SPORT
MEDICINE MANUAL

7

ISSUES SPECIFIC TO WOMEN

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7

A. Equal Opportunity to Sports

The original Olympic Games in Greece were restricted to participation by men only. This policy was re-instituted at the first modern Olympic Games in 1896 in Athens. Restriction was, in part, caused by the belief that vigorous physical activity would be detrimental to women's health and that childbearing might be adversely affected. These myths still persist in some countries today. Psychosocial factors still limit women's involvement in some cultures.

Women's Olympic Programme

Since 1990, the women's Olympic programme has been growing because of efforts by the IOC, the Organizing Committees and the IFs. All sports seeking inclusion in the programme must also include women's events.

Table 7.1 New Women's Sports/Events on the Olympic Programme.

Year	Sports/Events	Year	Sports/Events
1900	Tennis, Golf	1964	Volleyball, Luge
1904	Archery	1972	Archery
1908	Tennis, Skating	1976	Rowing, Basketball, Handball
1912	Swimming	1980	Hockey
1924	Fencing	1984	Shooting, Cycling
1928	Athletics, Gymnastics by teams	1988	Tennis, Table tennis, Sailing
1936	Skiing (Combined)	1992	Badminton, Judo, Biathlon
1948	Canoe	1996	Football, Softball, Beach volleyball, Mountain biking
1952	Equestrian, Cross-country skiing	1998	Curling, Ice Hockey
1960	Speed Skating	2000	Cycling, Modern pentathlon, Taekwondo, Trampolining, Triathlon, Waterpolo, Weighlifting

Differences do exist between men and women. Women's skeletal structure is usually smaller and shorter. The pelvis is wider and the legs less bowed. The shoulders are narrower and the arms show a greater "carrying angle". Reduced muscle mass leads to a 30% reduction in composite strength pattern in the "average" female as compared to an "average" male. Women have smaller blood volumes, haemoglobin concentrations, heart volumes and maximum oxygen uptakes. Increased body fat in females contributes to muscle mass being in smaller proportion to body weight. Since these differences apply to comparisons between the average man and woman, it is not unusual to find the best women athletes performances exceed most men's performances. The world records for women in athletics are only 8-10% below those for men. These differences in maximum performance are likely to become less as more and more women world-wide have increased opportunity to participate in Olympic sport. However, because of the physical difference between the sexes, some variance will always exist. Endogenous testosterone production is a major factor in creating the physical differences between men and women.

Regular physical training for sport by women has profound effects on the hormonal system and at least transitory effects on reproductive capacity. However, the physician should always remember that athletic women have all the same medical problems with the reproductive system as do women who are sedentary.

Major competitions such as the Olympic Games may require special consideration for the athlete using oral contraceptives. Any manipulation of the menstrual cycle to minimize disruption during the games should be initiated many months in advance of the competition. Travel, stress and temperature change may alter the normal menstrual cycle.

Table 7.2 Women's Participation in the Olympic Games - % of Events.

Year	Games of the Olympiad			Olympic Winter Games		
	Total Events	Women's Events	%	Total Events	Women's Events **	%
1900	86	3	3.5	-	-	-
1904	89	3	3.3	-	-	-
1908	107	3	2.8	-	-	-
1912	102	6	5.9	-	-	-
1920	152	6	3.9	-	-	-
1924	126	11	8.73	16	2	12.5
1928	109	14	12.84	14	2	14.28
1932	117	14	11.96	14	2	14.28
1936	129	15	11.62	17	3	17.64
1948	136	19	13.97	22	5	22.72
1952	149	25	16.77	22	6	27.27
1956	151	26	17.21	24	7	29.16
1960	150	29	19.33	27	11	40.74
1964	163	33	20.24	34	13	38.23
1968	172	39	22.97	35	13	37.14
1972	195	43	22.05	35	13	37.14
1976	198	49	24.74	37	14	37.83
1980	203	50	24.63	38	14	36.84
1984	221	62	28.05	39	15	38.46
1988	237	86*	36.28	46	18	39.13
1992	257	98*	28.13	57	25	43.86
1994	-	-	-	61	27	44.26
1996	271	108*	**39.85**	-	-	-
1998	-	-	-	68	31	**45.58**

Remarks: * including mixed events
** including mixed events from 1924 to 1998

B. Dysmenorrhea

Case History - Dysmenorrhea

An 18-year-old female swimmer has crampy lower abdominal pain on the first day of her menses. She has found that her ability to compete on that day is adversely affected by this level of dysmenorrhea. Non-steroidal anti-inflammatories were helpful but not completely effective. She sought advice from the physician since the Olympic Games swimming schedule eight months away coincided with her expected date of menses. She had menarche at the age of 13 years and has been very regular since with a menses every 29 to 31 days. The mild dysmenorrhea has been consistent and predictable through the past five years. She was not sexually active.

Discussion

The effect of menses on athletic performance is variable. Some common variations of menses, however, may create less than ideal circumstances. In the week of the premenstrual period, fluid retention may increase body weight. In most sports this would be a negative feature. Heavy and prolonged bleeding could be inconvenient and over time contribute to iron deficiency. Dysmenorrhea may range from minor transient lower abdominal cramps to severe episodes of abdominal pain. It is classified as "primary dysmenorrhea" when there is no pelvic pathology and "secondary dysmenorrhea" when there is an underlying gynecological problem such as endometriosis, adenomyosis, pelvic inflammatory disease, or pain due to an intrauterine device. In preparation for major competition, any negative feature should be avoided if possible.

In the athlete who faces several major competitions per year, an intervention strategy becomes necessary if she suffers from dysmenorrhea. Simple analgesics containing Acetylsalicylic Acid or Paracetamol (Acetaminophen) combined with Codeine have limited effectiveness. The availability of extensive choices of non-steroidal anti-inflammatory drugs (NSAIDS) has been an effective therapeutic development in the management of dysmenorrhea. These prostaglandin inhibitors often can decrease the symptoms of mild dysmenorrhea, particularly when initiated just prior to the expected date of onset. Drug use may be required for 1-3 days per cycle. Possible side effects of NSAIDS are gastro-intestinal upset and bleeding. Newer generation of NSAIDS, the COX-2 specific inhibitors, (Celebrex and Vioxx), have less incidence of gastro-intestinal upset and do not affect bleeding time.

Severe dysmenorrhea may require hormonal intervention. Not only may pain be controlled, but the actual timing of the menses can be manipulated to avoid convergence with the peak competitive dates. Initiation of a cyclic combined estrogen and progesterone product common to all oral contraceptives will allow these goals to be obtained. Progesterone only oral contraceptives also inhibit ovulation but do not appear to be as effective at reducing pain. There is usually a marked reduction in the symptoms of dysmenorrhea with the use of cyclic estrogen and progesterone. By phasic adjustment of the cyclic use of estrogen and progesterone, the actual date of menses can be altered over several months to avoid the competitive dates of the Olympic Games.

The positive effects of oral contraceptives include:

- predictable cycles
- reduction of dysmenorrhea
- reduction of menstrually induced anaemia
- reduction of risk of endometrial and ovarian cancer
- reduction of incidence of benign breast lesions, pelvic inflammatory disease and ovarian cysts
- prevention of early osteoporosis in amenorrheic athletes

The negative effects of oral contraceptives include:

- increase risk of thrombosis
- change in serum lipids
- alteration of carbohydrate metabolism
- possible breakthrough bleeding
- possible weight gain and increase in body fat
- possible increase water retention
- increase in gallbladder disease
- possible increase blood pressure
- suppression of hypothalamic system
- possible reduction of maximal aerobic performance

Absolute contraindications of oral contraceptives include: current or past history of thromboembolic disorders, cardiovascular disease, thrombophlebitis, liver disease, known or suspected estrogen dependent neoplasm, undiagnosed genital bleeding and known or suspected pregnancy.

The 18-year-old swimmer had a normal gynecological examination and did not have any contraindications to oral contraceptives. She was started on a combination estrogen and progesterone oral contraceptive on the first Sunday after the first day of her menstrual period. By shortening her cycle 1-2 days per month, the expected date of the menstrual period during the Olympic Games was altered. Withdrawal of the use of the oral contraceptive was recommended prior to the competition to avoid any potential negative effects on physical performance.

C. Amenorrhea

Case History - Amenorrhea

An 18-year-old distance runner has not had a regular menstrual flow for five months. Menarche occurred at age 15 and menses had been regular for two and a half years. She increased her training to 70 km per week and started weight training three times per week about seven months ago. Her body fat dropped from 18 to 12% as her training volume increased. She ate sparingly.

Discussion

Definition of amenorrhea

- "absence of menstrual bleeding" for 6 months or for a length of time equivalent to a total of at least three of her previous cycle lengths in a woman who has established menstrual cycles
- no menstrual bleeding by age 16 or by age 14 in the absence of sexual development

Prevalence

- up to 5% in general population, excluding pregnant women
- 10-20% of vigorously exercising women
- as high as 40-50% of elite runners and professional ballet dancers

Differential diagnosis of amenorrhea

- pregnancy
- pituitary tumour
- ovarian failure
- abnormalities of reproductive tract
- hypothyroidism
- hypothalamic amenorrhea
- polycystic ovarian disease

History

- age at menarche
- previous menstrual pattern when not on oral contraceptives
- history of amenorrhea
- sexual history
- pregnancy history
- use of birth control
- nutritional history (history of major weight loss)
- exercise history
- emotional stresses or illness
- symptoms of estrogen deficiency or androgen excess
- other medical history related to thyroid disease or prolactinoma
- history of stress fractures
- medication history and history of chemotherapy
- family history and personal history of physical illness

Exercise-associated or athletic amenorrhea is one cause of hypothalamic dysfunction leading to amenorrhea. High intensity exercise is more likely to be associated with amenorrhea, ie. runners with a weekly training mileage greater than 30 miles are at increased risk of amenorrhea.

Exercise at a moderate to intense level can produce changes in the menstrual cycle:

- decrease dysmenorrhea
- shorten luteal phase and inadequate production of progesterone
- anovulation
- delay menarche
- amenorrhea and oligomenorrhea (3-9 menstrual cycles/year)

Hormonal alterations related to athletic amenorrhea are:

- LH and FSH levels are normal or low
- estradiol levels are low; no withdrawal bleeding after a progestin challenge
- progesterone levels are low resulting in a shortened luteal phase
- prolactin is normal
- androgens are normal
- thyroid hormone levels are usually in the normal range, although total T4, total T3, free T4, free T3 are often lower than the mean. TSH is normal
- cortisol, both daytime and night, is slightly elevated

The female triad refers to three interrelated medical disorders: eating, amenorrhea and osteoporosis. Due to pressure to reach performance goals, an athlete controls her weight or percentage of body fat by disordered eating which causes menstrual dysfunction, which in turn leads to premature osteoporosis. It is important to identify women at risk and emphasis should be on prevention and early treatment. See Unit 13, section F - Eating Disorders for more information.

The 18-year-old distance runner was not pregnant and physical examination of her pelvis was normal. There was no recognized cause for the amenorrhea. Her haemoglobin was low and the serum ferritin level was reduced. Progesterone and estradiol were normal. Her bone mineral density was also normal. A 10% reduction in exercise, improved nutrition and an increase in body weight may initiate menses but competitive athletes are not likely to agree to such a regime. The athlete was advised to reduce her training schedule, to improve her nutrition and to reduce her stress levels. She was advised to return for further investigation, ie. prolactin levels, GnRH, etc, if no improvement took place as it is important to investigate amenorrheic athletes as early as possible.

D. Osteoporosis

Osteoporosis is characterized by low bone mass, microarchitectural deterioration of bone tissue leading to bone fragility and consequent increase in fracture risk. WHO definition: BMD less than 2.5 standard deviations of peak age matched. Bone mass peaks shortly after puberty at the end of the growth period, about age 18 and increases gradually until age 30, followed by progressive loss of bone mass. Acceleration of bone loss occurs after menopause and lasts approximately 5-10 years.

Risk factors of osteoporosis:

- age
- female
- poor dietary calcium
- family history
- early menopause (including bilateral oophorectomy before age 50)
- smoking
- excess alcohol use
- medications (corticosteroids, thyroid hormone over replacement, prolonged heparin use)
- white race
- slim body build
- lack of exercise
- long periods of amenorrhea
- hyperparathyoidism and multiple myeloma

Treatment

Calcium supplements - Several control studies indicate that calcium is effective in reducing bone loss, however, it is not satisfactory treatment alone for established osteoporosis. It is recommended that pre-menopausal women have dietary calcium intake of 1,000mg/day and post-menopausal and pregnant women 1,500 mg/day. Dietary calcium or calcium supplements (calcium carbonate or calcium citrate) are effective.

Vitamin D - Vitamin D 800 IU/day along with calcium may help slow down bone loss especially during winter months. Perimenopausal women have decrease of synthesis of Vitamin D in skin and decrease of Vitamin D absorption through the intestine. Vitamin D is found in dairy products.

Estrogen - Estrogen has been shown to improve bone density and reduce fractures. In addition, it causes decrease of total cholesterol. This benefit is reversed once hormone replacement is stopped. Estrogen therapy should begin after menopause, generally within 3-5 years, to improve bone density. The effective dose of estrogen to prevent bone loss is 0.625 mg/day of conjugated estrogen, or 2 mg/day of Estradiol, or 50-100 ug/day of transdermal estrogen. Progesterone should be considered in women without a hysterectomy either continuously or for at least 10 days in the cycle. Smoking may decrease the benefits of estrogen so smokers should either quit smoking or consider transdermal estrogen. The risks of estrogen therapy include endometrial cancer which is negligible if combined with progesterone. The risk of breast cancer is unclear but studies indicate a possible increase in breast cancer after 10 years of hormone replacement therapy and this risk may be increased if there is a family history of breast cancer. There is also a risk of a thromboembolic event.

Selective Estrogen Receptor Modulators (SERMS) - Since late 1997, Raloxifene has received approval from the FDA for treatment of osteoporosis. Raloxifene has antibone resorptive properties, decreases total cholesterol, (but not as effectively as hormone replacement therapy), inhibits endometrial proliferation and does not stimulate breast tissue in vitro. Bone mass density is increased (2-3%) over that of placebo treated patients but less than the increase achieved with 2 years of hormone replacement therapy. The reduction of fractures was more significant than expected from bone mass density results, with 50% reduction of vertebral fractures in postmenopausal women after 2 years which is similar to treatment with other antiresorptives (eg. alendronate) after 3-4 years. Side effects include possibility of a thromboembolic event with incidence equal to hormone replacement therapy, hot flashes and leg cramps. Due to its safety profile with respect to endometrial and breast cancers, it provides another choice to women who have concerns about some aspects of estrogen.

Calcitonin - Calcitonin works in preventing osteoporosis by inhibiting osteoclastic activity. It is a potent analgesic and is the treatment of choice in patients with pain from recent vertebral fractures. Calcitonin is available as a nasal spray as well as an injection.

Bisphosphonates - This family includes Etidronate (Didronal, Didrocal) which decreases vertebral fractures by over 50% and Alendronate (Fosamax) which is 1,000 times more potent than Etidronate. They act by inhibiting osteoclast-mediated bone resorption. All Bisphosphonates are poorly absorbed from the gastrointestinal tract and should be taken only with water.

Calcitriol - Studies indicate that Calcitriol (1,25 diOH vitamin D) is effective in reducing fractures and in reducing bone loss. When osteoporosis is caused by long periods of amenorrhea in premenopausal athletes, studies indicate that bone mass density can be partially restored with resumption of menses. Athletes with long periods of amenorrhea are at risk for stress fractures. Recommendations for female athletes include: taking complete thorough histories, bone mass evaluation, decrease in training intensity and volume, increase in total calories and calcium intake to 1,500 mg/day and possibly estrogen replacement therapy for women not willing to make changes in dietary and exercise patterns. Premenopausal women may consider combination estrogen and progesterone birth control pills as long as they do not have any contraindications to the pill.

Pregnancy in athletes can occur even with amenorrhea or apparent anovulation. Reversal of any transient decrease in fertility can occur at any time. When serious physical training is stopped, body weight should increase, amenorrhea or anovulation will disappear and fertility should return to the pre-exercise stress status.

E. Iron Deficiency

Iron is a trace element found in all cells of the body and is essential for life. It is responsible for electron transport and activation of oxygen (metalloenzymes) and for the transport of oxygen and carbon dioxide (haemoglobin and myoglobin). Iron deficiency is the most common nutritional deficiency in many populations. Although it reaches its greatest prevalence and severity in developing countries, it is also frequently encountered in affluent countries.

Table 7.3 Stages of Iron Deficiency.

Stage	Blood Indices					Bone Marrow Iron	Iron Absorption
	Serum ferritin	Fe	TIBC	Sat	Hgb		
Prelatent	Decrease	N	N	N	N	0 - trace	Increase
Latent	Decrease	Decrease	Increase	Decrease	N	0	Increase
Manifest	Decrease	Decrease	Increase	Decrease	Decrease	0	Increase
Abbreviations: N = Normal, Fe = serum iron, TIBC = total iron binding capacity, Sat = transferrin saturation, Hbg = haemoglobin							

Women are at an increased risk of iron deficiency due to the superimposed requirements related to menstruation, while endurance athletes (especially runners) are at an increased risk due to:

- inadequate dietary intake (vegetable foods have poor bioavailabiiity of iron and folate)
- malabsorption from the gut (mechanism unknown) plus phytic effect of fibre and tea
- gastrointestinal blood loss (mechanism unknown)
- iron loss in urine (increased red blood cell haemolysis has been observed in athletes)
- iron loss in sweat

Iron deficiency may develop suddenly, with acute haemorrhage, or gradually due to the presence of risk factors, as listed above. A negative iron balance (ie. the average amount of iron derived from the diet is less than the losses from the body) would cause:

- depletion of iron stores increased absorption from the gut
- a fall in plasma iron concentration
- impairment of erythropoiesis
- microcytic hypochromic anaemia

Suspicion of iron deficiency may begin with symptoms of general fatigue and a drop in endurance, but the diagnosis is usually made in the laboratory with the evaluation of:

- iron stores (serum ferritin concentration)
- iron deficient erythropoiesis (transferrin saturation, serum iron, red cell protoporphyrin concentration)
- iron deficient anaemia (haemoglobin concentration, hypochromic or microcytic red blood cells)

The preferred treatment of mild iron deficiency or low iron storage is that of oral iron supplementation (doses of approximately 50 mg elemental iron in a ferrous salt compound administered three times a day). Iron is best absorbed on an empty stomach with vitamin C. Inhibitors of iron absorption are tea, coffee, milk and eggs.

A well balanced diet inclusive of red meats is important in preventing iron deficiency but is no guarantee against its development. Routine checks (2-3 times a year) of iron status are advised, especially for female endurance athletes in their reproductive years. A low serum ferritin predisposes one towards the more severe anemic state of iron deficiency. Serum ferritin levels of greater than 60 ng/ml are reliable indicators of substantial iron stores. Levels less than 20 ng/ml are suspicious for inadequate iron stores. For adult males and females, the cut-off value for anaemia is a haemoglobin concentration of 13 and 12 g/dl respectively.

F. Exercise and Pregnancy

Exercise can be beneficial during pregnancy as long as there are no contraindications to exercise. Absolute contraindications to aerobic exercise include:

- ruptured membranes
- premature labour
- multiple pregnancies (ie. triplets)
- acute infection
- incompetent cervix
- fetal distress (decrease in fetal movements)
- intrauterine growth retardation
- severe maternal heart disease
- vaginal bleeding
- pregnancy induced hypertension

Guidelines for exercise need to be individualized for each athlete and may change during pregnancy as gestational age changes and as new situations arise during pregnancy.

Benefits of exercise include maintenance of aerobic fitness, promotion of good posture, muscle tone and sleep, prevention of back pain, prevention of excessive weight gain and maintenance of psychological well being.

Warning signs to stop exercising during pregnancy are: shortness of breath, dizziness, headache, chest pain, muscle pain, amniotic fluid leakage, decrease in fetal movements and when in labour.

Sports that should be avoided for all pregnant women include: scuba diving, contact sports, high altitude exertion and supine exercise after the first trimester. In addition, hyperthermia and dehydration

should be avoided. Maternal core temperature of 102.6° F (39.2° C) are potentially teratogenic in the first trimester.

Marked musculoskeletal changes during pregnancy can increase risk of injury due to shifts the centre of gravity causing increased back strain and hormonal changes leading to increase joint laxity and mobility. If an athlete suffers from joint laxity changes she should avoid weight bearing exercise.

As a general rule, pregnancy is not the time to start training in a new sport. The American College of Obstetrics and Gynaecology have guidelines that meet the needs of previously sedentary women but are not so clear for the previously recreational and competitive athlete. The duration of activity recommended is between 15-60 minutes and interval exercise is preferable over anaerobic workouts. Intensity should be 60-75% of maximal heart rate with 140 beats/min for the novice and 160 beats/min for the previously exercising woman. Frequency should be 3-4 times a week, with more frequent workouts of shorter duration during late pregnancy. Non-weightbearing exercises such as walking, swimming and cycling are suggested sports for both the novice and the athlete in late pregnancy.

Return to sport in the postpartum period is dependent on several factors including type of delivery (vaginal vs. cesarean), degree of vaginal laceration, postpartum infection, breast-feeding vs. bottle-feeding, urinary incontinence, adequate sleep and postpartum depression. In addition, as joint laxity may continue up to approximately 12 weeks postpartum, it is important to avoid twisting and heavy lifting sports during this time, and gradual return to sport is recommended. Kegel exercises and abdominal strengthening exercises may be beneficial. Water exercises should be avoided if there is excessive vaginal discharge. It is important to maintain hydration as well as caloric intake if breast-feeding, as these factors affect the amount of milk production. In addition, adequate sleep and decrease in stress will improve milk production. Similar to the pregnancy period, exercise has to be individually tailored in the postpartum period.

G. Gender Verification

Any female competitor taking part in the women's events or mixed gender events at the Olympic Games could be subject to gender verification. At the Olympic Games, upon request, gender verification tests (buccal smear) could be conducted under the supervision of a member of the IOC Medical Commission. The Chef de Mission of the relevant delegation will be required to present the female competitors with their identity cards at the examination room at the date and time appointed, with an interpreter if necessary. Identification of the competitor will be made by use of the identity card, which shall include the competitor's photograph, weight, height and accreditation number. In cases where the IOC requires it, the competitor's passport shall also be produced.

Female competitors holding a valid certificate of femininity issued by the IOC Medical Commission will be exempted from further tests upon presentation of the certificate.

If the test is inconclusive, the competitor will be required to undergo further tests as may be prescribed by the IOC Medical Commission. Should the results indicate the need for a meeting between the IOC Medical Commission and the NOC delegation, this shall be convened, at which time a physician (or other official) of the delegation and a representative of the International Federation may be present. A physical examination may be requested, to be performed by a gynecologist appointed by the IOC Medical Commission.

No results of the tests or physical examination will be made public.

H. References

For further information, refer to the following web sites:

http://www.msse.org/
http://www.sportsmedicine.about.com/health/sportsmedicine/msubwomen.htm
http://www.sportquest.com/questwomen.cfm