The Female Athlete Perspective

Coach/Parent/Administrator Guide

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Introduction

The Canadian Sport for Life (CS4L) resource paper describes a program for long-term athlete development (LTAD). This document provides guidelines for athlete development (training, competition and recovery) with special reference to growth, maturation and development for those involved in late-specialization sports.

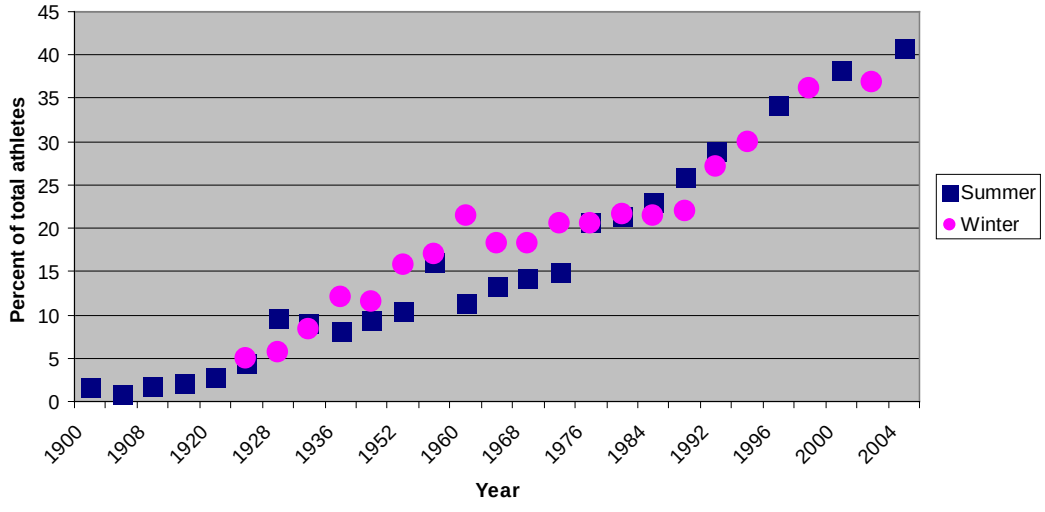
Changing Participation Rates of Girls and Women

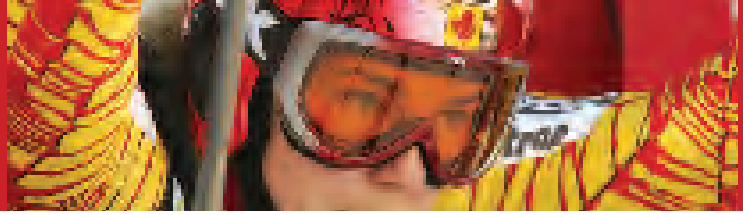
The number of women and young girls participating in regular physical activity, recreational sports and elite competitions has increased amazingly in the last 30 years. For example, let's look at the changes in Olympic participation rates:

"Consider that no women took part in the first modern Games in 1896. Today the balance remains weighted in favour of men, but it is tilting. At the XXVIth Games in Atlanta, for example, 97 of the 271 events were open to women, with 11 contested by both genders; 3,626 of the 10,629 athletes were women. Of the 307 Canadian athletes who competed in Atlanta, 154 were women and 153 were men, making this the first Canadian Olympic team ever to consist of more women than men, an impressive shift in a short time." (http://www.caaws.ca/e/milestones/)

The figure below shows the changing numbers of women participating in the Summer and Winter Olympic Games. At the 2004 Games in Athens, a record was set with women representing 40.7% of the total number of athletes competing.

Figure 1. Women's participation rates in Olympic Games



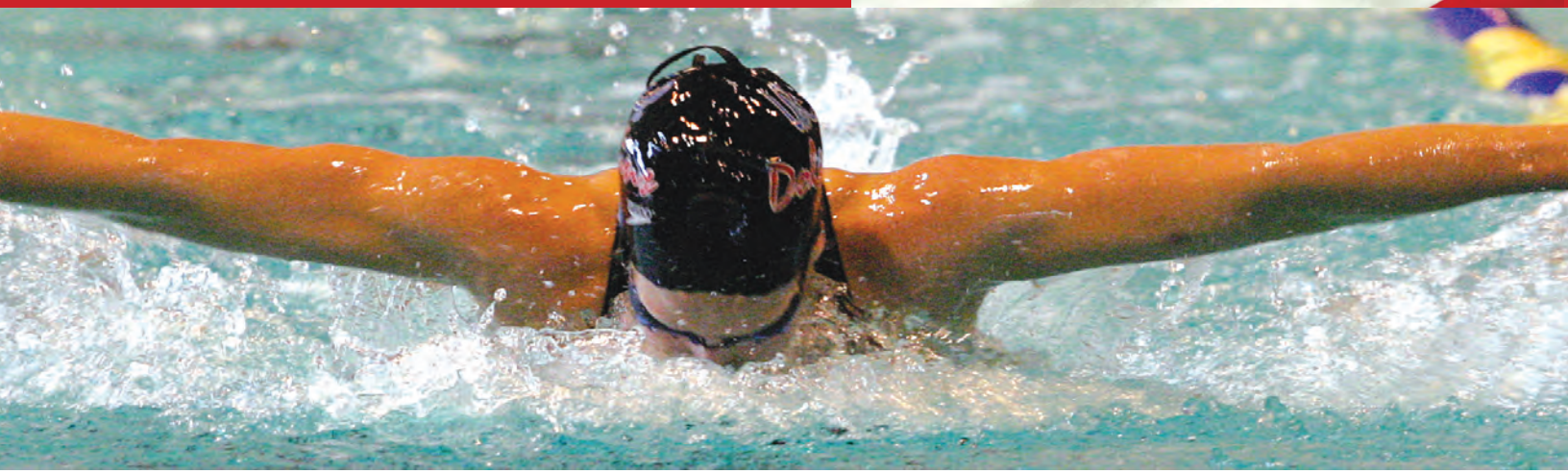


Women are not Men; Children are not Small Adults

Along with a growing interest in the LTAD model, it has been recognized that the development of a female athlete requires a slightly different approach compared to that used for a male athlete. Much of our understanding about training programs and other strategies used to build an elite athlete have been taken from research studies using YOUNG ADULT WHITE MALES (18-25 years of age). The results of these studies have then been directly applied to female athletes, regardless of age. In other words, it is common for male training programs to be applied to females and adult training programs to be applied to children and adolescents. The assumption that the same training program will enhance performance in females, children, and adolescents limits athlete potential. Training programs are not a "one size fits all".

There are intrinsic biological differences between the sexes; therefore, it makes sense to supplement the foundational CS4L/LTAD document with information about the female athlete. Because of increased physical activity participation rates of girls and women combined with an increased number of research studies examining the effects of exercise on females, we now have a better understanding of how to make training programs a better fit for women.

A recent publication (ACSM team physician consensus paper, 2003) shows higher rates of specific musculoskeletal injuries and medical conditions in female athletes. Increased understanding about the uniqueness of the female athlete will lead to athlete-appropriate education, improved awareness and prevention of the conditions known to interfere with female athlete performance.



Benefits and Risks Associated with Sport Participation

Participation in sport and regular physical activity brings with it a wide-range of physical and psychological benefits for all. In addition to improved health and wellbeing, physical activity is known to protect against cardiovascular disease, obesity, certain cancers and Type 2 diabetes. Regularly active young girls and women also show positive body weight management skills, stronger psychological development, and enhanced physical expertise.

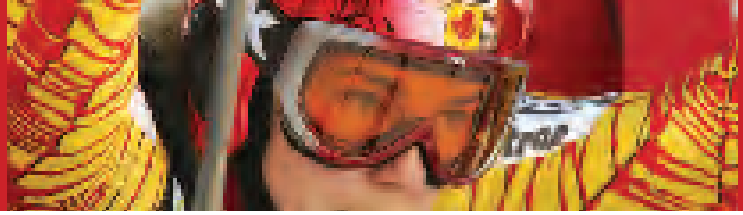
Despite these valuable benefits, there are potential risks associated with sport and physical activity participation. Especially for the young athlete, the risks are often linked with "striving to win at all costs." Rewards such as winning gold medals, winning a championship, acquiring a scholarship, recruitment, and professional ranking have invoked dangerous strategies that have led to increasing number of injuries and high dropout rates from sport at young ages (13-14 yrs). Sports have been cited as the leading cause of injury and visits to emergency room in adolescents. Injuries are barriers to performance; they may lead to an early exit from sport or contribute to reduced involvement in sport over the short-term and long-term.

Although impossible to avoid all injury, some sport injuries are predictable and potentially preventable. The US Centre for Disease Control and Prevention estimates that one half of all sports injuries in children and adolescents are preventable. Effective injury prevention would minimize disruption in participation and performance and maintain a healthy, lifelong relationship with physical activity.

"ATTENTION TO PREVENTION"

Female athletes experience select musculoskeletal issues and medical conditions as a result of and ultimately influencing their participation in sport. The major musculoskeletal sites affected in female athletes include injuries to the anterior cruciate ligament (ACL), patellofemoral joint (PFJ) and shoulder. The major medical conditions affected in female athletes include disordered eating, menstrual cycle disruption and impaired bone mineral health.

This document aims to highlight the LTAD stages where adjustments or adaptations to training can be employed with the intention of avoiding these known risks. "Attention to Prevention" is the major message of this paper.



Musculoskeletal Issues

Overview

Sport and recreational injuries in children and adolescents have a huge impact on lifelong involvement in sport and physical activity. Sports with a high rate of contact, jumping, sprinting or pivoting are linked with higher injury rates.

Not all injuries are caused by accidents or impact. Nearly half of all sport injuries in children and adolescents are overuse injuries. These overuse injuries often lead to a substantial loss of participation and increase the likelihood of re-injury. Knee, ankle, hip and foot injuries significantly increase risk of early development of osteoarthritis (OA). For example, 12-20 years following a knee injury (e.g. to the meniscus and/or ACL), more than 50% will have OA in the knee compared to 5% of an uninjured population.

Girls suffer higher injury incidence rates compared to boys, particularly in sports such as cross-country running, gymnastics and soccer. Injuries to the knee are greater in girls compared to boys with soccer having the highest injury rate, followed by basketball, field hockey, softball and volleyball. The reasons underlying increased injury rates in women compared to men include hormonal influence on neuromuscular control, ligament laxity as well as anatomic and biomechanical factors. Some of these factors that increase the risk for injury in women may be altered. Successful modification of these factors may lead to reduced injury.

Many injuries are predictable and preventable. There is evidence that injury prevention strategies are of benefit in elite adult athlete populations but there is a need to collect similar information on young developing athletes. Programs focusing on preseason conditioning, functional training, balance, core stability, education and sport-specific skills are effective in reducing injury rates.

1. Anterior cruciate ligament (ACL) and patellofemoral joint (PFJ) injury

Key message:

- **Teach correct technical execution during FUNdamentals and Learn to Train**
- **Reinforce correct technique and add strength and agility training during Train to Train, Train2Compete and Train to Win**

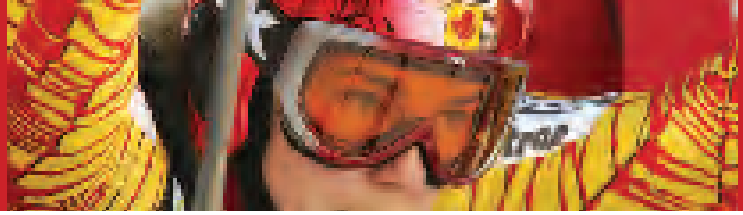
Due to higher participation rates of females in sport and physical activity over the last 2-3 decades, the prevalence of injury has also increased in this group. Anterior cruciate ligament (ACL) injuries are not only more common in female athletes but are considered to be the most severe of acute injuries. Women will incur 2-6 times the number of ACL injuries compared to men when matched for age, sport and level of competition. The short- and long-term effects of an ACL injury are large.

Some of the factors leading to increased risk in female athletes are changeable (e.g. biomechanical execution, neuromuscular activation, footwear, training surface, etc.) while other factors are not changeable (biological status e.g. hormonal levels, anatomical factors). The most common event associated with noncontact ACL injury is during deceleration, which happens when the athlete makes a cut or changes direction or lands from a jump. In general, poor use of flexion at the knee and hip are observed in female athletes during these manoeuvres.

There is a growing body of literature showing the positive effects of programs focusing on proprioception (position sense/balance), plyometrics, neuromuscular activation, functional training, sport-specific movement patterns, flexibility, agility and strengthening of muscle groups at multiple joints. In addition to reduced injury, improved performance has been noted (e.g. vertical jump, increased strength, enhanced technical execution). Significant improvements have been detected in six weeks but are typically seen over longer periods.

There is less information about patellofemoral joint (PFJ) injury rates and impact on physical activity but supplemental "lower limb" training is recommended, as described below.

The timing of these interventions is important. Prevention programs are recommended throughout the season with a special focus during the preseason.



2. Shoulder Injury

Key message:

- **Teach correct technical execution during FUNdamentals and Learn to Train**
- **Reinforce correct technique and add strength and functional training during Train to Train, Train to Compete and Train to Win**

Sports that demand repetitive overhead activity (e.g. baseball, softball, tennis, swimming, volleyball) often cause compensatory changes in the shoulder musculature.

In girls' tennis, 53% report a history of greater than one tennis-related injury (low back pain, shoulder and dominant wrist injury) compared to 29% for boys. Stress fractures distal to the elbow, shoulder girdle and ribs are also more common in female athletes. Rotator cuff tendonitis is often related to shoulder laxity and muscle imbalance while the overuse injury is the result of excessive repetition combined with insufficient recovery. Growth plate trauma (associated with repetitive compressive forces combined with load bearing) may lead to its premature closure. The prevalence of most upper body injuries increases with time in the sport and the intensity of involvement.

The effects of strength training programs in younger athletes have more commonly been examined in boys than in girls. Prior to puberty, there are no differences in body composition between boys and girls yet with the onset of pubertal events, muscle mass accrues in young boys at a faster rate. Strength gains occur more quickly in boys. Earlier literature questioned the safety and efficacy of youth resistance training programs but current recommendations suggest that youth strength training, although a specialized form of training, can lead to enormous benefits. Programs must be supported with qualified instruction and supervision combined with appropriate application of progressive overload principles.

Prevention programs (as described for ACL injury) have not yet been developed for the shoulder. Attention to risk factors that can be altered must be identified in addition to those that cannot be modified.

Medical Conditions

Overview

There is no question that regular participation in sport and physical activity promotes and maintains a healthy life. Compared to non-athletes, girls and women who play sports are healthier, perform better in school, are less likely to experience depression, develop a stronger sense of self, and use drugs, alcohol and cigarettes less frequently. But some female athletes struggle to balance the needs of their body with the energetic and psychological demands of their sport. For those who cannot reconcile this challenge, an early exit from sport, unreached potential and possible shattered life may result.

Female Athlete Triad

The female athlete triad (triad) was first described in 1992 by the Women's Task Force with the American College of Sports Medicine (ACSM) as a collection of 3 separate yet interrelated conditions of disordered eating, amenorrhea and osteoporosis. It was recognized that the independent effect of each condition was serious but when combined was potentially lethal. The first ACSM Position Stand was published in 1997 and the most recent version in 2007. Both the International Olympic Committee (IOC) and the International Federation of Sports Medicine (FIMS) carry a consensus statement on the triad.

1. Disordered eating

Key message:

- **Teach and implement positive eating habits during Active Start and FUNdamentals**
- **Reinforce positive eating habits; teach and implement positive fueling practices during Learn to Train, Train to Train, Train to Compete, Train to Win**
- **Deliberate emphasis during prepubertal and pubertal years (Learn to Train, Train to Train)**

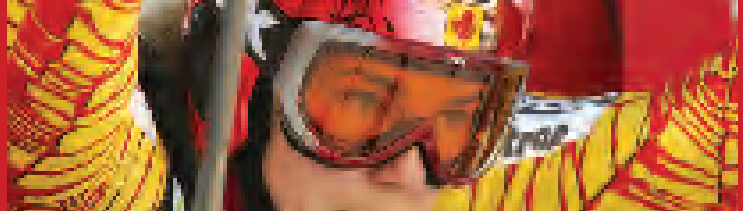
Proper nutrition is critical for good health and optimal sports performance. Young athletes need sufficient energy to support the demands of their growth in addition to meet the energetic requirements of regular training. Female athletes should ensure their daily intake provides a balance of macronutrients and micronutrients. Specific micronutrients that are important for the female athlete include calcium and iron.

Some athletes are challenged to match the energy deficit created by daily training with adequate energy intake. Eating behaviours can be described along a continuum with optimal dietary intake at one end of the spectrum and full blown eating disorders at the other end. Eating disorders are a set of psychiatric disorders that include distorted body image accompanied by substantial nutritional and medical complications. Disordered eating deviates from optimal dietary intake and includes a variety of behaviours that often lead to insufficient energy intake. Examples of disordered eating include restricted calorie intake, avoidance of specific macronutrients (e.g. carbohydrate, protein, fat), food aversion, pathogenic weight control strategies such as laxative or diet pill use, self-induced vomiting or excessive exercise. Disordered eating is a risk factor for developing an eating disorder.

The rate of disordered eating and eating disorders is much higher in athletes compared to non-athletes. The type of sports at risk for developing these conditions are endurance (e.g. middle and long distance runners, cross-country skiing), aesthetic (figure skating, gymnastics, synchronized swimming) and weight classification sports (e.g. rowing, martial arts). This does not preclude other sport categories (e.g. team sports such as basketball, volleyball, field hockey) from having athletes affected by aberrant eating practices.

Young athletes participating in early specialization sports such as gymnastics (rhythmic, artistic), diving, synchronized swimming and dance are known to adopt low energy intakes to avoid change in body composition associated with puberty. Such practices are implemented to reduce body weight and defend against maturational events such as fat deposition and breast development. Lower extremity injury is common in these groups and a potential for growth plate damage (premature femoral and tibial epiphyseal fusion secondary to injury) is of concern. The physiological consequences are numerous including possible attenuated growth and maturation during the training and competitive period. “Catch up growth” has been observed but evidence is inconclusive whether predicted adult height is achieved.

The responsibility of prevention sits with many. Since eating habits are developed in early childhood, parents play a vital role in modelling and implementing healthy and positive eating practices.



2. Loss of regular menstrual periods (amenorrhea and other menstrual irregularities)

Key message:

- **Teach the connection between menstrual function and energy intake during Learn to Train, Train to Train and Train to Compete**
- **Reinforce importance of positive eating and fuel habits on reproductive health during Train to Train, Train to Compete, Train to Win, Active for Life**
- **Deliberate emphasis during prepubertal and pubertal years (Learn to Train, Train to Train)**

The menstrual cycle requires energy to function properly. The energy derived from our daily food intake supports all of the events required for healthy reproductive function. The major menstrual-related event that requires energy is making the reproductive hormones such as estrogen and progesterone. These hormones control the regular uterine and ovarian events associated with the menstrual cycle (eg thickening of the uterine lining, maturing an egg for ovulation, sloughing of the endometrium and the resulting menstrual flow).

There may be times during an athlete's preparation where her energy intake does not match the energy expenditure of her training. This energy insufficiency may come as a result of low energy intake, increased training volume or a combination of the two. Depending upon the duration and severity of the energy insufficiency, various hormonal disturbances may occur and result in irregular periods (oligomenorrhea) or stop altogether (amenorrhea). A key hormone that may be lowered is estrogen.

Missing an occasional period is absolutely normal, especially up to the age of 19-20 years. So a single missed period does not mean the female athlete triad is present. Some girls who participate intensively in sports at a very young age may experience a significant delay in getting their first period (menarche). A delay of menarche beyond the age of 15 years should be discussed with a physician.

Some young athletes will have regular periods, but with increased training and changes to their eating habits, their periods may stop. Missed periods may also be due to something else, like a pregnancy or another medical condition. Several missed periods should be discussed with a physician.

Does the menstrual cycle influence performance? Does regular training always affect reproductive function? How much does an athlete need to eat to support her training in addition to her menstrual cycle? These questions and other related topics will be addressed in a future article for the Canadian Sport for Life website.

3. Reduced bone mineral health (osteoporosis and stress fractures)

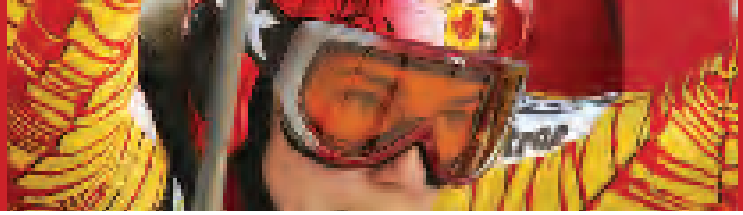
Key message:

- **Teach the connection between menstrual function, energy intake and bone mineral health during Learn to Train, Train to Train, Train to Compete, Train to Win, Active for Life**
- **Reinforce importance of positive eating and fuel habits on reproductive and bone mineral health during Train to Train, Train to Compete, Train to Win, Active for Life**
- **Deliberate emphasis during prepubertal and pubertal years (Learn to Train, Train to Train)**

A poor match between dietary energy intake and the energy expended due to training may lead to menstrual abnormalities and low estrogen levels. Low dietary energy intake often results in low calcium intake as well; calcium is an essential mineral for healthy bone deposition and strength. The combination of low estrogen with low calcium intake can lead to weak bones, poor bone formation, increased susceptibility to stress fractures and premature osteoporosis. Stress fractures may occur and limit participation in training and competition for long periods of time. Stress fractures occur more frequently in active women with menstrual irregularities; amenorrheic athletes are at a 2-4 fold greater risk for stress fractures compared to normally menstruating athletes.

Menstrual cycle history is a strong determinant of bone mineral density; with increasing numbers of missed menstrual cycles, bone mineral density drops. Loss of bone mineral density is largely irreversible.

The prepubertal and pubertal years are critical periods for maximizing peak bone mass. Inadequate energy and calcium intake may lead to irreversible decrements in bone strength and integrity.



Female Athlete Summary

To a large extent, the individual components of the female athlete triad are preventable. An overall strategy for promoting excellent health and optimal performance starts with teaching coaches, parents, athletes and trainers about wise food choices that provide sufficient energy to match the energy expended during training and competition.

Well matched dietary energy intake with energy expenditure due to rigorous exercise promotes an optimal training response (adaptability or trainability), recovery from training and competition as well as ensures adequate energy requirements needed for growth, development (bone mineral density, peak bone mass) and maturation (pubertal events, in particular menarche). Special attention should be given to younger female athletes; this includes investing the extra effort needed to inform parents of young children and adolescents about the nutritional requirements for their age and sport and the impact on reproductive and bone health.

Overall Summary

The number of young girls and women participating in physical activity and sport is increasing. Female athletes may experience select musculoskeletal injuries or medical issues as a result of their training, recovery strategies and competition. Any one of these conditions can interfere with her training and performance. With a greater understanding of the causes of these phenomena, we can move forward with effective prevention strategies. Implementing programs that address the unique needs of the female athlete will generate peak performances but not at the expense of the long-term health of the athlete.

Appendix One

Table 1. Attention to Prevention

<table>
<tr><th>LTAD Phase</th><th>Lower Body</th><th>Upper Body</th><th>Nutritional Health</th><th>Reproductive Health</th><th>Bone Health</th></tr>
<tr><td>Active Start</td><td></td><td></td><td rowspan="2">Teach + implement positive eating habits</td><td></td><td></td></tr>
<tr><td>FUNdamentals</td><td colspan="2" rowspan="2">Teach correct technical execution</td><td></td><td></td></tr>
<tr><td>*Learn to Train*</td><td rowspan="3">Reinforce positive eating habits; teach + implement positive fueling practices before/during/after training, competing)
Special emphasis</td><td colspan="2" rowspan="3">Teach the connection between menstrual function, energy intake and bone mineral health
Reinforce importance of positive eating and fuel habits across all phases
Special emphasis</td></tr>
<tr><td>*Train to Train*</td><td colspan="2" rowspan="2">Reinforce correct technique + strength, agility and functional training</td></tr>
<tr><td>Train to Compete</td></tr>
<tr><td>Train to Win</td><td colspan="2" rowspan="2"></td><td rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>Active for Life</td></tr>
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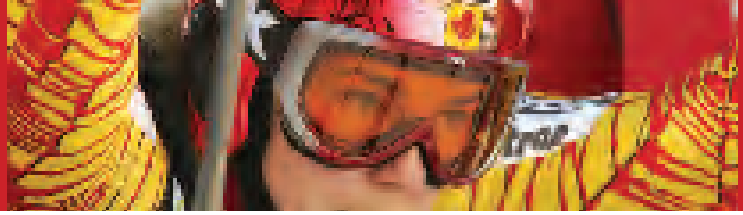
Women are not men

Children are not small adults



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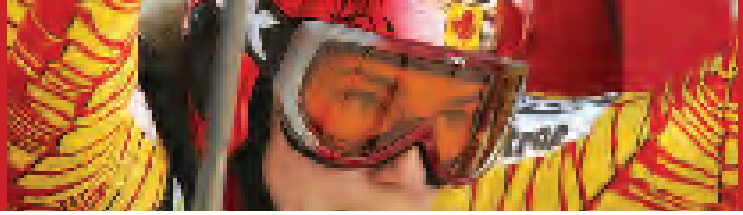

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