The Pattern of Age-related Height Loss: Evidence from a Study of Deep-learning Derived Phenotypes Based on Large-scale DXA Images

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After the age of 40, humans start to lose height when aging. Height loss is usually attributed to the decrease of upper-body length caused by vertebral compression, but clear evidence to support this hypothesis is scarce. It is unclear whether the lower body is also shortened during aging. This study, by taking advantage of available whole-body dual energy X-ray absorptiometry (DXA) images, aimed to investigate the roles that upper-body and lower body play in the height loss during aging. Deep-learning based approaches (convolutional neural networks ResNet-50, ResNet-152, and DenseNet) were adopted to identify landmarks on whole-body DXA images of 6125 adults aged between 45 and 96. The lengths of upper-body and lower body (including thigh and tibia) were then calculated by the distances between corresponding landmarks. Height was indeed found to be negatively associated with age. Males and females lost height in 2.48mm/year and 2.76mm/year respectively. Both the upper-body and lower-body contributed to the height loss during aging, but upper-body played a much more important role than the lower body. This pattern was more obvious in females than in males, probably due to the sharp loss of bone mineral density in aged females. This study provided valuable evidence on gender-specific pattern of age-related height loss in a large sample size, and also offered a practical application of automatic landmark detection by deep-learning based approaches on DXA images.

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