Chapter 1

Healthy Ageing

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More people are living longer. Consequently the provision of healthcare for older people is increasingly important. Central to that healthcare is to help people to make good lifestyle decisions as they get older to keep themselves as healthy and happy for as long as possible. But what are those lifestyle decisions? Are they the usual suspects (exercise, diet, socialising, avoiding cigarettes and excess alcohol)? What is the evidence that they work? How can we as healthcare professionals help our patients make these good decisions? This chapter addresses these questions. It starts with some background. There is a section on the more prominent theories of ageing. Then a summary of the evidence for how to improve the physical healthcare of people with mental health problems. Seven healthy lifestyle options are discussed. There is a box summarising the outcomes of some of the major cohort studies. We hope our readers pick up some tips for their own successful ageing as well as that of their patients.

Background

Healthy Ageing Is Complex

There is no easy way to define healthy ageing. Even the simplest definition of *health* includes biological, mental and social aspects. But if one focuses on the physical aspects there is an undeniable decline over a full lifespan. Our 'peak' level of physical function is usually in our mid-twenties and depends upon our genes and the many physical and psychological challenges we encounter in life. After the 'peak' there will be many factors contributing to the rate of decline. Do the factors that appear to promote healthy ageing mirror the factors causing chronic disease? What is the role of resilience? There is physical resilience allowing us to repair or accommodate to physical damage as it inevitably occurs, but there is also psychological resilience that allows us to change our behaviour to adapt to new challenges. None of these factors 'age' at the same rate. The clearest demonstration of this phenomenon is the contrast between 'functional ability' and 'well-being' over the lifespan. They are both 'U-shape' curves, but function peaks in the middle and well-being peaks at either end.

More People Are Living Longer

In Roman times only a few people lived into their eighties and average life expectancy was closer to 35 years. By the early 1900s, the average was 47 and that figure has almost doubled in developed nations over the last 100 years to 80 or more. As a consequence the percentage

of Americans over 65 has tripled from 4% to more than 13% [1]. Recent figures from England suggest that life expectancy has been steadily increasing and is now 80 years for men and 83 years for women [2]. According to the report, since 2001, death rates from heart disease and stroke have halved for both males and females. Over the same period, deaths from dementia and Alzheimer's disease have increased by 60% in males and have doubled in females. This partly reflects the fact that the population is ageing and that two-thirds of deaths now occur among those aged 75 and over, but also reflects an increased awareness of dementia.

More Time in Poor Health

The same figures suggest more of those extra years are spent in poor health (Table 1.1). Women can expect to live nearly a quarter of their lives in ill health and men a fifth [2].

Table 1.1 Life expectancy and health

	At birth males	At birth females	At age 65 males	At age 65 females
Life expectancy	79.5	83.1	18.7	21.1
Healthy life expectancy	63.4	64.1	10.5	11.2
Number of years in poor health	16.1	19.0	8.2	9.9
% of life in poor health	20.3	22.9	43.9	46.9

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Causes of Morbidity

There has been little change in the leading causes of chronic morbidity between 1990 and 2013. Low back and neck pain, skin diseases (mainly dermatitis, acne and psoriasis) and depressive disorders remain the leading causes overall for both sexes combined (Table 1.2). The age-specific morbidity rate (years lived with disability per 100,000 population) increases steadily from birth through to middle age and then more rapidly into old age. The over 80 age group experiences twice the morbidity rate of the 60–64 years group, which is in turn twice that of the 20–24 group. This reflects the fact that morbidity from many diseases increases with age; in particular, musculoskeletal conditions (including low back and neck pain), neurological diseases (including Alzheimer's disease and other dementias) and diabetes. The number of people with two or more comorbidities is likely to have increased in England from 1.9 million in 2008 to 2.9 million in 2018 [3].

Risk Factors for Disability

The Lifepath Consortium collated cohort studies of more than 100,000 older people from around the world. They used the outcome of physical functioning as assessed by the walking speed test. The major causes of loss of functioning were obesity, diabetes, physical inactivity and low socio-economic status [4]. Their findings suggest that people who have experienced socio-economic disadvantage live more of their shorter lives with disability.

Table 1.2 The leading causes of morbidity

1	Low back and neck pain
2	Skin diseases
3	Depressive disorders
4	Sense organ disorders
5	Migraine
6	Anxiety disorders
7	Falls
8	Diabetes
9	Chronic kidney disease
10	Other musculoskeletal
11	Iron-deficient anaemia
12	Chronic obstructive pulmonary disease
13	Oral disorders
14	Drug-use disorders
15	Congenital defects
16	Asthma
17	Schizophrenia
18	Osteoarthritis
19	Medication headaches
20	Alzheimer's disease
21	Bipolar disorder
22	Alcohol-use disorders
23	Epilepsy
24	Road injuries

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Risk Factors for Morbidity

In 2013, in England, the leading risk factors for morbidity were high body mass index (BMI) and high blood sugar. Smoking and alcohol use were also significant contributors to morbidity. The prevalence of smoking has declined from 19% to 16% in the last four years. However, there has been little change in other risk factors such as having a high BMI. There are many well-established risk factors for heart disease including age, hypertension, diabetes, raised cholesterol, smoking and a positive family history. However, modifying these risk factors where possible may only reduce the risk of dying from heart disease by a small amount. There is an important distinction between relative and absolute risk reduction. Treating hypertension may lead to a 40% relative risk reduction in heart attack or stroke,

which sounds very important. However, that may mean an absolute risk reduction of only 2% over 10 years (from 5% to 3%) [5].

Modern society sometimes appears to view older people as a homogeneous group, frail and valueless. These ageist attitudes can be insidious [6]. Older people, therefore, who also endure mental illness and poverty suffer a triple whammy of disadvantage.

Theories of Ageing

There are two main theories of ageing. One is that ageing is programmed into our genes and the other is that we age due to cellular changes over time [7].

Genetics

All organisms age. Even unicellular organisms that divide and appear to have no distribution of aged and young components do not have functional immortality. Time-lapse microscopy of *E. coli* shows division into different daughter cells. One grows slower, reproduces slower and is more likely to die – the ageing parent [8]. However, different species have different lifespans. The Antarctic sponge lives for up to 15,000 years [9]. Even within species, different breeds may have different lifespans. For example, Norwich terriers live almost twice as long as Scottish deer hounds [5]. Other evidence that ageing is genetically controlled comes from some gene disorders that appear to promote premature ageing. Progenia disorders result from a single mutation in the LMNA gene that produces progenin. With this disorder people appear to age rapidly and late adolescents look old. In Werner Syndrome (which has a similar presentation), there is a mutation on the WRN gene on chromosome 8. This gene is thought to be involved in reducing the repair of damaged DNA and leads to premature ageing [5]. The fact that we all age suggests immortality is either too costly or mechanistically difficult for natural organisms.

Longevity Genes

There may be many genes involved in withstanding a stressful environment. By optimising the body's functioning for survival, these genes can influence the chance of getting through a crisis. If they remain active for long enough they may be able to extend lifespan hence the term *longevity genes*. Many of these genes have obscure names such as daf-2, pit-1 and aak-1. These have been found to affect stress resistance and lifespan in laboratory organisms. Another example is SIR2; extra copies of this gene increase longevity in creatures as diverse as yeast, roundworms and fruit flies, and there is much current research on whether it does the same for larger animals [5].

Telomeres

The number of times a cell can divide is called the Hayflick Limit [10]. The Hayflick Limit for a typical human cell is 50–70 times before apoptosis. At the end of each chromosome there are tips called *telomeres* which protect the integrity of the DNA but cannot be replicated. Each time a cell replicates, a small part of telomere is cut off and so the telomere shortens. There is an enzyme called *telomerase* which extends the telomeres when cells divide and whilst all cells have the capacity to produce it, only certain cells including stem cells, sperm cells and white blood cells do so. This enables them to replicate more than

50 times within a lifetime. Free radicals, stress, inflammation and possibly vitamin D deficiency can also shorten the telomere and therefore the number of replications that the cell can make. However, some people do not experience telomere shortening and others have telomere lengthening and the significance of this is not yet known. Many systems are affected by ageing despite limited cell division, for example, nervous system, vision, muscles or bones [11].

DNA Damage and Repair

There are more than 70 million cell replications a day in the human body so it is not surprising there will be some errors. Ultraviolet light and oxygen free radicals can damage DNA [12]. Soon after life started on Earth many of the unicellular organisms were anaerobic in an atmosphere with little oxygen. As oxygen levels increased, cells started harnessing the energy from this in mitochondria. We live in an oxygen-rich environment but pay a price for this as it is a volatile element that is electron hungry and therefore easily degrades other substances (this effect is seen with combustion and rusting). Deham Mormon proposed a free radical theory of ageing in 1956 [13]. There is evidence that some compounds such as beta-carotene or vitamins C or E can work as antioxidants. Higher levels of superoxide dismutase (SOD) are associated with longevity in mice. Inserting extra SOD genes in fruit flies can extend life by up to 30% but not all species show this effect [14]. DNA repair capacity appears related to a species' longevity. Gene p53 appears to initiate DNA repair or cell death. Most cancer cells have a defective p53 gene. Siruins are proteins that appear to influence ageing by reducing errors in DNA.

The Disposable Soma Theory of Ageing

The Disposable Soma Theory developed by Tom Kirkwood in 1977 proposes that species can use energy on self-maintenance and reproduction in some environments or longevity in others [15]. The theory states that organisms age due to an evolutionary trade-off between growth, reproduction and DNA repair maintenance. Tom Kirkwood's motto in his Reith lectures was 'We're not programmed to die.' The Disposable Soma Theory explains that an organism only has a limited amount of resources or 'soma' that it can allocate to its various cellular processes. Therefore, a greater investment in growth and reproduction results in reduced investment in DNA repair maintenance, leading to increased cellular damage, shortened telomeres, accumulation of mutations, compromised stem cells and, ultimately, senescence. However, the relationship between reproduction and ageing remains controversial and the cellular mechanisms largely undiscovered.

Calorie Restriction

It was first reported more than 70 years ago that restricting an animal's calorie intake extends lifespan [16]. The restricted regime typically involves reducing an individual's food consumption by 60% from unlimited food. Animals ranging from mice to dogs and possibly primates not only live longer but also are far healthier during their lives. The only apparent trade-off in some species is a loss of fertility. The phenomenon was attributed to a slowing down of metabolism: cells produce less energy from food and therefore fewer toxic by-products. But this theory has been overtaken by new information showing that calorie restriction does not necessarily slow down metabolism.

Sugar

Sugars binding to blood proteins can cause cross-linking and advanced glycation end products. These may be associated with cataracts and atheroma. There is some evidence that metformin may prolong life and the Treating Age with Metformin Study is underway [17].

Gender

Beyond middle age, men have about 75–80% of the longevity of comparably aged women, although there is considerable variation. For example, the gender difference is almost 4 years in England (see earlier) whereas it is 12 years in Russia and 6 months in India. This diversity suggests that social and lifestyle factors have an important contribution. A biological basis for female longevity is that having two X chromosomes provides a backup for mutations. Female hormones, particularly oestrogen, are also thought to promote longevity; oestrogens have beneficial effects on lipids in the blood and protect women from heart disease. Men and women show different behaviour patterns that may influence longevity. There is some evidence that growth hormone/insulin-like growth factor-1 plays an important role in the regulation of ageing and disease [18].

Assessment of Healthy Ageing

There is no standard battery for assessing healthy ageing. However, there are tests that have some predictive power. Even as early as age 53, three measures of physical capability (grip strength, chair rise speed and standing balance time) predict mortality [19]. Lara et al. [20] identified five areas of testing for a proposed panel of biomarkers of healthy ageing:

1. Physical: grip strength, standing balance, dexterity, gait speed, timed up and go and chair rising
2. Cognitive: memory, executive functioning and processing speed tests
3. Physiology: blood pressure, FEV1, fasting glucose and lipids, waist circumference, bone density and muscle mass
4. Immune: inflammatory factors
5. Endocrine: hypothalamic-pituitary-adrenal (HPA) axis, sex hormones (testosterone and oestrogen) and growth hormones

Research by Wloch et al. [21] from the British Birth Cohort shows that there is a hierarchy of loss in functional ability with the loss of strength, balance and coordination (measured by grip, climbing stairs and walking 400 m) being the first tasks to be lost (top of hierarchy) and manual dexterity (e.g., feeding oneself) to be the last (bottom of hierarchy). This hierarchy of loss is evident in those as young as their forties. This offers the chance to intervene early to prevent functional decline.

People with Severe Mental Illness

The Mortality Gap and Physical Health

People with schizophrenia and bipolar disorder are dying up to 20 years earlier than the general population. This was the case in the old asylums and has been a consistent finding for more than a century. About three-quarters of this premature death is thought to be due to physical ill health. The mortality gap is widening as the health of the general population is

improving [22]. Cardiovascular disease is the most common cause of death in those with severe mental illness and the prevalence of cardiovascular disease is increased two to three times [23]. The authors found that antipsychotic use, raised BMI and elevated baseline cardiovascular parameters are the moderators of increased cardiovascular risk. Obesity, diabetes, hypertension, dyslipidaemia and smoking are the key modifiable risk factors. They are more likely to be present in lower socio-economic groups. It is a complicated picture because cardiovascular disease and severe mental illness share some pathophysiological features such as mitochondrial dysfunction, neuroinflammation and epigenetics. Furthermore, higher doses of antipsychotic medication predict greater risk of coronary heart and cerebrovascular disease. There is also the risk of sudden death due to the direct effects of antipsychotic medication on cardiac electrophysiology through QTc prolongation.

The metabolic syndrome occurs with the highest rate in those people with severe mental illness prescribed clozapine and the lowest in those who are unmedicated. For weight gain, clozapine and olanzapine are high risk; risperidone, quetiapine and amisulpride are moderate risk; and ziprasidone and aripiprazole are low risk. The prevalence of type 2 diabetes in people with severe mental illness is double that of the general population. The overall prevalence of metabolic syndrome in some groups of adults with severe mental illness may be as high as 60% but is likely to be lower in older people [23].

The incidence of cancer (excluding lung cancer) is not increased in people with severe mental illness but mortality is increased probably due to late diagnosis including the less effective uptake of screening. People with severe mental illness are more likely to have metastasis at diagnosis and a reduced survival after diagnosis. This may be due to medical comorbidity; drug interactions; lack of capacity; and the inability to cope with treatment regimens [24]. Respiratory diseases are more common. There is an increased rate of chronic obstructive pulmonary disease even when controlled for smoking. There are increased rates of tuberculosis, chronic bronchitis, asthma, pneumonia and death from pneumonia.

What Can Clinicians Do for Older People with Severe Mental Illness?

There are better outcomes if people are treated effectively for their mental illness as evidenced by reduced mortality; decreased suicide rate; and better functioning and ability to engage in healthcare [25]. However, the key factors driving the unhealthy ageing of people with severe mental illness appear to be poverty, unhealthy lifestyles, reduced access to healthcare, poor health literacy, reduced self-efficacy, lack of adequate community support and poorer quality of healthcare. As specialists we can ensure all individuals are enrolled with primary care. We can encourage health education and early contact in the event of symptoms. We can use antipsychotic medication effectively being mindful and reducing possible harmful effects. Prior to starting antipsychotic treatment a patient should have screening for cardiovascular disease and lifestyle risk factors such as raised BMI, hypertension, HbA1c, cholesterol, smoking and electrocardiogram (ECG) [26]. There should be ongoing monitoring – weekly weights in the first six to eight weeks; then weight, blood pressure, glucose/HbA1c and lipid profile at week 8 and week 12. Annual screening should continue whilst on an antipsychotic. It should be acknowledged there may be practical difficulties in providing such a high quality of service (ECGs, weekly weights, etc.). Specialists can at times take a lead with input from primary care and following the adage 'Don't just screen, intervene'. Always consider lifestyle interventions such as walking and smoking cessation groups. Care plans should include

physical health goals and the necessary support to achieve these. Encourage this group in particular to adopt the seven healthy lifestyle choices.

Seven Healthy Lifestyle Choices

Be Social

Social interactions are very important for healthy ageing [27]. Higher levels of social interaction have been found in older people who are ageing healthily, and there are studies showing levels of social interaction are associated with self-rated health and well-being (see [28] for a review). However, social interactions are complex and include different aspects such as social contact, social activity, social integration and social support. They can be measured by quantity or quality with some evidence the latter is more important. There are differences in loneliness if measured objectively or subjectively or in terms of who people spend time with. One study found that spending time with friends increased positive affect and decreased negative affect; while spending time with family increased both positive affect and negative affect [29]. Other studies have highlighted the importance of family support and involvement in reducing loneliness amongst other successful strategies [30]. People should be encouraged to join groups, see friends and keep in contact with their families.

Be Loving

The evidence suggests it helps to remain sexually active if you can. In a recent US study about a quarter of men and a third of women aged 18–35 report being very happy with their sex lives [31]. That percentage jumps to more than 50% for those aged over 65. Of those over 65, 50% were sexually active and almost 40% wanted to have sex more frequently. In another study, men having two or more orgasms a week were less likely to die during follow-up. For women, sexual satisfaction correlated positively with longevity. The frequency of sexual activity generally declines with age; however, an important factor is the presence of a partner. Biological changes can influence sexual activity, for example, vaginal lubrication diminishes after the menopause and men may find it difficult to maintain an erection [32]. These problems may be enquired about and amenable to medical intervention.

Exercise

Exercise can have a powerful effect on the body's growth and repair that balance biological processes causing decline and decay. It is associated with successful ageing [27]. Without regular exercise, muscles atrophy and we begin to walk with a slow and shuffling gait. We become short of breath on minimal exertion and feel less steady on our feet. The frailty sometimes associated with old age is largely preventable and even reversible. The key is to challenge the body to regular exercise. Inflammation is a natural response to insults and normally is a natural protective factor for healing. It can, however, become overactive, and an inflammatory response is implicated in numerous common ailments. Exercise can harness the benefits of that inflammatory response. There is evidence for a dose-related response to exercise (U-shaped curve). Couch potatoes and elite athletes have a lower life expectancy, while those doing moderate exercise have best outcomes [33].

Eat Healthily and Stay Trim

Nutrition has an important role in healthy ageing. A high BMI is the highest risk factor for morbidity [2]. Oversimplified advice for or against various foods is not necessarily the best approach. There are many different ways of eating healthily. Communities eating mainly fish tend to live longer as do those who eat mainly vegetables and fruits. Groups that live primarily on grains also seem to do well. Eating too much sugar can damage health while adequate dietary fibre (soluble and insoluble) helps health and reduces constipation. Most people have too much salt in their diet. The *UK Eatwell Guide* offers guidance [34]. Metabolism tends to reduce with age. Sometimes people want to eat smaller meals more frequently. A number of longitudinal studies (e.g., Framingham Heart Study [41], see the box in the following text) have found that being slightly overweight may be associated with improved longevity whereas obesity significantly reduces survival.

Keep Stimulated

Mental stimulation is a good thing for healthy ageing and is a developing field of research. Taking on new challenges such as art classes or bridge can also improve social stimulation. This may take advantage of the brain's 'plasticity'. A 2000 study of London cab drivers found that drivers had a larger right hippocampus than control subjects [35]. There was a direct correlation between the size of the hippocampus and the length of time on the job. It appears that the challenge of memorising complex routes and actively using the information has a physical impact on the brain. Early retirement, by contrast, has been associated with earlier death [36]. Spirituality plays a central role in many people's lives as they get older, and there is evidence it can be associated with healthy ageing [37].

Sleep Well

Matthew Walker in his book *Why We Sleep* makes the case that adequate sleep helps mental and physical health as we age [38]. He summarises the evidence that routinely sleeping less than six hours a night reduces the immune system and increases the risk of cancer. Insufficient sleep increases the risk of developing Alzheimer's disease. Sleep disruption contributes to all the major psychiatric conditions including depression, anxiety and suicidality. Sleep evolved soon after life and has a 'rich litany of functions' dispensing a 'multitude of health-ensuring benefits'. Dreams provide a 'consoling neurochemical bath that mollifies painful memories' [38]. Older people need just as much sleep as younger people but often have more fragmented sleep because of medications, coexisting medical problems and weakened bladders. Ageing is associated with a regression in sleep timing (going to bed earlier) due to earlier release of melatonin. 'Power naps' probably only convey short-term benefits on concentration if sleep deprived but do not replace proper sleep. Perhaps doctors should prescribe sleep? The most important sleep hygiene rule is going to bed and waking up at the same time of day.

Don't Smoke or Drink Too Much Alcohol

The evidence is clear that smoking damages cardiovascular health, increases the risk of cancer and is associated with poor ageing [27]. As mentioned previously, smoking rates

have decreased to 16% in England [2] but were much higher when our current older folk were young. The number of older people exceeding recommended levels of alcohol intake is increasing and there are no age-based sensible drinking limits. There is a danger of too high a proportion of the ageing population exceeding recommended drinking levels that are too high in the first place. Disrupted routine and loss may lead to increased alcohol intake. The social acceptance of women drinking alcohol will reduce gender-based differences. Even moderate drinking (less than 1–2 units a day) may be associated with liver and brain damage, insomnia, depression, accidents and osteoporosis [39].

Change

Most of our patients know that it is healthier to exercise, stop smoking and maintain good weight but this knowledge in itself is not enough to effect change. Most people find it hard to get motivated to change their lifestyle. As doctors we may have had many years of training but very little training on how to help our patients modify their lifestyles. However, we have an important role in society and our patients' lives that we can use to our patients' advantage by helping with change.

Motivational interviewing is a helpful framework for these discussions and has been shown to be effective in promoting health behaviours [40]. A key aspect to motivational interviewing is to be goal focused. Planning a clear achievable goal such as a sustained modest reduction in food intake and amount of exercise may be a first step. The second key aspect is that this is a person-centred approach so it will depend upon the person's existing lifestyle and preferences. A third component is the chance to explore ambivalence. There will be some initial hardships in lifestyle change, and this needs to be acknowledged and balanced against the benefits. The resolution of this ambivalence is central to the technique so the clinician directs discussion to these elements.

Healthy ageing starts before you are born and what you do throughout your life also makes a big difference. Some people when challenged about their poor lifestyle decisions say they would rather enjoy their current time and die a little earlier. Unfortunately, the evidence shows poor lifestyle decisions increase the number of years lived in poor physical health. Good choices are fun: our patients need to have access to the best evidence to advise lifestyle change. They also need to appreciate that good choices are just as important as you get older.

It will sometimes be helpful to refer older people for occupational health or physiotherapy assessments. Community-based complex interventions in preservation of physical function and independence in elderly people have been shown to work [41].

A positive disposition such as optimism is associated with healthy ageing. Feeling in control and having a sense of purpose are also important [28]. We can help our patients to be more optimistic, monitor their own health, make the right lifestyle choices and seek professional help when necessary.

Cohort Studies Looking at Healthy Ageing

Framingham Heart Study

The Framingham Heart Study is a long-term, ongoing cardiovascular cohort study involving residents of the town of Framingham, Massachusetts. The study began in 1948 with more