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Nutrition Bytes

Title

The Effect of Exercise on High Density Lipoprotein-Cholesterol Levels in Men

Permalink

<https://escholarship.org/uc/item/9233v8gs>

Journal

Nutrition Bytes, 1(1)

ISSN

1548-4327

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Publication Date

1995

Peer reviewed

This paper will describe the relationship between different types, duration, and intensities of exercise and the resultant effect on plasma high density lipoprotein cholesterol (HDL) in men. I have chosen this topic with the hopes of guiding my own efforts in avoiding the familial atherosclerosis that both my paternal grandfather and father have been plagued with at relatively young ages. In particular, having vigorously and systematically weight trained for the past seven years, I wanted to find out whether I had been helping my vessels as well as my muscles.

In the 1970s, investigators noticed a correlation between societal HDL plasma concentrations and incidence of premature heart disease (1). Furthermore, they found that HDL had an "antiatherogenic" effect (2) and that endurance type exercise increased its levels (3).

It has been suggested that lipoprotein lipase (LPL) is the enzyme responsible for increasing HDL levels (4). LPL catabolizes triglyceride rich lipoproteins to free fatty acids and protein, which has the effect of increasing HDL production by the liver. This hypothesis has been tested by many investigators by comparing male distance runners to sedentary controls. While several have found an increase in LPL in adipose and muscle tissues among the running group (5), one researcher (6) found no significant difference in LPL levels during a longitudinal study that employed initially sedentary men subjected to training. In an endeavor to implicate other enzymes, hepatic lipase, which may remove cholesterol from HDL and LDL when passing through the liver, and lecithin: cholesterol acyltransferase, which converts free cholesterol to cholesterol esters (for HDL packaging), levels have been changed with exercise (7). As will be discussed later, these types of discrepancies have led some to question whether the type of physical training and its weight changing effects are also responsible for HDL changes.

Studies that have compared exercise to HDL levels hoped to find that exercise increases plasma HDL concentration. As this has not been the case in every study, it has led some to investigate which exercise conditions, intensities, and duration are most effective. The difficulty in comparing one study to another is that controls, age groups, and sex have been differently utilized. I will discuss these investigations starting with those that used common sports as a means of exercise and continuing with those that took painstaking efforts to experimentally quantify the exercise.

Most studies have made the distinction between vigorous (aerobic), phasic (anaerobic), and sedentary exercise types. In particular, professional soccer and ice hockey players were compared for HDL levels. The more aerobically trained soccer players had higher HDL levels than did the anaerobically valuable ice hockey players (8). When compared to control, nonprofessional tennis players have been blessed with significantly higher HDL than sedentary control (9). In general, long distance runners, cross country skiers, and speed skaters note higher HDL (control compared), while those who participate in "speed or power" events like sprinting or weight lifting have HDL levels near or even below those of sedentary controls (7). Men who report a vigorous lifestyle, albeit on the job or in leisure time are credited with higher HDL levels than their sedentary counterparts (7). These studies, which consider nonexperimental activities, indicate that

HDLC increases are more likely with constant, heavily aerobic activities than with more sporadic, anaerobic ones. However, generally any activity (with the possible exception of weight lifting 'unfortunately') seems to confer statistically significant higher HDLC levels over sedentary controls.

In an effort to more accurately define the length and intensity of exercise that increases HDLC levels the most, investigators have used careful experimental procedures to quantify the effects of these different exercise modalities. Studies measuring the effect of acute exercise have found that for middle aged men, who exercised at 60% of their maximum heart rate for thirty minutes experienced an increase in HDLC both during and thirty minutes post exercise (10). Changes represented up to a 25% increase in HDLC levels above levels recorded before exercise commencement. Another study found that for men who bicycled at 55% of their maximum oxygen consumption for forty minutes experienced statistically significant increases in HDLC during exercise (beginning at 10 minutes), which was still elevated, but declining at fifty five minutes after exercise completion (11). Furthermore, the study divided its subjects into subgroups and compared the level of increase between groups entitled "well trained" and "moderately trained" athletes prior to the exercise. Interestingly, while the "well trained" group started with a higher HDLC level, the "moderately trained" group experienced significantly higher increases. These data suggest that less well trained men will increase their HDLC level by a larger percentage during acute exercise, which could serve as an effective propaganda tool to recruit less active men into initiating exercise.

A different study compared two groups that ran an equivalent distance, one at 60% of maximal oxygen uptake and the other at 90%. Both cases noted an increase in HDLC over control and the higher intensity exercise conferred a larger increase (25 vs. 14%) (12). Finally, a study found a 10.8% increase in HDLC after subjects underwent low endurance exercise (45% of maximal oxygen consumption) until exhaustion (4.5 hours) (7). Therefore, at least with acute exercise tests, HDLC increases even in low levels of intensity for prolonged duration. The benefits of exercise on HDLC concentrations can be detected almost immediately, with higher intensity offering a significantly larger increase. But, in the event a patient cannot maintain this high intensity level, significantly longer exercise periods might provide a suitable alternative.

Some researchers have tried to correlate exercise intensity to HDLC increases over longer time periods. One such study compared HDLC changes in men after twelve weeks of cycle ergometer exercise at 65%, 75%, and 85% of maximally achieved heart rate and found significant increases in the 75% and 85% experimental groups, but not in the 65% group (13). They then suggested that exercise at 75% of maximally achieved heart rate was the threshold required for HDLC increases. A different study used a walk / run training program with middle aged men for 3 days per week at 48 minutes per day for 20 weeks at exercise requiring 65 to 85% of their heart rate reserve. In contrast to above, they noted a significant increase of 16.6% after 20 weeks of this aerobic training (14). From the above studies, it has been suggested that a threshold exercise level exists that is dependent on exercise intensity, duration, or some combination of both. One longitudinal study measured cholesterol levels at three month intervals for a year in men who were

previously sedentary runners. They found that HDLC did not change until the nine month mark in men who were running at least ten miles per week (15). Despite the controversial nature of the collected data, it appears that the threshold concept in terms of exercise duration and intensity seems to be important in changing HDLC levels. In particular exercise at 75% of maximal heart rate for 30 minutes, or running at least ten miles a day for nine months is effective at increasing HDLC over a long time course. Due to the inconclusive, incomplete, and at times contradictory data, perhaps it would be most effective for the individual patient to see what modes of exercise are most attainable given his lifestyle and available time for exercise. Then, he should vary different duration and intensities of aerobic activity to see which is most effective at changing his HDLC concentrations. In general, it seems that the more aerobic, longer duration, continuous exercises are the most beneficial guidelines.

However, the final discussion of this topic is still unresolved. Some have suggested that in long term studies, several factors have not been appropriately controlled for over the study duration. In particular, weight changes have been implicated in changing HDLC levels rather than exercise amounts. In one experiment, when a six week exercise program was implemented under an iso-weight diet, there was no change in HDLC levels (16). This suggests that whether weight loss per se is implicated in increasing HDLC concentrations, exercise routines might not be. In other interesting research, it was found, when comparing a moderate running program that lasted for one year to a sedentary control group, that changing HDLC was correlated to weight change (17). More importantly though, when comparing the HDLC change in sedentary individuals who lost weight to that in the running group who lost weight, there was a significant increase in HDLC in the latter group. This information suggests that both weight change and exercise are involved in providing healthier HDLC levels.

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