and specific exercises appear in the CSEP booklet "Active Living During Pregnancy: Activity Guidelines for Mother and Baby."¹²

As summarized in the PARmed-X for Pregnancy, muscular strengthening exercises should be included for the upper and lower back (to promote good posture), the abdomen (to promote good posture, prevent low back pain, prevent diastasis recti, and strengthen the muscles of labor), upper body (to support the breasts), and buttocks/lower limbs (to facilitate weight bearing and prevent varicose veins). Pelvic floor exercises (Kegels) should also be included to strengthen the pelvic floor muscles and prevent urinary incontinence.³⁰ Warm-up and cool-down exercises should also be incorporated and should include range of motion exercises and static stretching exercises for all major joints and muscle groups, respectively.

SAFETY PRECAUTIONS

Safety precautions for muscle conditioning are included in both the PARmed-X for Pregnancy and its companion booklet.^{11,12} Briefly, these include the following: the need to avoid exercise in the supine position after the fourth month of gestation (to avoid the supine hypotension reaction); maintenance of good posture during daily activities; emphasis on controlled, static exercises versus ballistic movements during stretching; the need to discontinue abdominal exer-

cises if diastasis recti develops; and avoidance of the Valsalva maneuver during resistance exercises.

To examine the safety of maternal strength conditioning, a recent study from this laboratory examined fetal heart rate responses to strength conditioning exercises in late gestation.³¹ Healthy pregnant women (n = 12) performed three sets of different exercises involving different muscle masses (handgrip, single leg extension, double leg extension) at 50%, 70%, and 90% of their 10 repetition maximum in both the supine (30° tilt) and sitting postures. The order of the exercises for each subject was randomized. With the exception of occasional mild, transient bradycardic responses to exercise in the supine posture, fetal responses to exercise were unremarkable and supported the safety of moderate resistance training in late gestation, provided that the supine posture is avoided.

Nutritional Guidelines

The PARmed-X for Pregnancy and its companion booklet^{11,12} also include basic advice for healthy eating. This includes the need to choose healthy foods from the four major food groups in accordance with Canada's Food Guide to Healthy Eating, along with adequate fluid intake. The need to gradually increase caloric intake to accommodate the increased energy requirements of pregnancy and to replace additional calories used for exercise was also emphasized; dieting to lose weight is discouraged. Finally, advice was given to avoid alcohol intake and cigarette smoking completely and to limit caffeine intake. Detailed nutritional guidelines for pregnancy and postpartum were published by Health Canada in 1999³² and are available in the Internet (www.hc-sc.gc.ca).

Postpartum Exercise

The CSEP's "Active Living in Pregnancy" booklet¹² advises that women who have had

a healthy, uncomplicated pregnancy can resume mild activities such as walking, pelvic floor exercises, and moderate stretching immediately after delivery. Women with caesarean sections or other complications should consult their pre/postnatal health care provider before resuming activity. With their health care provider's approval, most women can resume their normal exercise programs after their postnatal checkup at approximately 6 to 8 weeks postpartum.

The CSEP booklet also includes recommendations for aerobic and muscle conditioning. Aerobic exercise should be done using conventional heart rate target and RPE targets for at least 15 minutes, 3 to 5 days per week. A series of postnatal exercises involving the mother and baby are also provided and include walking with a stroller, pliés, toe raises, modified pushups, and strengthening exercises for the abdominal and inner/outer thigh muscles.

Summary

Evidence-based guidelines for exercise in pregnancy have been developed in Canada as a result of cooperation between exercise scientists, the CSEP, Health Canada and the SOGC. After medical screening using the PARmed-X for Pregnancy, previously inactive women are encouraged to begin prenatal exercise programs involving both aerobic and muscle conditioning. Aerobic exercise should be performed regularly (at least 2 days per week), and exercise duration can be gradually and progressively increased from 15 to approximately 30 minutes per day over the course of the second trimester. Exercise intensity should be prescribed and monitored using modified heart rate target zones combined with the RPE method. The "talk test" can be used as a final check to prevent overexertion. Muscle conditioning exercises are also suggested to promote general conditioning and good posture, to facilitate labor, and to prevent gestational low back pain, urinary incontinence, diastasis recti, and varicose veins.

Women should avoid exercise in the supine posture after the fourth month as well as performance of the Valsalva maneuver during resistance exercise. Static stretching should be used and ballistic movements should be avoided. Advice for postnatal exercise and good nutrition was also provided.

Acknowledgment

The Exercise/Pregnancy Research Program at Queen's University has been supported by the U.S. Army Medical Research and Materiel Command (Contract #DAMD17-96-C-6112), the Canadian Forces Personnel Support Agency, the Ontario Thoracic Society, Ontario Thoracic Society Block Term Grant Funding, William H. Spear Foundation (Queen's University), Health Canada (NHRDP), the Canadian Fitness and Lifestyle Research Institute and NSERC (Canada).

References

1. Caldwell F, Jopke T. Questions and answers: ACSM 1985. *Physician Sportsmed.* 1985;13:145-147.
2. Lotgering FK, Gilbert RD, Longo LD. The interactions of pregnancy and exercise: A review. *Am J Obstet Gynecol.* 1984;149:560-568.
3. Wolfe LA, Ohtake PJ, Mottola MF. Physiological interactions between pregnancy and chronic exercise. *Exerc Sport Sci Rev.* 1989;17:295-351.
4. Wolfe LA, Hall P, Webb KA, et al. Prescription of aerobic exercise during pregnancy. *Sports Med.* 1989;8:273-301.
5. Lotgering FK, Longo LD. Exercise and pregnancy: how much is too much? *Contemp OB/GYN.* 1984;23:63-77.
6. Gauthier MM. Guidelines for exercise during pregnancy: too little or too much? *Physician Sportsmed.* 1986;14:162-169.
7. Wolfe LA, Brenner IKM, Mottola MF. Maternal exercise, fetal well-being and pregnancy outcome. *Exerc Sport Sci Rev.* 1994;22:145-194.
8. American College of Obstetricians and Gynecologists (ACOG). *Exercise During Pregnancy and the Postnatal Period.* ACOG

- Home Exercise Programs. Washington DC: ACOG, 1985.
9. American College of Obstetricians and Gynecologists (ACOG). Exercise During Pregnancy and the Postnatal Period. ACOG Technical Bulletin 189:2–7. Washington DC: ACOG, 1994.
 10. American College of Obstetricians and Gynecologists (ACOG). Exercise During Pregnancy and the Postnatal Period. ACOG Committee Opinion No. 267:1–3. Washington DC: ACOG, 2002.
 11. Canadian Society for Exercise Physiology (CSEP). Physical Activity Readiness Medical Examination for Pregnancy (PARmed-X for Pregnancy). Available from CSEP, 185 Somerset St. W., Suite 202, Ottawa, ON K2P 0J2, Canada, 1996.
 12. Canadian Society for Exercise Physiology (CSEP). Active Living During Pregnancy. Available from CSEP, 185 Somerset St. West, Suite 202, Ottawa K2P 0J2, Canada, 2002/also available on the Internet at: www.csop.ca/forms.asp.
 13. Ohtake PJ, Wolfe LA, Hall P et al. Physical conditioning effects on heart rate and perception of exertion in pregnancy [abstract]. *Can J Spt Sci*. 1988;13:71P.
 14. Brenner, IKM, Monga M, Webb KA, et al. Controlled prospective study of aerobic conditioning effects on pregnancy outcome [abstract]. *Med Sci Sports Exerc*. 1991;23:S169.
 15. Webb KA, Wolfe LA, McGrath MJ. Effects of acute and chronic exercise on fetal heart rate. *J Appl Physiol*. 1994;77:2207–2213.
 16. Wolfe LA, Walker RMC, Bonen A, et al. Effects of pregnancy and chronic exercise on respiratory responses to graded exercise. *J Appl Physiol*. 1994;76:1928–1936.
 17. Ohtake PJ, Wolfe LA. Physical conditioning attenuates respiratory responses to steady-state exercise in late gestation. *Med Sci Sports Exerc*. 1998;30:17–27.
 18. Brenner IKM, Wolfe LA, Monga M, et al. Physical conditioning effects on fetal heart rate responses to graded maternal exercise. *Med Sci Sports Exerc*. 1999;31:792–799.
 19. Wolfe LA, Mottola MF, Bonen A, et al. Controlled, randomized study of aerobic conditioning effects on neonatal morphometrics. *Med Sci Sports Exerc*. 1999;31:S138.
 20. Wolfe LA, Preston RJ, Burggraf GW, et al. Effects of pregnancy and chronic exercise on maternal cardiac structure and function. *Can J Appl Physiol*. 1999;77:909–917.
 21. Stevenson L. Exercise in pregnancy. Part 1: Update on pathophysiology. *Can Fam Physician*. 1997;43:97–104.
 22. Stevenson L. Exercise in pregnancy: Part 2: Recommendations for individuals. *Can Fam Physician*. 1997;43:107–111.
 23. Canadian Academy of Sports Medicine (CASM). Position Statement on Pregnancy and Exercise. Available from CASM, 1600 James Naismith Dr., Gloucester, Ontario, K1B 4N4, Canada, 1999.
 24. Davies GAL, Wolfe LA, Mottola MF, et al. SOGC and CSEP clinical practice guidelines for exercise in pregnancy and postpartum. *Can J Appl Physiol and J Obstet Gynecol Can* (in press), 2003.
 25. Lotgering FK, Van Doorn MB, Struijk PC, et al. Maximal aerobic exercise in pregnant women: heart rate, O₂ consumption, CO₂ production, and ventilation. *J Appl Physiol*. 1991;70:1016–1023.
 26. Wolfe LA, Mottola MF. Aerobic exercise in pregnancy: An update. *Can J Appl Physiol*. 1993;18:119–147.
 27. Avery ND, Wolfe LA, Amara CE, et al. Effects of human pregnancy on cardiac autonomic function above and below the ventilatory threshold. *J Appl Physiol*. 2001;90:321–328.
 28. Wolfe LA, Kemp JG, Heenan AP, et al. Acid-base regulation and control of ventilation in human pregnancy. *Can J Physiol Pharm*. 1998;76:815–827.
 29. Campbell MK, Mottola MF. Recreational exercise and occupational activity during pregnancy and birth weight: a case-control study. *Am J Obstet Gynecol*. 2001;184:404–408.
 30. Morkved S, Bo K. Effect of pelvic floor muscle training in prevention and treatment of urinary incontinence: a one-year follow up. *Br J Obstet Gynecol*. 2000;107:1022–1028.
 31. Avery ND, Stocking KD, Tranmer JE, et al. Fetal responses to maternal strength training exercises in late gestation. *Can J Appl Physiol*. 1999;24:362–367.
 32. Health Canada. Nutrition for a Healthy Pregnancy: National Guidelines for the Childbearing Years. Ottawa: Minister of Public Works and Government Services Canada, 1999. (Also available on Internet at: www.hc-sc.gc.ca)