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Can mind-body exercises be a solution for an aging / aged society?

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The world's elderly population is growing dramatically. Worldwide, the percentage of individuals over 60 has increased from 9.2% in 1990 to 11.7% in 2013, and is projected to reach 21.1% by 2050 ^[1]. The increased average age of the human population presents a huge biological, social, and cultural challenge for the 21st century. For instance, the oldest members of our population are disproportionately affected by age-related dementia ^[1]. Thus, a cost-effective and easily implementable solution to maintaining the health of elderly adults is urgently needed.

Based on the Physical Activity Guidelines for Americans (2nd edition, 2018), regular physical activity is one of the most important things people can do to improve their health. It is suggested that older adults should commit to at least 150 minutes to 300 minutes a week of moderate-intensity activity, or 75 minutes to 150 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. In addition, it is also recommended that older adults participate in multicomponent physical activity that includes balance training as well as aerobic and muscle-strengthening activities.

In a recent paper in *Brain Behavior and Immunity*, Qi and colleagues ^[2] found that a 12-week Qigong Wu Xing Ping Heng Gong can improve cognitive function, increase hippocampal volume. The new work provides an outstanding example of how mindful exercise can produce profound effects in older adults.

The role of exercise in healthy aging has been endorsed by a rich amount of literature and has been considered as a prevention strategy and treatment for pre-clinical Alzheimer's Disease (AD) and late-stage AD. Studies have shown that muscles secrete myokines that contribute to the regulation of hippocampal function^[3]. For example, myokine cathepsin B can pass through the blood-brain barrier to enhance brain-derived neurotrophic factor (BDNF) production and neurogenesis—memory and learning ^[3].

Furthermore, studies have shown that exercise can increase the volume of the hippocampus, a key region in memory function, and improve neurogenesis ^[4]. In a previous study,

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Erickson et al [4] found that aerobic exercise training (compared to stretching control) can improve spatial memory, producing an increase in volume of the left and right hippocampus by 2.12% and 1.97%, respectively, over a one-year period, whereas the stretching control group displayed a 1.40% and 1.43% decline over this same interval. The increased hippocampal volume is associated with greater serum levels of BDNF, a mediator of neurogenesis in the dentate gyrus.

Recently, mind-body exercise has drawn the attention of the public and demonstrated its potential in improving psychological and physical function and maintaining healthy aging in older adults [5]. Studies suggest that meditative movements, combining both physical exercise and mindfulness, may have an additive effect and produce greater improvements than those achieved from mindfulness or physical exercise alone [6]. In an early study, Tao et al [7] found that 12-weeks of Tai Chi and Baduanjin, two popular mind-body exercises, could significantly increase grey matter volume in the medial temporal lobe (hippocampus / parahippocampus), insula, and putamen compared to the effects of health education. Memory quotient (MQ) and visual reproduction subscores were associated with grey matter volume increases in the putamen and hippocampus. In another study, investigators found that three-months of Baduanjin can improve cognitive function and modulate both the function and structure of the hippocampus and anterior cingulate cortex in patients with mild cognitive impairment[8].

Most recently, Qi and colleagues [2] found that compared to stretching, a 12-week mind-body exercise (Qigong) can improve processing speed (using Symbol Digit Modalities Test) and sustained attention, increase hippocampal volume, and reduce peripheral IL-6 levels; a greater reduction of peripheral IL-6 levels is associated with a greater increase of processing speed performance. The results further illustrate how mindful exercise can modulate cognitive function, inflammation, brain structure, and their association. Taken together, these findings suggest that mind-body exercise can be valuable for both older adults and those with cognitive decline.

Although previous studies have demonstrated the potential of mind-body exercises, future studies on mind-body exercises are still urgently needed to 1) further develop mind-body exercise to enhance its benefit effects; 2) facilitate the acceptance / implementation of mind-body interventions as a promising self-regulation method for the older adults; and 3) tailor mind-body exercise to an older population.

Literature suggests that the response to mind-body exercise is very heterogeneous. Some individuals only exhibit a moderate response to mind-body exercise. Thus, exploring new methods / platforms to enhance the effects of these promising mind-body exercises based on their underlying mechanisms may represent a crucial step for future studies.

Accumulating evidence suggest that the brain may play an important role in mind-body exercises[9] and in complicated networks such as the default mode network, cognitive control network, and sensory-motor network. Theoretically, one possible method for enhancing the effect/efficiency of mind-body exercises is to artificially modulate brain networks involved in mind-body intervention during or before the exercises. For

instance, transcranial direct current stimulation (tDCS) is a safe and clinically applicable neuromodulation tool that can alter cortical excitability. Investigators have started to combine mind-body interventions and tDCS in older adults and have achieved some encouraging results.

Recently, with the development of Information and Communication Technology (ICT), E-medicine, or remote medicine, has developed rapidly. Mind-body interventions / Qigong are traditionally taught and practiced with an instructor, in person. Due to the COVID 19 pandemic, many instructors have started teaching mind-body interventions / Qigong remotely through Zoom or other online communication platforms. The advantage of virtual training is clear; it is safer during the pandemic, and more convenient and efficient. These characteristics may facilitate the implementation of mind-body exercises in society. Nevertheless, virtual training may somehow interfere with social communication / support among participants, which is believed to be an important factor. Finding a way to maximize the advantages of the tele-medicine while maintaining all the key components of mind-body exercise should be further investigated.

Moreover, mind-body exercise encompasses a family of complex practices, each with different characteristics and focuses. Although the exact mechanisms of these interventions are still under investigation, studies have found that different mindfulness interventions may be associated with both shared and unique mechanisms ^[10]. Therefore, these exercises may be associated with different effects. Elucidating the common and distinguished mechanisms associated with different exercises and identifying the optimal mind-body exercises for each individual / subgroup (older population, for instance) / disorder (i.e. individualized mind-body exercise / intervention) are also crucial next steps for mind-exercise research.

In summary, mind-body exercises may be a valuable solution in sustaining the health of the older population and preventing / slowing the development of dementia. It is time to implement this cost-effective method in maintaining the health of elderly adults in an aging / aged society.

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