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Women's Rehabilitation Issues: Women and Physical Training

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"In most every aspect, women's sports programs have experienced a significant rise over the past two or three decades," Baumgardner writes.[1] Yet studies of women's sports injuries are still relatively new, and few studies have dealt specifically with the epidemiology of sports injuries. Whiteside analyzed men's and women's injuries in college sports from data in the National Athletic Injury/Illness Reporting System records for the 1975-76 and 1976-77 seasons.[2] Only sports conducted for women and men that had five or more schools reporting were included in the study.

Basketball had the highest rate of reportable injuries for game and practice-related situations for both men and women, followed by gymnastics and baseball/softball. The relative frequency of significant injuries was highest in men's and women's gymnastics in competitive situations, followed by basketball. In practice, basketball had the highest rate of significant injuries. The number of practice injuries was proportional to the time at risk. Sprains were the most common reportable injury for women in game situations. Fractures and neurologic problems were infrequent in all sports. The pattern of reportable injuries by body part was similar for men and women, but women had a higher relative frequency of ankle injuries.

Both women and men have higher rates of injury in contact sports. Injuries generally are more numerous in practice than in games, but are proportional to the time the athlete is at risk. The relative frequency of injuries is higher in game situations for both women and men. In this survey, men had a higher relative frequency of game-related strains and fractures in basketball and gymnastics than did women.

More knowledge is needed about the response of women to physical training. Kowal examined the occurrence of injuries in 400 women, aged 18-29 years, who completed an 8-week basic training cycle as recruits.[3] They participated in an integrated endurance training and conditioning program for one hour per day, five or six times a week. The program included calisthenics and a run of one to two miles at an initial 10-minute-per-mile pace.

Self-report questionnaires indicated that 54% of 347 women sustained injuries requiring medical attention during the training period. The rate for men undergoing the same training was 26%. Injuries resulted in an average loss of 13 training days, and 41% of injuries prevented participation in all physical activity. Injuries usually resulted from a combination of continued hard training after onset of symptoms, inherent structural weakness, or biomechanical anomaly. Tibial and femoral stress fractures constituted one-third of all injuries. Factors correlated with injuries included body composition, leg muscle strength, previous athletic participation, self-perception of fitness, and psychosomatic predisposition.

Major factors in injuries in women undergoing exercise training include lack of previous conditioning, greater body weight and percent fat, and limited leg strength. These factors probably operate in conjunction with such inherent physiologic characteristics of women as wide pelvis, less strength, and greater joint flexibility to produce and increased risk of injury during training. Susceptibility to injuries can be identified before training begins and minimized through proper remedial care, hospitalization, and training time lost, and preventive programs could reduce the occurrence of such injuries. Remedial physical training and toughening programs, custom-made, flexible orthotics and proper breaking in of footwear could be beneficial in many cases.

The injury rates in women were significantly higher than the injury rates of the men, according to Kowal.[3] To reduce the number of side-effects and possible injuries that may occur during rehabilitative exercise, considerations in training women separately from men is in order.

Muscular Strength, Endurance and Hypertrophy

Meadors et al. compared the development of muscle strength and endurance in college women utilizing one of three different progressive resistance exercise programs.[4] The training programs included the DeLorme, isokinetic, and controlled repetition-based exercise. Each experimental group and the control group consisted of nine women who trained three days per week for eight weeks. Muscle strength and endurance variables measured were knee extension, knee flexion, elbow extension, elbow flexion, and hip extension.

Analysis of variance (ANOVA) showed no significant differences between groups with regard to pre-test muscle strength and endurance scores. Analysis of covariance (ANCOVA) of the post-test scores showed significant increases ($P<.05$) in four of the five muscle strength variables, and in three of the five muscle endurance variables. Thus, in eight weeks women through training can improve their muscular strength and endurance.

Hoffman et al. investigated whether strength differences between men and women are a function of body size.[5] Thirty subjects of each sex were investigated at the start of military academy cadet training. The men had a mean age of 20.2 years and mean height and weight of 69.5 in. and 71.1 kg., respectively. The women had a mean age of 19.4 years and mean height and weight of 65.7 in. and 59 kg., respectively. Both bench press and leg press tests were carried out, and skin-fold measurements were recorded. The findings do not support the view that strength differences are a function of body size. With the effects of lean body weight and height held constant, the male cadets were significantly stronger than the females. Only differences in upper body strength were significant.

It appears that even if strength differences between the sexes are in part related to differences in body size, the cause of these strength differences must be attributed to further factors. Studies have found that men are stronger than women in the arms per unit of lean weight, whereas relative leg strength is similar in the two sexes. Adjusted bench press and leg press means may be biased because of differences in lean weight proportions between the sexes. Within the limitations of this study, male cadets are stronger than females with effects of body size held constant. The difference in strength is attributable to upper body strength. When we consider that the effects of body size were held constant, why did the authors find significant strength differences in the upper body and not in the lower body? Further studies are needed to determine if it may be due to cultural, physiologic or perhaps mechanical reasons.

It is believed that women experience less skeletal muscle hypertrophy consequent to heavy-resistance training than men. A study by Cureton et al.[6] was conducted to test this hypothesis, using both traditional indirect indicators and direct measures of muscle size. Seven men and eight women were studied before and after a 16-week weight-training program; three men and four women served as controls. They trained three days per week at 70% to 90% of maximum voluntary contraction using exercise designed to produce hypertrophy of the upper arm and thigh.

In the study group, strength significantly increased on both elbow and knee flexion and extension test. Absolute changes were significantly greater in the men than in the women in two of the four tests, whereas percentage changes were not significantly different. Substantial muscle hypertrophy occurred in the upper arms of both men and women, as evidenced by significant increases in upper arm circumference, bone-plus-muscle cross-sectional area (CSA) as estimated by anthropometry, and muscle CSA determined from computed tomography. Changes in men and women were not significantly different, except for the absolute increase in estimated bone-plus-muscle CSA, which was significantly greater in men. There was no

muscle hypertrophy in the thighs of either men or women, evidenced by nonsignificant changes in thigh circumference, bone-plus-muscle CSA, and muscle CSA. Changes in men and women in body weight, fat-free weight, and fat weight were insignificant. Thus, it would appear that relative changes in strength and muscle hypertrophy consequent to weight training are similar in men and women.

This study confirms that changes in body weight, fat-free weight, and fat weight are insignificant after a 16-week, rigorous, weight-training program. Although both men and women gained strength, there would not be enough change to produce a different somatotype rating. Thus, in time spent in a rehabilitative exercise program, substantial strength gains occur but hypertrophy changes do not result in an increased somatotype rating.

Static strength of men appears to be inversely related to relative endurance time, and it has been suggested that the relative endurance ability of men varies with muscle strength because of morphological and physiologic changes associated with muscle hypertrophy and strength training. Heyward analyzed the relative endurance ability of women in terms of muscle, static muscle strength, and critical occluding tension level (COTL).[7] Studies were done in 56 women physical education majors, 28 in a high-strength and 28 in a low-strength group. One fourth of the subjects in each group were assigned to relative endurance testing at 30%, 45%, 60% and 75% maximal tension, with the local circulation to the forearm muscles intact and occluded by a pressure cuff.

No significant difference in endurance times was found between the high and low-strength women. The relation between grip strength and relative endurance time was significant at each tension level. The COTL was the same for high and low-strength women.

Rehabilitative strength training does not result in substantial gains in muscle mass in women, and the problem of a reduction in capillary-to-fiber size ratio associated with hypertrophy would be relatively insignificant for high-strength women. Since high and low-strength women perform with the same degree of circulatory impairment in relative endurance tests, their endurance times should not differ significantly. In contrast to men, the relative endurance of women does not vary as a function of strength. This may be explained in part by the relatively small difference in muscle mass between high- and low-strength women and their similarities in COTL.

With the emergence of greater opportunities for women to participate in sports programs, more research studies are needed, to increase our understanding of the female body's reaction to strength training and athletic injuries.

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