New model of health promotion and disease prevention for the 21st century

Our susceptibility to disease increases as we grow older. **Robert Butler and colleagues** argue that interventions to slow down ageing could therefore have much greater benefit than those targeted at individual disease

Many countries now have ageing populations and are facing an increased prevalence of age related diseases and escalating healthcare costs. However, if ageing is combined with extended years of healthy life, it could also produce unprecedented social, economic, and health dividends. In recent decades, scientists have shown that the underlying biological processes of ageing, which give rise to most diseases and other age related health problems, can be delayed. We argue that a concerted effort to slow ageing would provide a broad strategy for primary prevention that would greatly enhance and accelerate improvements in health at all ages.

Rise of human longevity

Life expectancy at birth rose by a remarkable 30 years in developed countries during the 20th century, initially because of reductions in infant, child, and maternal mortality and then because of declining mortality in middle and old age.[1 2] In 1900, about 40% of babies born in countries for which reliable data existed were expected to live beyond age 65.[3] Today in these same countries more than 88% of all newborns will live past age 65 and at least 44% will live beyond age 85. This dramatic extension of life has provided social and economic benefits.

The traditional medical approach to ameliorating modern chronic diseases has been to tackle them individually, as if they were independent of one another. This approach flows naturally from our experience with acute diseases, where patients seek medical care for one condition at a time. In fact, applying this same strategy to infectious diseases in the 20th century helped to deliver the first longevity revolution.[4] Although some infectious diseases have chronic effects on health (such as malaria and HIV infection), and others remain difficult to treat (including tuberculosis and most viral diseases), public health efforts to combat these diseases have made it possible for people in today's developed nations to live long enough to experience one or more of the degenerative and neoplastic diseases that are now the dominant causes of morbidity and death.

Diminishing returns from disease specific model

Medical research worldwide has already accomplished much, and is certain to achieve more in decades to come, but its effectiveness will become limited unless there is an increased shift to understanding how ageing affects health and vitality. Most medical research teams are oriented towards the analysis, prevention, or cure of single diseases, despite the fact that nearly all of the diseases and disorders experienced by middle aged and older people still show a near exponential increase in the final third of the life span. Now that comorbidity has become the rule rather than the exception, even if a "cure" was found for any of the major fatal diseases, it would have only a marginal effect on life expectancy and the overall length of healthy life.[5]

The change in strategy we are calling for requires a systematic attack on ageing itself. Although such a strategy was clearly articulated more than a quarter of a century ago,[6 7] there has been little progress towards making the necessary changes.[8] However, recent

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A playground designed specifically for pensioners has opened in a park in north Manchester. The "Older People's Play Area" in Dam Head Park, Blackley is the country's first for the over-60s. It features six pieces of equipment to keep senior citizens fit by strengthening hips, toning legs, and training the upper body. The local residents' association got the idea to set up the facility after being inspired by a similar playground in Germany

advances in understanding the complex biological mechanisms responsible for ageing suggest that it is feasible to translate this strategy into practice.[9] Evidence in models ranging from invertebrates to mammals suggests that all living things, including humans, possess biochemical mechanisms that influence how quickly we age and that they are adjustable. It is possible—for example, by dietary intervention or genetic alteration, to extend life span and postpone ageing related diseases such as cancer, cataracts, cognitive decline, and autoimmune diseases.[10-14]

"Even if a 'cure' was found for any of the major fatal diseases, it would have only a marginal effect on life expectancy"

We are not calling for the modification of human genes to extend healthy life—that would not be practical, useful, or ethical. However, investigating how genetic mutations influence the basic rate of ageing is likely to provide important clues about how to develop drugs that do much the same thing.[15 16]

Attempts to develop preventive measures against individual conditions related to ageing have been, for the most part, frustrating and unsuccessful. But in striking contrast, all of these conditions, and more, can be ameliorated or postponed simultaneously by well validated interventions that slow ageing.[17-19] The interventions that have worked in laboratory animals are not now appropriate for disease prevention in humans. However, we believe that exploration of the mechanisms by which ageing can be postponed in laboratory models will yield new models of preventive medicine and health maintenance for people throughout life, and the same research will also inform a deeper understanding of how established interventions, such as exercise and healthy nutrition, contribute to lifelong wellbeing.

Recommendations

The potential of fundamental research into ageing to contribute practical benefits to improve health at all ages, but particularly at older ages, has been under-recognised by most of the scientific establishment, and, importantly, by many of those who decide on allocation of resources for health research.[20 21] Now that most people in developed nations reach old age in reasonable health, and scientific progress has been made on interventions capable of postponing nearly all the diseases and disabilities that affect older people, the time has arrived for national policies to support and develop practical interventions that slow ageing.

The research strategy that we propose is intended to supplement, rather than substitute for, research into specific diseases, which will continue to discover new and improved therapies and approaches to preventive medicine. We propose, however, a large increase in resources available for investigations into how diseases such as type 2 diabetes, congestive heart failure, Alzheimer's disease, Parkinson's disease, osteoporosis, sarcopenia, and most cancers, either interact with ageing or share mechanisms in common with it. We further propose greatly increased funding for basic research into the fundamental cellular and physiological changes that drive ageing itself.

The pursuit of extended healthy life through slowing ageing has the potential to yield dramatic simultaneous gains against many if not all of the diseases and disorders expressed in later life. The most efficient approach to combating disease and disability is to pursue the means to modify the key risk factor that underlies them all—ageing itself. Pursuing an aggressive research strategy to devise interventions against ageing suitable for humans requires that it is a goal worth pursuing (it is), and that we have good leads to follow (we do), but it does not require that we know, in advance, which of the current ideas about mechanisms affecting the rate of ageing are most likely to produce effective interventions. A fresh emphasis on ageing should vastly accelerate the health, economic, and social benefits of the extension of healthy life, which we refer to collectively as the longevity dividend.[22]

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