The nonagenarian athlete: Researchers study Olga Kotelko's brain

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University of Illinois Beckman Institute postdoctoral researcher Agnieszka Burzynska and her colleagues analyzed the brain and cognition of Olga Kotelko, a 93-year-old track-and-field athlete. Burzynska is now a professor at Colorado State University. Credit: L. Brian Stauffer

In the summer of 2012, Olga Kotelko, a 93-year-old Canadian track-and-

field athlete with more than 30 world records in her age group, visited the Beckman Institute for Advanced Science and Technology at the University of Illinois and submitted to an in-depth analysis of her brain.

The resulting study, reported in the journal *Neurocase*, offers a surprising first glimpse of the potential effects of exercise on the brains and cognitive abilities of the "oldest old."

A retired teacher and mother of two, Kotelko started her athletic career late in life. She began with slow-pitch softball at age 65, and at 77 switched to track-and-field events, later enlisting the help of a coach. By the time of her death in 2014, she had won 750 gold medals in her age group in World Masters Athletics events, and had set new world records in the 100-meter, 200-meter, high jump, long jump, javelin, discus, shot put and hammer events.

Lacking a peer group of reasonably healthy nonagenarians for comparison, the researchers decided to compare Kotelko with a group of 58 healthy, low-active women who were 60 to 78 years old.

"In our studies, we often collect data from adults who are between 60 and 80 years old, and we have trouble finding participants who are 75 to 80 and relatively healthy," said U. of I. postdoctoral researcher Agnieszka Burzynska, who led the new analysis. As a result, very few studies have focused on the "oldest old," she said.

"Although it is tough to generalize from a single study participant to other individuals, we felt very fortunate to have an opportunity to study the brain and cognition of such an exceptional individual," said Beckman Institute director Art Kramer, an author of the new study.

In one long day at the lab, Kotelko submitted to an MRI brain scan, a cardiorespiratory fitness test on a treadmill and cognitive tests. (All of

the data are available at XNAT, a public repository; Kotelko and her daughter agreed to make her data public.)

"During dinner after the long day of testing, I asked Olga if she was tired, and she replied, 'I rarely get tired,'" Kramer said. "The decades-younger graduate students who tested her, however, looked exhausted."

The women in the comparison group underwent the same tests and scans.

The researchers wanted to determine whether Kotelko's late-life athleticism had slowed - or perhaps even reversed - some of the processes of aging in her brain.

"In general, the brain shrinks with age," Burzynska said. Fluid-filled spaces appear between the brain and the skull, and the ventricles enlarge, she said.

"The cortex, the outermost layer of cells where all of our thinking takes place, that also gets thinner," she said. White matter tracts, which carry nerve signals between brain regions, tend to lose their structural and functional integrity over time. And the hippocampus, which is important to memory, usually shrinks with age, Burzynska said.

Previous studies have shown that regular aerobic exercise can enhance cognition and boost brain function in older adults, and can even increase the volume of specific brain regions like the hippocampus, Kramer said.

Kotelko's brain offered some intriguing first clues about the potentially beneficial effects of her active lifestyle.

"Her brain did not seem to be, in general, very shrunken, and her ventricles did not seem to be enlarged," Burzynska said. On the other hand, she had obvious signs of advanced aging in the white-matter tracts

of some brain regions, Burzynska said.

"Olga had quite a lot white-matter hyperintensities, which are markers of unspecific white-matter damage," she said. These are common in people over age 65, and tend to increase with age, she said.

As a whole, however, Kotelko's white-matter tracts were remarkably intact - comparable to those of women decades younger, the researchers found. And the white-matter tracts in one region of her brain—the genu of the corpus callosum, which connects the right and left hemispheres at the very front of the brain—were in great shape, Burzynska said.

"Olga had the highest measure of white-matter integrity in that part of the brain, even higher than those younger females, which was very surprising," she said.

These white-matter tracts serve a region of the brain that is engaged in tasks - such as reasoning, planning and self-control - that are known to decline fastest in aging, Burzynska said.

Kotelko performed worse on cognitive tests than the younger women, but better than other adults her own age who had been tested in an independent study.

"She was quicker at responding to the cognitive tasks than other adults in their 90s," Burzynska said. "And on memory, she was much better than they were."

Her hippocampus was smaller than the younger participants, but larger than expected given her age, Burzynska said.

The new findings are only a very limited, first step toward calculating the effects of exercise on cognition in the oldest old, she said.

"We have only one Olga and only at one time point, so it's difficult to arrive at very solid conclusions," Burzynska said. "But I think it's very exciting to see someone who is highly functioning at 93, possessing numerous world records in the athletic field and actually having very high integrity in a brain region that is very sensitive to aging. I hope it will encourage people that even as we age, our brains remain plastic. We have more and more evidence for that."

More information: "White-matter integrity, hippocampal volume and cognitive performance of a world-famous nonagenarian track and field athlete" *Neurocase*, 2015.

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