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### **Exercising our brains, muscles and cells to fight the ageing process.**

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### **Abstract:**

Life expectancy is increasing, but the time spent in good health (health-span) is not keeping pace, with implications for health, social care, and pensions resulting in estimated costs more than doubling by 2050. Thus, understanding the many factors that contribute to healthy ageing versus frailty, and potential things we can do to promote healthy ageing is important. For example, how does stress, being physically inactive and poor dietary practices affect our body, leading to unhealthy ageing? As part of the 2015 Pint of Science series, researchers interested in brain health, muscle function and the immune system from the School of Sport, Exercise and Rehabilitation Sciences at the University of Birmingham, UK discussed the effects that ageing itself and stress, physical activity and nutrition can have on our health and wellbeing. The objective of our presentation was to question the lifestyle that we lead and discuss realistic alternatives to incorporate healthy activity, such as exercise, into our lifestyles to improve our healthy ageing. Here, we aim to briefly summarise this presentation and illustrate the effectiveness of physical activity, in a variety of forms, for ageing healthily.

## Commentary/brief review

Public health interventions along with health care and education improvements over several decades have led to an increase in life expectancy and global population ageing<sup>1</sup>. However, an inactive lifestyle in old age is one of the main causes of muscle wasting, which increases the risk of falls, fractures and disability and reduces quality of life<sup>2-4</sup>. If we do not find a way to prevent muscle wasting in old age, we will be faced with an unprecedented number of frail/disabled older individuals in our society. Further, age is one of the most important risk factors for brain diseases such as dementia and stroke<sup>5</sup>, but even with natural healthy ageing brain structure and function is altered, thus our ageing (and sedentary) population presents a looming economic and social issue. Urgent implementation of effective countermeasures is critical to fully prepare for the challenges of the world's changing demographics and to create an equitable, affordable and sustainable ageing society for the future. Major efforts need to focus on prevention, with emphasis on modifiable risk factors such as engagement in physical activity right across the life span.

Engaging in regular physical activity has clear benefits for our health, preventing and treating diseases that drive poor quality of life, thereby reducing the incidence of morbidity and premature mortality (for example, depression, dementia, cardiovascular and cerebrovascular disease, type 2 diabetes, and some cancers). Thus, exercise has a significant role to play in both the prevention and treatment of disease as well as minimise the effects of ageing. However, despite its clear benefits, 80-100% of us (depending of age and sex) do not meet public health recommendations for physical activity [i.e.,  $\geq 30$  min of moderate-intensity exercise on at least 5 days of the week ( $\geq 150$  min $\cdot$ wk<sup>-1</sup>), or 20 min of vigorous-intensity aerobic exercise training on at least 3 days of the week ( $\geq 75$  min $\cdot$ wk<sup>-1</sup>)<sup>6,7</sup>]. In fact, 'physical inactivity' has now become a top 10 killer in our society<sup>8</sup>. A busy lifestyle and the associated 'lack of time' is frequently cited as a common barrier to engaging in regular exercise<sup>9</sup>; however, in addition to this perceived barrier to being active, this busyness also has direct negative implications for our health and well-being. Research has demonstrated that psychological stress can make us ill and contribute to the development of a range of diseases. For example, long-term ongoing stress or distress like caregiving, bereavement, or depression can actually worsen how our bodies' immune system function, making us more susceptible to infections, and less likely to recover quickly from infections and wounds or surgery (e.g.,<sup>10-14</sup>). Further, if we do not invest our time in quality relationships, this can also worsen our immunity as well as making us less able to cope with the stressful events that life throws at us<sup>15</sup>. On the other hand, exercise can help to reduce

feelings of stress and decrease the risk or worsening of depression <sup>16, 17</sup>. However, we continue to lead busy stressful and sedentary lives.

One recent solution to this lack of time issue for engaging in regular physical activity is the emergence of high-intensity interval exercise training, or 'HIT'. A number of studies have now shown some promising and exciting effects on important predictors of health for relatively much less time commitment (e.g., <sup>18, 19</sup>). This is great news for those of us struggling to find the time to fit exercise into our busy lives, but is it for everyone, regardless of age and health status and does it work for all aspects of our health? Based on the evidence to date the most likely answer to these questions is "probably not", which makes intuitive sense given a one-solution-fits-all is seldom the way life works. Regardless, it is still far too early to make an informed decision one way or the other. Key questions remain about the effectiveness of HIT for whole-body health<sup>20</sup>. Rather than engaging in the argument of whether HIT is better than moderate-intensity exercise, we should be more interested in how it works and why it works. In fact, this relates to all exercise and may help us to optimise physical activity for everyone; for example, those that do not find HIT appealing to try or do not respond (biologically) to this form of exercise. What is it about exercise that stimulates adaptation and optimises function? Why do different forms of exercise like HIT work for some individuals and not others of similar health and demographic status? Can we increase the beneficial effects of exercise by supplementing it with so-called 'super foods' or perhaps perform exercise in conditions that enhance its effectiveness on the whole-body and specific tissues such as the brain and skeletal muscle (e.g., undertaking resistance training with targeted protein supplementation <sup>21, 22</sup> or exercising in water to enhance shear-stress mediated vascular adaptation <sup>23</sup>)? It is these types of questions that researchers interested in physical activity and health should be focusing on. Answering such questions may identify more alternative ways to access the health benefits that exercise provides. On the other hand, regardless of whether we can stimulate greater adaptation with alternative strategies (e.g., heat conditioning or hydrotherapy <sup>20</sup>) if the motivation to perform these is not present, as is the case with current physical activity health guidelines, then the greater physiological stimulus matters little. What is needed is a broad approach to address the inactivity epidemic in our society, including understanding the physiology of adaptation to exercise, the motivation for engagement in exercise, the way we teach physical education at schools, as well as potential policy changes required to encourage (and perhaps reward) greater engagement in physical activity in society. There is no doubt that this is a complex problem, requiring input and collaboration across a wide range of research disciplines.

Our advice is to get active, in any form. Increasing your physical activity level does not necessarily require a gym membership; it requires identifying and designing a plan to become more active and committing to it. Taking the stairs, walking or cycling to work, walking further from your car to your office chair, breaking up prolonged sitting time with brief periods of standing are examples of ways that you can start being more active in everyday life and ward off many of the negative health consequences of inactivity. Exercise training is just an accumulation of regular activity, and evidence indicates that accruing exercise across a day is perhaps more beneficial than a single longer session (e.g., <sup>24</sup>). If you like the idea of short bursts of exercise at higher intensity, give it a go - but this does not need to require all-out efforts from the first time you try it. The main objective is to increase your level of activity and doing bursts of activity during your day (e.g., walking up to flights of stairs) could be an ideal way to do this. In situations where this type of exercise may not be feasible (i.e., for institutionalised or hospitalised older individuals) simply rising repeatedly from a chair/bed offers an excellent means of maintaining muscle strength and function in the legs, critical in offsetting the progression towards disability. Finally, seek medical advice to identify potential risk factors that you need to be aware of, and this will also give you an objective measure of your health status to compare against as you see the positive results of being more active in your life.

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