The Academy of Medical Sciences

Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'
September 2019

Summary

- We welcome the opportunity to respond to this House of Lords' Science and Technology Committee consultation on ageing. This response was informed by previous Academy work and input from our Fellowship.[1,2,3]
- There are a number of barriers that must be overcome to achieve the Government's 2035 healthy ageing goal, including a growing, ageing population with multiple morbidities and more years in ill-health, persistent inequalities, rising obesity and sedentary behaviour and an increasingly isolated older population.
- Our understanding of the mechanisms of ageing is advancing but more research needs to be done - in particular interdisciplinary research which addresses the impacts of ageing across the life course.
- Biomedical and technological interventions for age-related conditions should be considered within the wider context of societal benefit and values, be supported by a robust evidence base and applied to the populations of relevance. The benefits of individual interventions should be spread across the whole population, not only the most affluent and educated, and not widen inequalities in older age.
- Interventions must be considered alongside preventative approaches on a societal level, which can prevent or delay many age-related conditions from occurring. We need national policies to reduce inequities and improve public health. We know many of the lifestyle and environmental factors that affect ageing, yet these are not being acted upon on a national level. Raising the health and wellbeing of less affluent sectors of society to the levels of the most privileged groups would go a long way to achieving the Government's aims.

1. How complete is the scientific understanding of the biological processes of ageing and their epidemiologies (including the relative roles of genetics, epigenetics, lifestyle, environment, etc.)?

Ageing is a complex, multidimensional biological process that is not currently fully understood. Our knowledge of the mechanisms and cellular hallmarks of ageing has advanced.[4] This greater understanding of the mechanisms underlying ageing has revealed potential targets that could influence multiple disease-related processes.[5] However, further research is needed to clarify biological mechanisms in animal models, and to determine the extent to which they apply to ageing and disease processes in humans.[6] Additionally, understanding the relationship between these biological processes and human epidemiology is still at an early stage.

The impact of environmental and lifestyle factors on lifespan is both well-known and substantial. However, attempts to study ageing processes at a population level have produced variable results and we are only beginning to understand how environmental factors relate to the biological processes of ageing.[7,8,9] Studies of human twins suggest that the genetic contribution to ageing trajectories is relatively small (2-21% in different organ systems), compared with the influence of other factors.[10]

[1] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf

[2] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

[3] Academy of Medical Sciences (2009). *Rejuvenating ageing research.* www.acmedsci.ac.uk/viewFile/publicationDownloads/ageingwe.pdf

[4] Lopez-Otin C, *et al.* (2013). *The hallmarks of aging.* Cell. **153(6)**, 1194-1217.

[5] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf

[6] *Ibid*

[7] Marioni RE, *et al.* (2019). *Tracking the epigenetic clock across the human life course: a meta-analysis of longitudinal cohort data.* J Gerontol. Series A, Biol Sci Med Sci. **74(1)**, 57-61.

[8] Wang Q *et al.* (2018). *Telomere length and all-cause mortality: a meta-analysis.* Ageing research reviews. **48**, 11-20.

[9] McCrory C, *et al.* (2019) *How does socio-economic position (SEP) get biologically embedded? A comparison of allostatic load and the epigenetic clock(s).* Psychoneuroendocrinology. **104**, 64-73.

[10] Moayyeri A, *et al.* (2016). *Aging Trajectories in Different Body Systems Share Common Environmental Etiology: The Healthy Aging Twin Study (HATS).* Twin Res Hum Genet. **19(1)**, 27–34.

Significant differences in lifespan and healthspan between socioeconomic groups highlights the important role of modifiable lifestyle factors and environment; differences in four health behaviours can predict an estimated increase of 14 years of chronological age.[11]

Ongoing research at the population level includes longitudinal population studies (such as the English Longitudinal Study of Ageing and the National Survey of Health and Development), which have integrated many different research methods. However, these studies do not fully represent populations, their diversity and impacts of life-course, environmental and social determinants on ageing. They also usually do not include detailed biological measures needed to monitor ageing processes. Cohort studies using data on the full spectrum of determinants of health and disease, alongside genetics, biomarkers, infectious disease exposure and the microbiome will help address gaps in our knowledge. These studies are expensive, resource intensive and require considerable commitment by participants.[12,13] They are long-term international resources for health and other disciplines, requiring shrewd and imaginative investment to ensure that the future benefits associated with large, integrated and increasingly electronic datasets are realised.

2. **How firm is the scientific basis for public health advice about healthy lifestyles as a way to increase health span, including physical health and mental health?**
There is already a substantial body of evidence about lifestyle and environmental factors that affect ageing trajectories, and about interventions that can mitigate the impact of advancing age. The benefits of balanced diets, physical activity, social connectedness, moderate alcohol consumption and not smoking are uncontested.[14] There is also a growing body of evidence linking cognitive ability and personality traits (such as conscientiousness) to health in later life.[15,16] However, these have yet to be fully exploited to protect and improve the health of the public in old age.[17]

There are gaps in our understanding because much of this evidence has come from observational studies rather than intervention studies and the evidence base on healthy lifestyles is often reliant on self-reported measures. Randomised control trials of the impact of lifestyle changes on long-term health at older ages are difficult to carry out because of their cost and duration. There is an urgent need for more studies using objective measures, particularly of sleep and physical activity.

Observational data have indicated the importance of the whole life-course in healthy ageing. We need to understand further how to most effectively promote lifelong health through investment in early years, and to understand the socioeconomic determinants and biological process of ageing across the life course, particularly at key transition points in life – childhood, puberty, starting a family, retirement – to develop effective interventions.[18] This contrasts with the current focus on older age alone as the target for interventions. Early prevention is a missed opportunity.

There are practical impediments to public health advice being acted on. Adopting a healthy lifestyle is strongly influenced by the psychological, social, cultural and physical environments in which we live and our own life courses. There is strong evidence of the harmful effect of certain lifestyle choices (e.g.

[11] Khaw KT, *et al.* (2008). *Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study.* PLoS Med. **5(1)**, e12.
[12] Medical Research Council (2014). *Maximising the value of UK population cohorts: MRC strategic review of the largest UK population cohort studies.* www.mrc.ukri.org/publications/browse/maximising-the-value-of-uk-population-cohorts/
[13] http://www.ukbiobank.ac.uk/about-biobank-uk/
[14] World Health Organisation (2009). *Global Health Risks.* www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf?ua=1&ua=1
[15] Calvin CM, *et al.* (2011). *Intelligence in youth and all-cause-mortality: systematic review with meta-analysis.* Int J Epidemiol. **40(3)**, 626– 644.
[16] Jokela M, *et al.* (2013). *Personality and all-cause mortality: individual-participant meta-analysis of 3,947 deaths in 76,150 adults.* Am J Epidemiol. **178(5)**, 667–675.
[17] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf
[18] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

smoking, alcohol, and diet) and working practices (e.g. job insecurity, low incomes and unemployment) on mental and physical health and wellbeing, which leads to poor health in older age.[19]

Another major issue is developing and implementing better ways to establish and sustain behaviour change in the public, particularly for habits that are entrenched in late youth or early adulthood. For example, although there have been great strides in combining pharmacological and behavioural methods of smoking cessation, continuous abstinence rates are still less than 25%.[20] We have a growing body of evidence on behaviours that adversely affect our health, but limited understanding of which aspects of our environments – singly and together – are most important in driving unhealthy behaviours, often unconsciously. We know even less about how to create environments – physical, economic, social and digital – to enable healthier behaviours from the early years and allow them to flourish across the life course.[21] Legislative approaches are a crucial and effective tool, this has been shown in policies on smoking, soft drinks and dietary salt.[22]

3. Which developments in biomedical science are anticipated in the coming years, in time to contribute to the Government's aim of five more years of healthy and independent life by 2035?

A better understanding of ageing and its translation can make a significant contribution to achieving the healthy ageing target, but this will require a multidisciplinary approach to build an integrated understanding of ageing processes, the effects on health, and how they can be modified to enhance health and wellbeing. However, biomedical developments can come with unintended consequences e.g. increased medicalisation across the life course, interventions without evidence of long-term benefit and long-term treatment that can lead to other conditions, along with potentially harmful polypharmacy.

Success will depend ultimately on behavioural change and public policy being part of a broad collaborative effort.[23] The likelihood of influencing health in ageing is a long-term effort and more likely to be influenced by reducing inequalities and applying population-level changes. Implementing policies to create environments that promote healthier ageing and reduce inequalities will require strong political commitment.[24]

4. How complete is the understanding of behavioural determinants and social determinants of health in old age, and of demographic differences?

There is strong evidence showing that life expectancy and healthy life expectancy are associated with socioeconomic status, ethnicity and geographic region. In England, average life expectancy in the poorest communities is seven years lower than in the wealthiest, and disability-free life expectancy is 17 years lower.[25] Only in the least deprived parts of the UK are individuals likely to reach retirement age without some form of disability.[26] There is increasing evidence that social isolation and loneliness are risk factors for ill-health at older ages[27] and new evidence of the impact of age discrimination,

[19] Science Advice for Policy by European Academies (2019). *Transforming the future of ageing.* https://www.sapea.info/wp-content/uploads/tfa-report.pdf

[20] Jackson SE, *et al.* (2019). *Modelling continuous abstinence rates over time from clinical trials of pharmacological interventions for smoking cessation.* Addiction. **114(5)**, 787–797.

[21] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

[22] Academy of Medical Sciences (2019). *2019 Richard & Hinda Rosenthal Symposium: Behaviour change to improve health for all.* www.acmedsci.ac.uk/file-download/80493906

[23] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf

[24] *Ibid*

[25] The Marmot Review (2010). *Fair Society, Healthy Lives: Strategic Review of Health Inequalities in England post-2010.* www.instituteofhealthequity.org/projects/fair-society-healthy-lives-the-marmot-review/fair-society-healthy-lives-full-report

[26] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf

[27] Holt-Lunstad J, *et al.* (2010*). Social relationships and mortality risk: A meta-analytic review.* PLoS Medcine. **7(7)**, e1000316.

including increased risk of certain health issues and unhealthy behaviours.[28,29] In addition, more subtle determinants of healthier ageing are emerging, such as optimism, meaning and purpose in life.[30]

Much of our evidence is geography, population and generation specific. Machine learning and artificial intelligence could provide opportunities for better interventions, but are highly reliant on data that is representative and complete.[31] More complete population-relevant evidence on the determinants of health and ageing is required across different societies, cultures and generations.[32]

There is an urgent need for more cross-disciplinary research in social science, anthropology, law, ethics, political science, media and cyberspace, and community development research so we can engage and co-produce evidence with communities, in order to understand the roles of media, communities, government and industry. Although we have sufficient evidence to take further action in areas such as smoking cessation and obesity prevention, it is still important to generate evidence for surveillance, address gaps in knowledge and determine the effectiveness of national policies and local programmes.

5. **What technologies will be needed to facilitate treatments for ageing and ageing-related diseases, and what is their current state of readiness?**

There are a number of technologies that should continue to be developed to facilitate treatments of age-related diseases including:

- Technologies that can track the course of disease, including before symptoms occur. For some diseases, such as dementia, this is particularly challenging as there can be multiple risk and protective factors (i.e. health and cognitive reserve, lifestyle, genetics, etc.) and pathologies that interact resulting in symptoms.[33]
- Clinical and molecular biomarkers for diagnostics. Standardised biomarkers would enable the results of research and the impact of interventions to be compared more easily. Clinically, biomarkers should provide insight into patients' health status and likely lifespan to support clinical management; biologically meaningful biomarkers would be useful to explore underlying mechanisms of ageing and disease.[34]
- New technologies, such as apps and new devices, for healthcare delivery and supporting adherence to interventions.[35]
- Digital maturity within the health and social care systems, which is crucial for high-quality data.[36] The Longevity Science Panel has argued that difficulty accessing data collected by public bodies, particularly by private sector organisations, is a major obstacle to the planning and provision of future services.[37,38]

Technologies endorsed by the NHS or social care systems should be evaluated for their effectiveness and cost-effectiveness. The benefits of these interventions must be considered alongside preventative approaches on a societal level, which can prevent or delay many age-related conditions from occurring.

[28] Jackson SE, *et al.* (2019). *Associations between age discrimination and health and wellbeing: cross-sectional and prospective analysis of the English Longitudinal Study of Ageing.* Lancet Public Health. **4(4)**, e200-e208.
[29] Science Advice for Policy by European Academies (2019). *Transforming the future of ageing.* https://www.sapea.info/wp-content/uploads/tfa-report.pdf
[30] Steptoe A. (2019). *Investing in happiness: the gerontological perspective.* Gerontology. **10**, 1-6.
[31] Academy of Medical Sciences (2019). *Artificial Intelligence and Health.* www.acmedsci.ac.uk/file-download/77652269
[32] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428
[33] Alzheimer's Disease International (2014) *The World Alzheimer Report 2014, Dementia and risk reduction: analysis of protective and modifiable factors.* www.alz.co.uk/research/WorldAlzheimerReport2014.pdf
[34] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf
[35] Academy of Medical Sciences (2014). *Patient Adherence to medicines.* www.acmedsci.ac.uk/file-download/37126-552f6b3fdab3a.pdf
[36] Academy of Medical Sciences (2017). *Digital maturity of local health and social care systems: the industry perspective.* www.acmedsci.ac.uk/file-download/77817565
[37] Academy of Medical Sciences (2016). *Influencing the trajectories of ageing.* www.acmedsci.ac.uk/file-download/42128-58521f0caf63a.pdf
[38] Longevity Science Panel (2015). *Public Data for the Private Sector: Better solutions for the ageing population.* http://www.longevitypanel.co.uk/viewpoint/public-data-for-private-sectors/

6. What technologies will be needed to help people to live independently for longer, with better health and wellbeing? What is the current state of readiness of these technologies, and what should be done to help older people to engage with them?

Smart and assistive technologies are likely to see significant developments over the coming years. They are expected to be able to support improvements in nutrition, disability, mobility, medication safety and monitoring of health status. These interventions will likely need to be tailored to the individual and their needs. There is a need for a coordinated strategic approach for technology development, considering unmet needs, as well as a better understanding of how technologies can be employed at a societal, community, household or individual level.

7. How can technology be used to improve mental health and reduce loneliness for older people?

There is considerable scope for internet and communication technologies to reduce loneliness and potentially improve mental health by maintaining contact with family and friends.[39] Additionally, technologies such as mental health and mindfulness apps are being developed that could also help older people. In the future, virtual experiences may be more commonplace and could be valuable in sustaining social contact.

However, these technologies should not aim to replace in-person contact. Improved mental health and reduce loneliness for older people can be achieved through initiatives such as: encouraging social clubs, placing care homes in the heart of communities and making travel easier for people with impairments. One such scheme is social prescribing, which recently had an injection of government funding, enabling GPs to refer patients to social activities and other types of support to improve health and wellbeing.

8. What are the barriers to the development and implementation of these various technologies (considered in questions 5-7)?

There are a number of barriers to the development of such technologies:

- Suitable technology interfaces are key to ensure usability for audiences with increased age-related cognitive and physical frailty. This requires careful working with communities to co-produce and tailor technologies to enhance acceptability, applicability and use.[40]
- Interdisciplinary working is vital. We need to develop a UK-wide transdisciplinary research capacity with a holistic understanding of the wide range of determinants of health, and the skills and approaches necessary to address them.[41]
- Our current state of knowledge has limits. Interventions must be based on a robust, peer-reviewed evidence-base which may be challenging for some conditions where the causes are poorly understood, such as dementia.[42]
- Data-driven technologies are only as good as the data they use.[43] We currently lack data and data analytical tools which could have significant impact on the healthy ageing agenda.[44]
- We need a globally relevant framework to ensure equitable societal benefit from technologies. This should provide guidance for technology development to consider inequalities, the United Nations Sustainable Development Goals and social value, alongside traditional economic approaches to help prioritise the most promising technologies.
- Differing priorities of government departments, the NHS, social care and local authorities can make working together effectively challenging. This could be a barrier to achieving the five more years of healthy life goal by 2035.

[39] Rafnsson SB *et al.* (2016) *Longitudinal Influences of Social Network Characteristics on Subjective Well-Being of Older Adults: Findings From the ELSA Study.* Journal of Aging and Health. **27(5)**, 919-34.

[40] Holthe T *et al.* (2018) *Usability and acceptability of technology for community-dwelling older adults with mild cognitive impairment and dementia: a systematic literature review.* Clin Interv Aging. **4(13)**, 863-886

[41] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

[42] Pickett J *et al.* (2018). *A roadmap to advance dementia research in prevention, diagnosis, intervention, and care by 2025.* Int J Geriatr Psychiatry. **33(7)**, 900–906.

[43] Academy of Medical Sciences (2018). *Our data-driven future in healthcare.* www.acmedsci.ac.uk/file-download/74634438

[44] Academy of Medical Sciences (2019). *Artificial Intelligence and Health.* www.acmedsci.ac.uk/file-download/77652269

10. **What more is required for the UK to benefit from commercialisation of its discoveries and inventions relating to healthy ageing, as envisioned by the Government's Industrial Strategy?**

The UK provides a supportive environment for piloting technologies and interventions, with funding available for SMEs and spin-outs. However, grants can be too administratively burdensome for the average small business or spin-out to have the capacity to take on and there can be difficulties with scale-up. Achieving widespread adoption in the UK health and social care systems is also challenging.[45]

In comparison to the US, the commercialisation of research in the UK is low, despite a strong research base in ageing.[46] Better contact between those in technology transfer and venture capital with scientists may help expedite this.

The UK has a wealth of valuable health data on a large and diverse population. Appropriate access to health data to enable R&D can drive innovation and significant health benefits to the public. The Government needs to ensure data are shared responsibly, with meaningful public and patient engagement on this topic. The Academy's 'Data-driven technologies' report and current work by HDR UK explores this issue in further detail.[47,48]

11. **How feasible is the Government's aim to provide five more years of health and independence in old age by 2035?**

We face a growing and ageing population with multiple morbidities and more years spent in ill health; reaching the goal of five more healthy years by 2035 requires a step change in both within and outside the health sector.[49]

Past improvements in public health in the UK have been a combination of improvements in healthcare as well as changes outside for traditional health sector, for example health system changes like vaccination, family planning, antenatal care, screening programmes and comprehensive healthcare have been supported to improve health through policy changes for cleaner air, and better housing and education.[50]

Government policies should apply across the whole life course and aim to reduce inequities, improve interventions to prevent and treat ill health, and maintain physical, cognitive and social function. Areas where policies could contribute to healthy ageing include: better regulation of the food industry; promoting education for all; reducing alcohol consumption and smoking; incentivising physical activity for all ages; and encouraging active modes of transport.[51,52] A body like the UK Strategic Coordinating Body for Health of the Public Research (SCHOPR) could help provide strategic oversight.[53]

12. **To what extent are inequalities in healthy ageing, as well as differences in acceptance of technologies, a barrier to achieving the aims of the Government's Ageing Society Grand Challenge?**

There are major inequalities in health outcomes in the UK (see question 4). There are large differences in health across characteristics including education, income, area of residence, gender and ethnicity, all

[45] Academy of Medical Sciences (2017). *Accelerating access to medical innovation: a research agenda for innovation science.* www.acmedsci.ac.uk/file-download/80863587

[46] World Intellectual Property Organization (2019). *Global Innovation Index 2019* https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019.pdf

[47] Academy of Medical Sciences (2018). *Our data-driven future in healthcare.* www.acmedsci.ac.uk/file-download/74634438

[48] https://www.hdruk.ac.uk/about/

[49] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

[50] *Ibid*

[51] *Ibid*

[52] Science Advice for Policy by European Academies (2019). *Transforming the future of ageing.* https://www.sapea.info/wp-content/uploads/tfa-report.pdf

[53] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.* www.acmedsci.ac.uk/download.php?f=file&i=37428

of which are affected by wider social, political and economic contexts.[54] Socioeconomic factors contribute to inequalities in many health problems of older age, including coronary heart disease, dementia, diabetes and frailty. Focusing on raising the health and wellbeing of less affluent sectors of society would go a long way to achieving the Government's aims.

Individual-based interventions are likely to benefit the most affluent and educated, widening inequalities in older age. Significant improvements in population health require policies that support action at the national level which should be developed with significant public engagement with diverse groups; as different groups can have different attitudes and expectations on ageing and ill health.[55]

13. What would be the implications of a paradigm shift to people leading healthier lives for longer, and spending less time suffering ill health?

A paradigm shift would have significant impact, with the UK population experiencing substantial and ongoing improvements in physical health, mental health, health-related quality of life and health equity. The benefits would include people being able to contribute economically for longer, and reduce burdens on the NHS, care services and families. Issues that will need to be addressed as part of this shift are continued paid employment in older age, rise in the dependency ratio, controlling health and social care costs, and supporting the very old who may not be unhealthy but nevertheless frail.[56]

Fully-defining the implications of healthier lives will require modelling with multidisciplinary longitudinal studies. It is vitally important for the future that the population research infrastructure is maintained, so that we can understand better the ramifications of any shifts to longer healthier lives across all sectors of society.

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[54] World Health Organization Commission on Social Determinants of Health (2008). *Closing the gap in a generation: health equity through action on the social determinants of health.*
http://www.who.int/social_determinants/thecommission/finalreport/en/
[55] Academy of Medical Sciences (2016). *Improving the health of the public by 2040.*
www.acmedsci.ac.uk/download.php?f=file&i=37428
[56] *Ibid*