Exercise Associated With Improved DNA Repair Capacity

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Regular exercise is associated with a decreased risk of several cancers (e.g., breast, colon, thyroid), and moderate-intensity activity is thought to enhance DNA repair processes. However, studies have suggested that very high intensity exercise may actually cause DNA damage. Some researchers have proposed that the relationship between exercise and DNA damage may follow a somewhat U-shaped curve. That is, moderate exercise may protect against DNA damage, whereas no exercise does not, and excessive intense exercise may actually increase DNA damage. For example, studies have shown short-term increases in DNA damage associated with running a marathon or with running to exhaustion on a treadmill, but not with steady running for 45 minutes.

Drs. Stephanie Whisnant Cash, Marian Neuhouser, and colleagues in Public Health Sciences investigated how DNA damage and repair are related to various levels of physical activity among 220 adults ages 50-76 years. Study subjects, who were already enrolled in a component study of the VITAL (VITamins And Lifestyle) cohort, provided information via questionnaire on their physical activity over the past month, as well as other demographic and health factors. Researchers estimated each subject's metabolic equivalent task (MET)-hours per week based on duration, frequency, type, and intensity of activities reported. They considered each subject's total amount of physical activity, as well as the total amounts of moderate-plus-high-intensity activity (for activities with MET values of 4 or more) and high-intensity activity (for MET values of 6 or more).

Dr. Cash et al. assessed DNA damage and the capacity for repair in viable blood cells using the comet assay, which can detect single and double strand breaks in DNA. After measuring baseline levels of DNA damage, the authors then estimated each subject's capacity for DNA repair by irradiating samples of the viable blood cells for 9 seconds to induce double- and single-strand breaks in the DNA. Repair capacity was measured at 15 and at 60 minutes following the short burst of ionizing radiation, and it was expressed as a percentage relative to the level of baseline damage.

The investigators did not observe a relationship between DNA damage and physical activity at any level of exercise. DNA repair capacity over 15 minutes was not associated with physical activity, but over 60 minutes DNA repair was higher in the cells of persons who had reported more total physical activity and higher-intensity physical activity. Specifically, after accounting for differences in age, sex,

body mass index, and current use of multivitamins, each additional MET-hour of any physical activity per week was associated with a 0.21% higher mean DNA repair capacity (β = 0.21, 95% CI 0.0057-0.41). Similarly, each extra MET-hour of high-intensity physical activity was associated with a 0.31% higher mean DNA repair capacity (95% CI 0.20-0.60). Physical activity recommendations of 150 minutes/week are roughly equivalent to 7.5 MET-hours per week. This weekly average MET value is equivalent to an approximately 1.6% higher DNA repair capacity at the 60-minute measure.

This work suggests that physical activity in older, healthy adults may help to prevent cancer through enhanced DNA repair. Higher intensity activities in particular (running, swimming, fast cycling) appeared to be associated with the greatest benefit to DNA repair capacity. Biologically, physical activity may increase DNA repair by inducing expression of enzymes which dispose of harmful oxygen radicals and repair DNA damage .This was the first study which was able to assess both DNA repair and damage in relation to a variety of activity levels and intensities. As Dr. Cash noted, "This study expands on previous research in that it examined a range of physical activity levels, whereas the literature to date has been limited to exhaustive treadmill tests on aerobically trained individuals." Recent physical activity does not appear to be related to DNA damage (at least at the levels observed in this population of healthy older adults), and supports the idea that an exercise regimen which includes moderate as well as vigorous physical activity is beneficial for cancer prevention. "Our results provide evidence for a beneficial association of physical activity with DNA repair, and given that DNA damage is a risk factor for cancer, enhanced DNA repair (e.g. through physical activity) may represent a potential cancer prevention mechanism," Dr. Cash noted.

Cash SW, Beresford S AA, Vaughan TL, Heagerty PJ, Bernstein L, White E, Neuhouser M. 2013. Recent physical activity in relation to DNA damage and repair using the comet assay. *J. Phys. Act. Health* Epub ahead of print, Apr 5.