Mario Scattolini

Reproductive Responses to Endurance Exercises in Women:

FROM CORSETS TO SHIN SPLINTS

Jerilynn Prior and Yvette Vigna

Les auteures examinent le rapport entre exercice d'endurance et changements du cycle menstruel. Des données récentes suggèrent que ces changements sont des changements d'adaptation, qu'ils sont réversibles, et peuvent être un avantage pour la femme active. De nombreuses athlètes, par exemple, semblent expérimenter moins de symptômes prémenstruels, et moins de crampes lorsque leur activité physique est intense. Les changements physiques et ceux du cycle menstruel font partie du processus de conditionnement.

Whalebone corsets and social convention, bustles and babies have limited western women's physical activity. Although whalebone undergarments have long since disappeared, only in the last ten years has convention allowed women to participate in rigorous activities. With increasing numbers of women becoming involved in intense sports, questions are being asked about the effects of this activity on reproductive function and pregnancy.

This article will review evidence associating endurance-type exercise with changes in the menstrual cycle. Recent data suggests that these alterations are adaptive, reversible, and may be of benefit to the active woman. Practical ways to document and evaluate hormonal changes and guidelines to protect against any undesirable effects of exercise will also be discussed.

The normal menstrual cycle seems straightforward enough: vaginal bleeding for a few days each month. In reality, though, the "period" is a very precisely regulated and complex sequence of carefully timed events. More than seven hormones act in the brain, the pituitary gland, the ovaries, the uterus, and on each other to prepare the female for the fertilization of an ovum and the successful nurture of a fetus to full term.

But there are phases of life when reproduction may be decreased or temporarily stopped. Energies are sometimes needed for even more basic functions, such as when intense labour is required to respond to a natural disaster. At other times the individual may be under duress due to illness or emotional turmoil and temporarily lose her period. Anthropologists, for example, have documented the work and birth spacing of the !Kung San women of the Kalahari Desert in Africa. These nomadic women use no birth control, yet they have their children three to five years apart. The women are food gatherers, walking twenty or thirty kilometres a day carrying heavy loads; it appears that the energy required by these women in food gathering decreases their fertility. After settling in villages, a fact which offers a change in agricultural food supplies and a more sedentary lifestyle, the Kalahari women give birth every eighteen months to two years.

Changes in the menstrual cycle associated with natural disasters, psychological stress, and physical activity are probably caused by alterations in the hormone-directing part of the brain, the hypothalamus. The hypothalamus produces gonadotrophin-releasing hormone (GnRH), which stimulates the pituitary gland to produce and release luteinizing hormone (LH) and follicle-stimulating hormone (FSH). These two pituitary hormones promote production of the ovarian steroids estrogen and progesterone.

The normal menstrual cycle is twenty-five to thirty-two days in length, counting from the first day of flow up to the last day before the next bleeding. An egg is released (ovulation) at midcycle. The number of days of bleeding is from two to five days.

The normal cycle can be divided into two parts (see figure 1, top bar). The first part of the cycle, the follicular phase, begins on the first day of bleeding and ends at ovulation. The follicular phase is usually fourteen to eighteen days. During the follicular phase, a small sac of the ovary (follicle) containing an egg is stimulated to grow to maturity. Although several follicles develop at the beginning of this phase, usually only one reaches maturity.

The largest increase in estrogen is observed during the latter part of the follicular phase, just prior to ovulation. The high estrogen signal is received by the hypothalamus and pituitary gland and leads to a sudden pituitary release of LH and FSH. This large LH surge, preceded by a smaller FSH surge, triggers ovulation. Estrogen stimulates the inner lining of the uterus (endometrium) to grow in preparation to receive the egg.

The second half of the cycle, referred to as the luteal phase, is ten to sixteen days in duration. The luteal phase begins after ovulation and lasts until the next flow starts. After the egg has been expelled, the mature follicle is called the corpus luteum. Both estrogen and progesterone are produced by the corpus luteum, but progesterone is dominant. It is the declining production of these two ovarian hormones by the corpus luteum that causes menstruation at the end of the luteal phase. Progesterone slows the growth of the endometrium, protecting it from overstimulation.

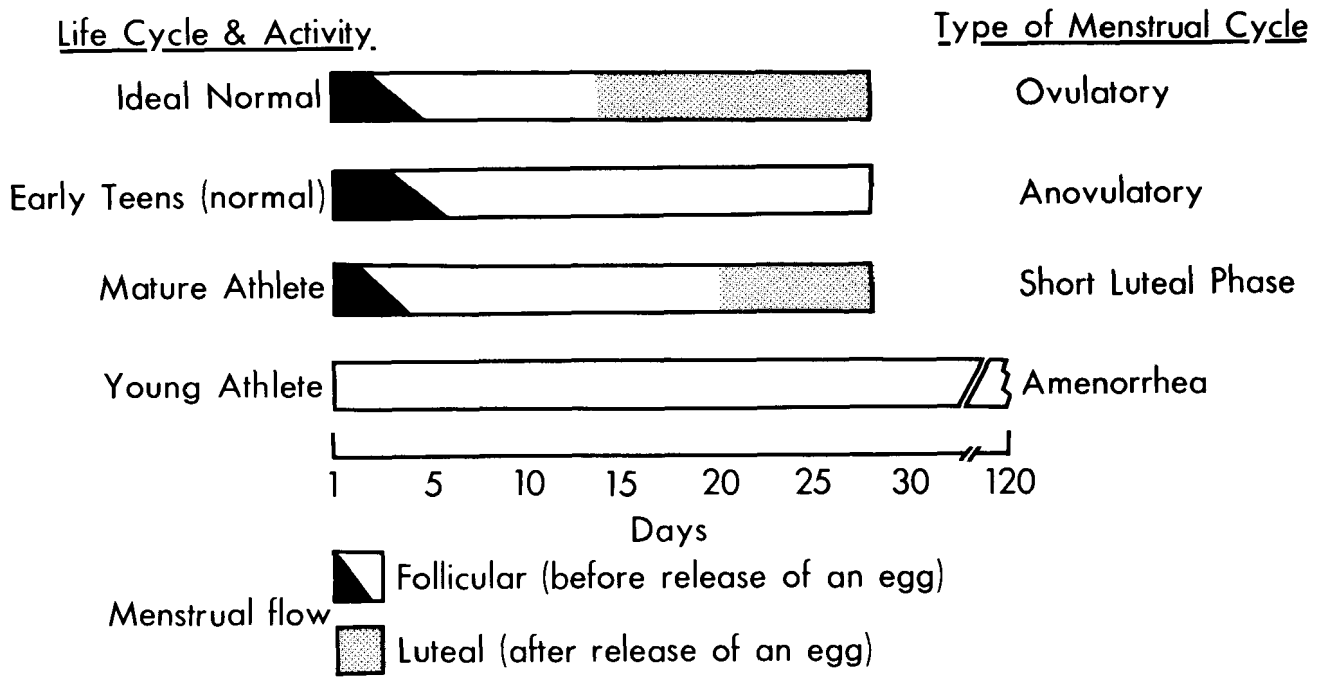
Figure 1 attempts to simplify and clarify the patterns of the menstrual cycle that occur in different phases of a woman's reproductive life. The ideal normal cycle shows the pattern of a mature woman with a fourteen-day luteal phase. The second bar illustrates the cycle of a normal teenager, showing a cycle of normal length and flow but without ovulation occurring.

The illustration shows that the first three types of cycles are the same length (twenty-eight days) with approximately five days of flow. The second cycle (Early Teens — Normal) is anovulatory and is often characteristic of the first ten years following menarche (the initiation of menstruation). Ovulation does not take place and the luteal phase is absent. Usually there are no cramps and no premenstrual symptoms.

If a young woman begins an exercise program within the first ten years of reproductive life (see figure 1, lower half), she may become amenorrheic (having fewer than three periods a year). This response is most likely to happen in women who have not been pregnant, have had irregular periods, and/or are thin. In contrast to the young athlete, the normally menstruating mature woman who begins exercis-

FIGURE I

The four characteristic types of menstrual cycles vary with the age of the person and her activity level.



ing, has been pregnant, and/or has had regular periods may show the pattern of luteal-phase shortening. Although this type of cycle can be twenty-eight days in length, it is often shorter and has a luteal phase of fewer than ten days. It is usually associated with infertility.

The mechanisms that produce a short luteal phase in women doing endurance training are unknown. It may be the body's protective response when demands are placed on it which make pregnancy undesirable or dangerous. The woman who is exercising and has a short luteal phase may not observe any alteration in her menstrual cycle. Unless she is amenorrheic, changes may go unnoticed because cycles of very different types often have the same flow duration and total length.

Major weight loss (more than 5 per cent of body weight), severe stress, exercise-induced increases in the production of the pituitary and hypothalamic hormones endorphin and prolactin, and a high energy output have all been postulated to be causes of menstrual-cycle changes. These factors cause alterations in the hypothalamus and in the ovarian production of estrogen, leading to menstrual-cycle variations. At present researchers do not have sufficient data to know conclusively whether these hormonal changes are initiated in the hypothalamus or in the ovaries, although several lines of evidence suggest the primary alteration is in the central control system.

During the 1950s and 1960s many athletic trainers reported that female athletes experienced a decrease in premenstrual symptoms and cramping when they were physically active. In the late 1970s a group from Colorado did a questionnaire survey of college-age women engaged in track-and-field events. These results showed that women running middle distances and training more than forty miles per week experienced amenorrhea with increasing frequency as their mileage increased. Similar findings were documented in ballet dancers and young competitive swimmers. Most people interested in the female athlete, however, have continued to say that women running marathons usually maintain a normal cycle. These studies, though carefully done, did not use any specific criteria other than the length of time between periods and the duration of menstrual flow to document what was happening within the menstrual cycle.

We have been following women training for a marathon and evaluating not only cycle length but also basal body temperature. When progesterone is secreted, internal temperature rises because of the heat-producing properties of progesterone. It is possible for a woman to document her menstrual cycle and determine if she is ovulating (when there is an increase in progesterone) by simply taking her temperature in the morning before she gets out of bed. An increase in temperature occurs at midcycle; this temperature plateau persists until the time of menstruation. Researchers using basal body-temperature methods found that mature women, average age thirty-five, with normal menstrual-cycle histories, had luteal phase shortening especially with more intensive training. In our sample, one-third of the cycles submitted by fourteen women (a total of forty-eight cycles) had shortening of the luteal phase (see figure 2). Another third of the cycles were anovulatory. Surprisingly, the length of the usual training run was discovered to be significantly associated with short luteal phase or anovulatory cycles (see figure 3). In-

creased endorphin production during longer runs may suppress gonadotrophin-releasing hormone and prevent ovulation. It is also possible that longer runs raise core temperature; this increase in body temperature begins to affect the hypothalamus. Interestingly, women with menstrual-cycle changes experienced no weight loss in association with anovulation and luteal-phase shortening.

runners. Researchers have also found that sedentary patients with prolactin-producing tumours and experiencing amenorrhea and low estrogen levels also have lower bone density.

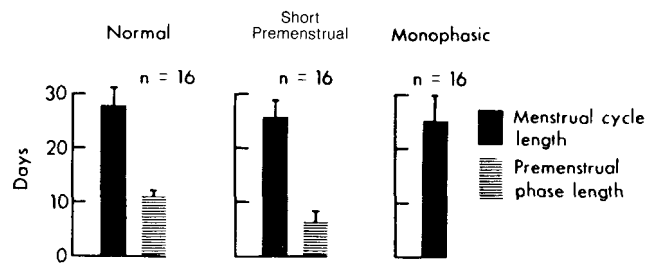
Bone develops at a maximum rate in the late teens and early twenties, with the largest bone mass occurring prior to the thirtieth year. Bone density gradually decreases over the years; at menopause this process accelerates. By the time some women reach sixty or seventy they start experiencing fractures because of their thin bones (osteoporosis). Low estrogen levels associated with delayed menarche are a significant concern because they may predispose a woman to osteoporosis at an early age.

Fortunately, bone growth can be improved by increasing the intake of calcium in the diet. (This addition to the diet will even prevent increased bone loss at the time of menopause.) The normal dietary intake of calcium is between 400 and 800 milligrams per day. Often the teenager does not have adequate calcium in her diet; certainly the one who is taking fewer than four servings of dairy products each day does not. Calcium supplementation is easy to take in the form of Tums. Each table contains 200 milligrams of calcium in the form of calcium carbonate. The teenager or amenorrheic athlete who takes two tablets of Tums in the morning and three at bedtime will receive more than adequate amounts of calcium orally, and she may also prevent osteoporosis.

Another concern of the amenorrheic athlete is that estrogen levels are too low to adequately support the vagina. Estrogen makes the vaginal tissue elastic, resilient, and moist enough to prevent injury. If the athletic woman is experiencing painful intercourse from dryness and soreness of the vagina, local estrogen replacement such as vaginal cream (Premarin) will markedly improve the symptoms. As little as half an applicator of estrogen vaginal cream at bedtime once a week will prevent symptomatic vaginal atrophy. This small amount of estrogen is unlikely to cause any systemic effects or other complications.

A final concern about irregular periods or amenorrhea is the question of birth control. The woman who is falsely assured that she will not get pregnant may be surprised to discover that she is. Fertility can be re-established quickly, especially if the woman has a short period of rest, is injured, or decreases her usual level of vigorous activity. Therefore, even if she is not having regular menses, the athletic woman should always take precautions. Used conscientiously, barrier methods such as the diaphragm and jelly (or

FIGURE II

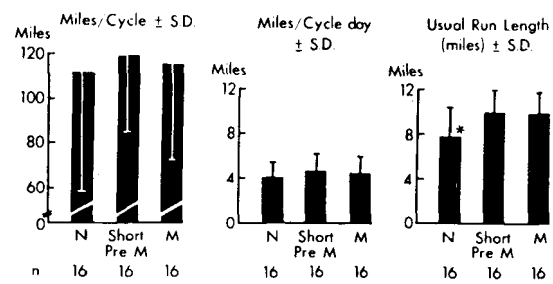


Fourteen mature women recorded their basal temperature during a total of forty-eight cycles of marathon training. Normal cycles had premenstrual (luteal) phase lengths of ≥ ten days, short premenstrual phase cycles < ten days, and monophasic (anovulatory) cycles had a flat basal-temperature record.

Amenorrhea observed in young ballet dancers or swimmers and shortening of the luteal phase in women marathon runners are not normal by sedentary standards. The next question is, are these harmful? The teenager who begins an intensive physical program, such as swimming or ballet, prior to normal menarche (age twelve) may experience delay in the onset of her first period. Occasionally menstruation is delayed until age eighteen. Associated with these reproductive delays is an alteration in both the timing of breast development and breast size. The small-breasted athletic teenager may also have a lengthening of her arms and legs in relationship to her height. Until menstruation begins, estrogen levels are not high enough to close the epiphyses (ends of long bones), so the limbs increase in length. This lithe youngster may have an advantage in competitive gymnastics, swimming, or ballet because of her shape.

There is potential concern about the normal development of bone strength with prolonged amenorrhea and about difficulties with normal sexual functioning if estrogen levels are low. Stress fractures may be more likely to occur in amenorrheic runners than in regularly cycling

FIGURE III



*Running characteristics during marathon training in forty-eight cycles from fourteen women. The training is evaluated in the three menstrual-cycle types: normal (N), short premenstrual (short Pre M) with luteal phase < ten days, and monophasic or anovulatory (M). Miles/cycle = total mileage during one menstrual cycle. Miles/cycle day = miles cycle divided by the cycle length in days. Usual run length = miles/cycle divided by running days in that cycle. S.D. = standard deviation *p < 0.02 by AnoVA versus short Pre M and M.*

Figures II and III from Canadian Journal of Applied Sports Sciences, *vol. 7, no. 3, Sept., 1982, p. 175.*

condom and jelly) are recommended over hormonal manipulations such as the oral-contraceptive pill or invasive measures such as the intrauterine device.

Researchers have much to learn about the origin of menstrual-cycle changes associated with intense athletic activity. It may be helpful for the woman who is having premenstrual symptoms and severe cramping to increase her activity level. Most athletes experience fewer symptoms when they are engaged in intense physical activity and have shortened their luteal phase. This observation has not been documented systematically, but we are currently doing studies on this in our centre. Clearly, regular intense exercise improves a person's sense of well-being, helps in dealing with the stresses of daily life, and gives the individual a feeling of accomplishment and satisfaction. The cardiovascular system also improves, probably resulting in longer life, less heart disease, and decreased peripheral-vascular disease. All of these advantages outweigh the potential complications discussed earlier.

If the athletic woman has been unable to get pregnant, she needs medical evaluation. It is advisable that she decrease the intensity of her training. In most instances, it is not necessary to stop exercising but simply decrease the intensity of speed or distance. A woman training for her first marathon may experience menstrual-cycle changes, but when she trains for subsequent marathons there will be fewer changes as her body adapts to the stress of exercise. Several women with infertility have become pregnant following an injury or when they were preoccupied with some other chore that prevented their usual physical activity. There is no evidence for any abnormality of the offspring. It is not clear at this point if the labour and delivery process is different for the athletic woman compared to the "normal" sedentary woman.

Menstrual-cycle alterations and changes in the physique are part of the process of conditioning and are determined by the age and maturity of the person. In most instances, the hormonal alterations benefit the individual, unless she wants to conceive. Taking supplemental calcium, treating vaginal dryness with estrogen cream, using barrier methods of contraception, and being in touch with body changes may prevent any possible detrimental effects from endurance training. As more women are documenting what is happening with their bodies during exercise training, researchers will have more understanding about these physiological changes and their causes. Although most women would gladly exchange shin splints for a corset, more careful scientific studies are needed to minimize any potentially harmful effects of exercise.

Further Reading:

B. Schwartz *et al.*, Exercise-associated Amenorrhea: A Distinct Entity?" *American Journal of Obstetrics and Gynecology* 141 (1981): 622-670.

J.C. Prior, "Endocrine 'Conditioning' with Endurance Training: A Preliminary Review, "*Canadian Journal of Applied Sports Sciences* 7 (1982): 148-157.

Jerilynn Prior is a practising endocrinologist and teaches in the Department of Medicine at the University of British Columbia.

Yvette Vigna is a runner and nurse.

PREMENSTRUAL SYNDROME CENTRE

The Premenstrual Syndrome Centre, the first of its kind in Canada, is now open in Mississauga, Ontario, under the direction of Dr. James C. Henderson. The actual cause of PMS is not fully understood, but hormone imbalance is a major consideration. Symptoms vary with each woman, though PMS may alter a woman's ability to cope, possibly destroy her self-esteem, and affect her relationships with family and friends. The centre offers a program of evaluation diagnosis, treatment, and re-evaluation. For more information contact the Premenstrual Syndrome Centre, 1077 North Service Road, Applewood Plaza, Mississauga, Ontario L4Y 1A6, or call (416) 273-7770.

LE BOTTIN
entraide au féminin

The Network

Le Bottin des Femmes, 38, chemin des Vingt
Saint-Basile-le-Grand J0L 1S0 (514) 866-0553

It is now two years since we launched the Bottin des Femmes and, as you well know it fullfilled a need, and in that respect it has been a tremendous success. Women in Quebec finally had access to a directory listing them under their particular profession and/or career. But even more, it was a much needed tool for promoting themselves and furthering their career goals.

Along the way, we realized that regrouping reduced our isolation and thus helped us to take our rightfull place in society and to share the power we have so far been excluded from. Thousands of women across the country learned that in order to change the existing order of things, we would need each other's help and support.

Thus the importance of networking.

Joining a network means cutting down on isolation. The network provides access to a multitude of information, services and contacts, all of which are essential to business growth and career advancement. Even more, networking means personal and collective moral support.

Our Network is going international! We now have delegates abroad.

Women's Lip

Women's Lip, the collected feminist writings of Bonnie Kreps, contains more than a decade of works by one of the women involved in starting the women's movement in Canada. Her writings reach more than three million readers through *Homemaker's Magazine*, for which she wrote "The Case Against Pornography." This author/filmmaker speaks to both women and men through her work. *Women's Lip*, priced at $10.00 (plus 7% postage and handling; orders must be pre-paid), is available from Orca Sound Publishing, P.O. Box 652, Station A, Vancouver, B.C.

Index/Directory of Women's Media

The Women's Institute for Freedom of the Press announces that the *1983 Index/Directory of Women's Media* is now available. The directory, which includes over 700 women's publications and organizations involved with the media, is published to increase communication among women nationally and internationally. The annotated index of women's media activities and research provides a history of the women's media movement. To order a copy, send $8.00 to WIFP, 3306 Ross Place, N.W., Washington, D.C. 20008.

THE MARION PORTER PRIZE, CRIAW

The Canadian Research Institute for the Advancement of Women invites nominations for the Marion Porter Prize for the most significant feminist research article published in 1982.

Contact:
Chairperson, Awards Committee,
c/o CRIAW, Suite 415,
151 Slater Street,
Ottawa, Ontario K1P 5H3
613-563-0681/82

Deadline: August 31, 1983