Changes in Aerobic Power in Men, Ages 25 to 70

This study defined the time related decline in aerobic power of men and quantified the rate of change due to age, body composition, and level of physical activity. Physical activity was determined by self report (SR-PA), and estimates of % body fat were derived from skinfold thicknesses. Maximal aerobic power (VO₂peak) was determined by indirect calorimetry during a maximal treadmill test. The cross-sectional sample consisted of 1,499 healthy men, ages 25 to 70 yrs. The longitudinal sample consisted of 125 men from the same population, who were examined twice. The total sample was divided into four 10-yr age groups (except the oldest group, age 55+). Regression models were used to define and compare the independent effect of age, % fat, and SR-PA on VO₂peak. Longitudinal changes were computed using repeated-measures ANOVA. To control for the differences in time between pre- and posttreadmill test, elapsed time between tests was used as a covariate.

For the cross-sectional sample, SR-PA, maximal heart rate, and VO₂peak all decreased while % fat increased with age. Body weight increased for the three youngest groups but decreased for the 55+ group. These age-group means masked the true change in body weight, however, since fat weight increased and fat-free weight decreased for all groups. Correlations between % fat and VO₂peak and SR-PA and VO₂peak were significantly higher than the age-VO₂peak correlation. The % fat correlation was significantly higher than the SR-PA correlation. Multiple regression demonstrated that SR-PA and % fat accounted for nearly 43% of the additional VO₂peak variance beyond that attributed to age. For the longitudinal sample, the change in VO₂peak was a function of changes in SR-PA, % fat, and their interaction. In a post hoc analysis the longitudinal sample was split into four groups according to the four possible combinations of changes in % fat and SR-PA. Longitudinal changes in aerobic power were shown to be directly related to independent changes in SR-PA and % fat. The men who showed the greatest yearly increase in aerobic power were those who increased their level of activity and lowered their body fat, whereas those who became more sedentary and increased their body fat showed the steepest yearly decrease in aerobic power.


Resilience to Exercise Detraining in Older Adults

The benefits of increasing strength in the elderly have been well established in terms of increasing functional independence, as has the ability of older individuals...
to respond to training in much the same way as younger persons. The issue of detraining in older adults, however, has received less attention. This study examined the effects of detraining on gains made in a cardiovascular (CVE) or resistance (RE) training program in a group of healthy older adults. Sixty-five women and 34 men (age 67.9 ± 5.1 yrs) were randomly assigned to either an RE, CVE, or control group. Exercise groups trained for 16 weeks, detrained for 10 weeks, and retrained for 16 weeks, or trained for 16 weeks and detrained for 26 weeks. Control groups were sedentary for 26 weeks and then trained for 16 weeks. RE consisted of an 8-station circuit of isotonic lower limb exercise 3 times a week at 12-RM. CVE was performed 3 times a week on a circuit of treadmill, cycle, rowing, and upper body exercise at 50% VO₂max for 20 min, progressing to 75% VO₂max for 45 min. All groups performing CVE increased VO₂max (p < .05) for training and retraining. A small detraining effect occurred for these groups, but VO₂max values remained higher than at baseline. Retraining showed a cumulative effect on VO₂max that was greater at Week 42 than at Week 16. Subjects accumulating 32 weeks of CVE demonstrated greater VO₂max than those accumulating only 16 weeks. Increases in quadriceps peak torque, but not total work, were also found post CVE. For RE groups, isotonic and isokinetic strength increased after training and retraining. Strength measures declined to baseline levels with detraining. Retraining increased strength to initial posttraining levels, but did not show the same cumulative effects as that of CVE. Following RE, VO₂max increased at both 16 and 42 weeks compared to baseline. This study reveals a greater resilience to detraining after cardiovascular training compared to strength training, contrary to that typically reported in younger people. Some crossover training benefits are evident for RE and CVE, and a return to prior performance levels with retraining appears to be made easier for both types of exercise because of a previous training experience.


Long-Term Physical Activity Participation and Plasma HDL-C Levels

The centers for Disease Control and Prevention, the American College of Sports Medicine, and the American Heart Association have all recommended modest amounts of moderate-intensity physical activity for preventing coronary heart disease (CHD). Although an exercise related increase in plasma high-density lipoprotein cholesterol (HDL-C) may be one factor linking regular physical activity to a reduced risk for CHD, the dose and amount of time required for physical activity to increase HDL-C levels in older sedentary adults is uncertain. King et al. compared HDL-C changes over 2 years in 114 men and 93 postmenopausal women, ages 50 to 65, and randomly assigned them to one of three exercise training conditions: (a) moderate intensity, home-based, (b) high intensity, home-based, or (c) high intensity, group-based. The training consisted primarily of walking/jogging at 60 to 73% of peak treadmill heart rate (HR) in the moderate intensity group, and at 73 to 88% of peak treadmill HR in the high intensity group. The moderate intensity group was instructed to exercise more frequently
than the higher intensity group (5 vs. 3 times a week) to approximate weekly caloric expenditures across conditions. Significant increases in HDL-C ($p < 0.01$) were observed after the 2nd year (but not the 1st year) in the home-based exercise programs. Because aerobic capacity increased significantly after the 1st year and was maintained after the 2nd year in all three exercise conditions, the significant increases in HDL-C in the two home-based programs cannot be ascribed to differences in training intensities or fitness changes across conditions. Thus the present findings support the current recommendations for modest amounts of moderate-intensity physical activity, and also demonstrate the importance of maintaining long-term increases in physical activity for achieving health benefits in older sedentary adults.


**Cognitive Processes and Physical Activity Stages of Change**

Studies in which the stages-of-change theory was applied to participation in regular physical activity have been criticized for simply categorizing individuals into various stages of readiness rather than identifying the underlying cognitive processes that mark each stage of the change process. Courneya investigated the relationship between the stages of change for physical activity and the psychological components of the theory of planned behavior. Older ($N = 288$, mean age 71.5 yrs) members of a multipurpose center responded to questionnaires about physical activity history, stage of readiness to participate in regular physical activity, behavioral and control beliefs, attitude, subjective norm, perceived behavioral control, and intention. The results indicated that all subjects could be categorized into one of the five stages of change (precontemplation, contemplation, preparation, action, or maintenance), with 56% of the respondents reporting they were in the maintenance stage. The psychological constructs shared 63% of the variance with the stages of change, and discriminated each stage from every other stage except between the action and maintenance stages. Precontemplators had more negative attitudes and lower control beliefs than did contemplators, and also had lower intentions, attitudes, subjective norms, perceived behavioral control, and control beliefs than did individuals in all other stages. Contemplators could also be distinguished from subjects in the preparation, action, or maintenance stages by intention, attitude, perceived behavioral control, subjective norm, and control beliefs. Finally, subjects in the preparation stage could be differentiated from subjects in the action or maintenance stages by intention, attitude, perceived behavioral control, control beliefs, subjective norm, and behavioral beliefs. These results suggest the theory of planned behavior can further our understanding of the cognitive forces behind the process of physical activity behavior change in older adults.

Age Related Changes in Strength and Bone Health

Calmels et al. examined a population of peri- or postmenopausal women to determine whether the age related declines in bone mineral density and muscle strength were related. The maximal isokinetic strength of the flexors and extensors of the knee (30 and 180°/s) and elbow (30 and 120°/s) was assessed in 106 women between the ages of 44 and 87 years. Bone mineral density (BMD) of the lumbar vertebrae (L2-L4) and proximal femur was measured with DEXA (Hologic QDR 1000). As expected, muscle strength declined over several decades, and the loss varied with the muscle group tested and the speed of the test. There was also an age related decline in vertebral and femoral BMD, which was greatest between the 5th and 6th decades and between the 7th and 8th decades. Femoral BMD was significantly correlated with upper and lower body muscle strength. Vertebral BMD was significantly correlated with upper body strength. To Calmels et al., the most important findings were the concomitant decline in upper body muscle strength and bone mineral density between the 5th and 6th decades, and the decline in lower body muscle strength after the 6th decade which precedes the decline in lower body bone mineral density that occurs between the 7th and 8th decades. The cross-sectional design limits the generalizability of the findings, and ultimately longitudinal data will be needed to resolve the relationship between muscle strength and bone loss with aging.


Site-Specific Losses of Body Fat Following Strength Training

This was an intervention study that examined the effects of a strength training program of 16 weeks (1 hr/session, 3 sess/wk) on total and regional body composition and muscle mass in 14 women 60 to 77 years of age. Strength was assessed by 1-RM procedures for the elbow flexors, latissimus dorsi, shoulders, chest, hip extensors, quadriceps, and hamstrings. Total body composition was measured with hydrodensitometry, and regional body composition of the abdomen (L4-L5) and midthigh were measured by CT scans (GE HiLight/Advantage Scanner). Skinfolds (midaxilla, triceps, biceps, abdomen, suprailiac, subscapular, and thigh) and circumferences (biceps, waist, hip, abdomen, and thigh) were also measured. Strength training began at 50% of 1-RM (2 sets of 12 reps) and increased every 2 weeks until final loads were about 67% of 1-RM values. Upper body strength increased by 51% and lower body strength by 65%. Total body composition, skinfolds, and circumferences did not change following training; however, intra-abdominal adipose tissue decreased significantly and there was no change in abdominal subcutaneous adipose tissue. These data may be clinically significant as they relate to risk for cardiovascular disease in both sexes.

Can Testosterone Predict the Loss of Stature in Old Age?

Vertebral fractures are the most common osteoporotic fractures in women over 75 years of age. Early research suggested that the loss of trabecular vertebral bone, which contributes to fractures, was due to estrogen deficiency. Since both testosterone and estrogen have receptors on osteoblasts and can improve calcium balance in osteoporotic women, this study investigated the relationship of endogenous sex steroids to the loss of stature in postmenopausal women, which is commonly associated with osteoporotic vertebral fractures. This was a prospective, community-based program in which 170 postmenopausal women aged 55–80 years participated. Both biologically available hormones (Estradiol/SHBG and Testosterone/SHGB) and bioavailable testosterone (non-SHBG-bound) were determined approximately 12 years following the initial blood collection. It was determined that the loss of stature (0.22 cm/year) was strongly related to age but not to estrone and estradiol levels. Both estimated and measured bioavailable testosterone predicted future height loss independent of age, obesity, cigarette smoking, alcohol intake, and the use of thiazides and estrogen. The results of this study suggest that endogenous testosterone plays a role in the prevention of vertebral osteoporosis in elderly women.


Physical Fitness and Bone Health

The relationship between physical activity and bone health is somewhat equivocal; some studies demonstrate that physical activity programs can either reduce the rate of bone loss or increase bone mass in some sites, while other research reports no effective response to exercise. The inconsistencies in these results are often explained by the inadequacy of the exercise programs, the time period for the programs, and the various methods of assessment for activity and bone mineral density. This cross-sectional study examined the relationships between different indicators of physical fitness and the many confounding factors related to bone density in 55 women aged 65 and older. Physical fitness was assessed by direct measurement of maximal oxygen consumption; isokinetic muscle strength of the knee and elbow flexors and extensors was assessed with a Cybex II isokinetic dynamometer; and muscle area of the quadriceps and psoas was assessed by computed tomography (CGR 10,000 scanner). Anthropometry, dietary calcium intake, and both chronological and gynecological ages were also recorded. Bone mineral densities of the lumbar spine and proximal femur and the peripheral level of the radius and tibia were measured with a Hologic QDR 1000 densitometer. It was determined that VO₂max was a major determinant of femoral mineral density as well as the predictor of radial and tibial densities, while arm strength weakly predicted radial and tibial mineral densities and leg strength only predicted the trochanter and upper femoral densities. The results of this study indicate that the physical abilities measured accounted for significant amounts of variance in lumbar spine and proximal femur bone mineral density.

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