

3

Health in older age

Demographic and epidemiological changes

Population ageing

One reason that ageing is emerging as a key policy issue is that both the proportion and absolute number of older people in populations around the world are increasing dramatically. Fig. 3.1 and Fig. 3.2 show the proportion of people aged 60 years or older by country in 2012 and projections for 2050. There is currently only one country where this proportion exceeds 30%: Japan. However, by the middle of the century, many countries will have a similar proportion of older people to that of Japan in 2012. These include countries in Europe and North America, but also Chile, China, the Islamic Republic of Iran, the Republic of Korea, the Russian Federation, Thailand and Viet Nam.

In Fig. 3.1 and Fig. 3.2, population ageing may appear to be less relevant to sub-Saharan Africa. Yet although the population structure in sub-Saharan Africa will stay young in relative terms, this region already has double the number of older adults than northern Europe, and this figure is expected to grow faster than anywhere else, increasing from 46 million in 2015 to 157 million by 2050 (1). Furthermore, life expectancy at age 60 in sub-Saharan Africa is 16 years for women and 14 years for men, suggesting that for those who survive the earlier perils of life, a long old age is already a reality. Older people in sub-Saharan Africa also have several roles that are critical for continued socioeconomic development (1).

The pace of population ageing in many countries is also much greater than has been the case in the past (Fig. 3.3). For example, while France had almost 150 years to adapt to a change from 10% to 20% in the proportion of the population that was older than 60 years, places such as Brazil, China and India will have slightly more than 20 years to make the same adaptation. This means that the adaptation that these countries need to go through will have to be undertaken much more quickly than was often the case in the past.

Why are populations ageing?

There are two key drivers of population ageing. The first is increasing life expectancy: on average, people around the world are living longer. Although

Fig. 3.1. Proportion of population aged 60 years or older, by country, 2015

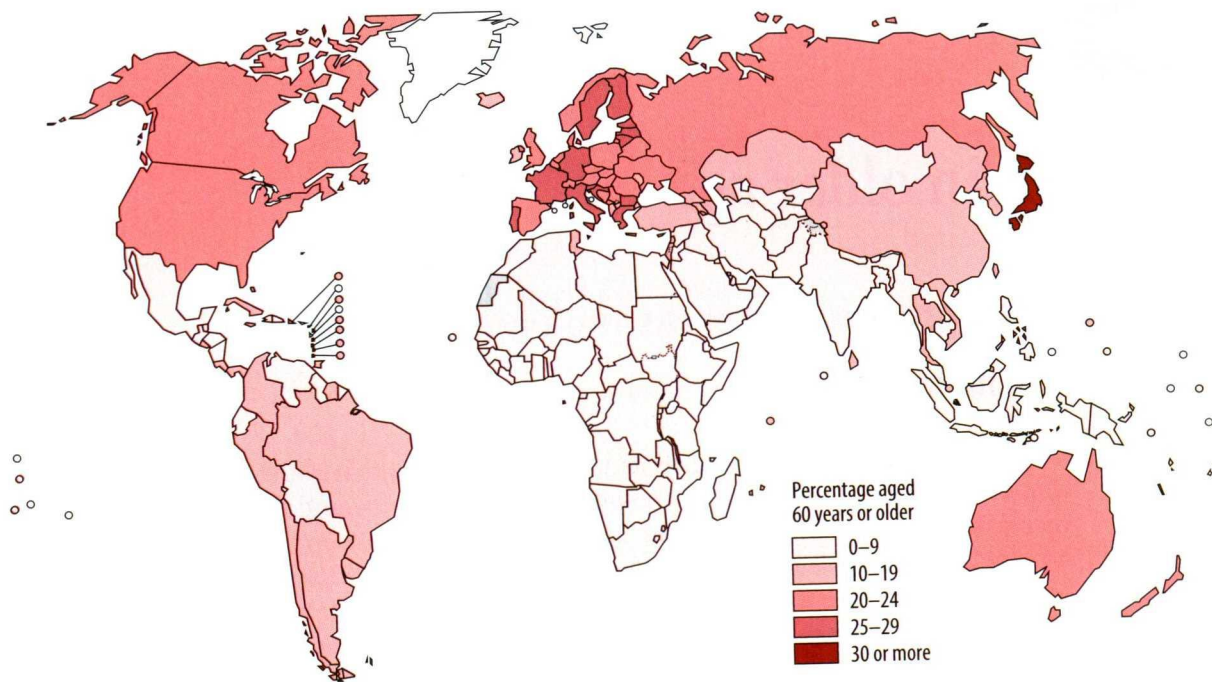


Fig. 3.2. Proportion of population aged 60 years or older, by country, 2050 projections

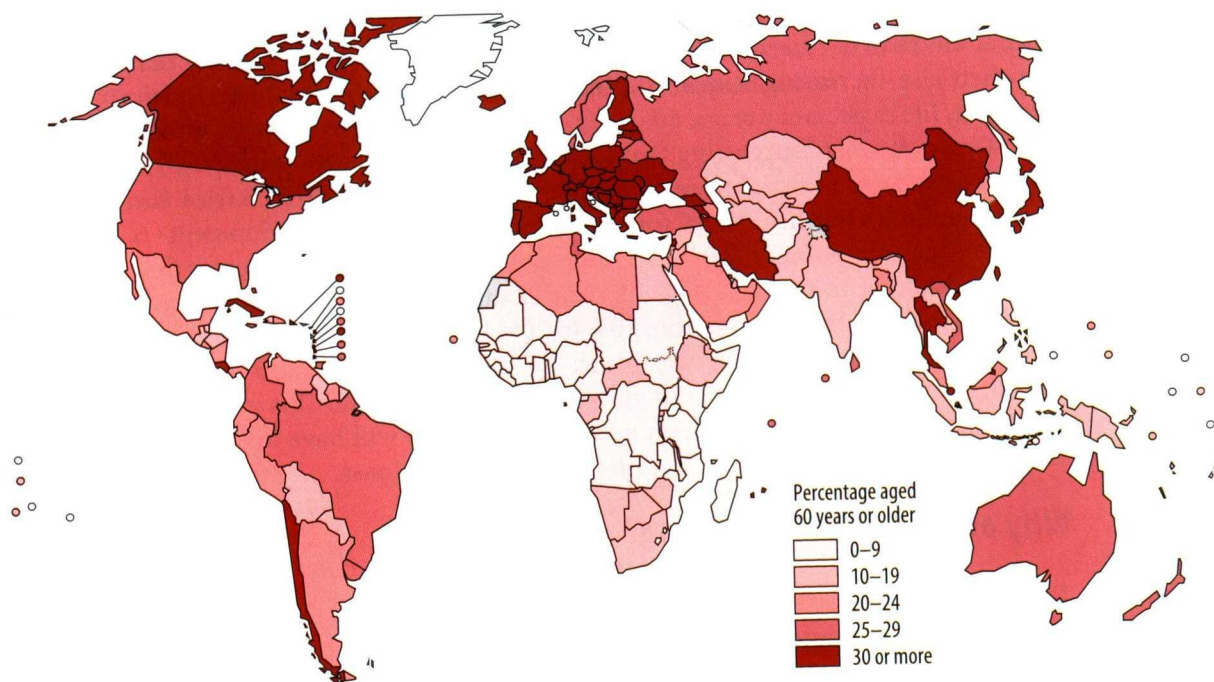
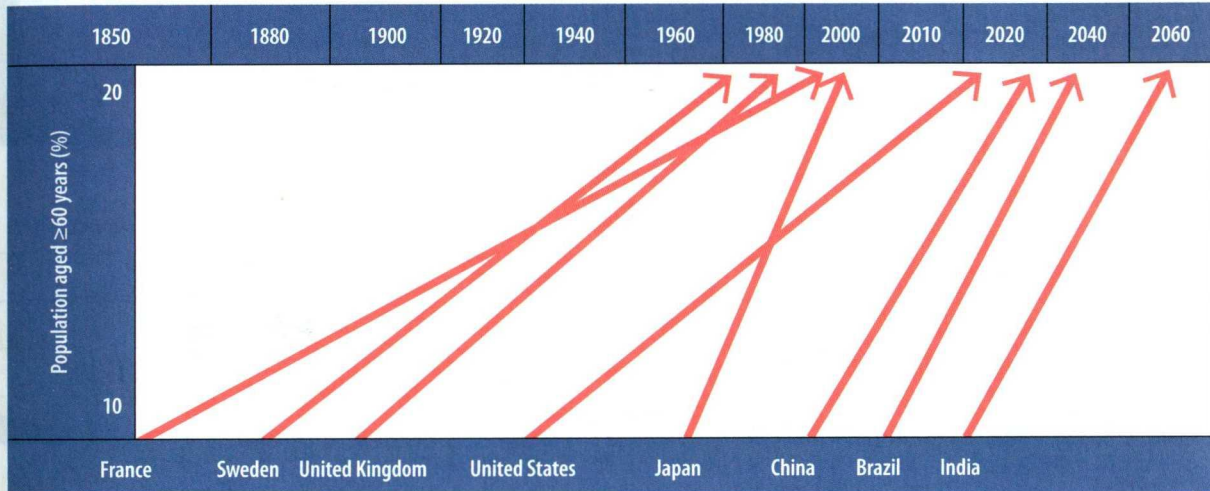


Fig. 3.3. Period required or expected for the percentage of the population aged 60 years and older to rise from 10% to 20%



a small part of this global increase is due to the improved survival of people at older ages, most reflects improved survival at younger ages. This has accompanied the historically unprecedented socioeconomic development that has taken place globally during the past 50 years.

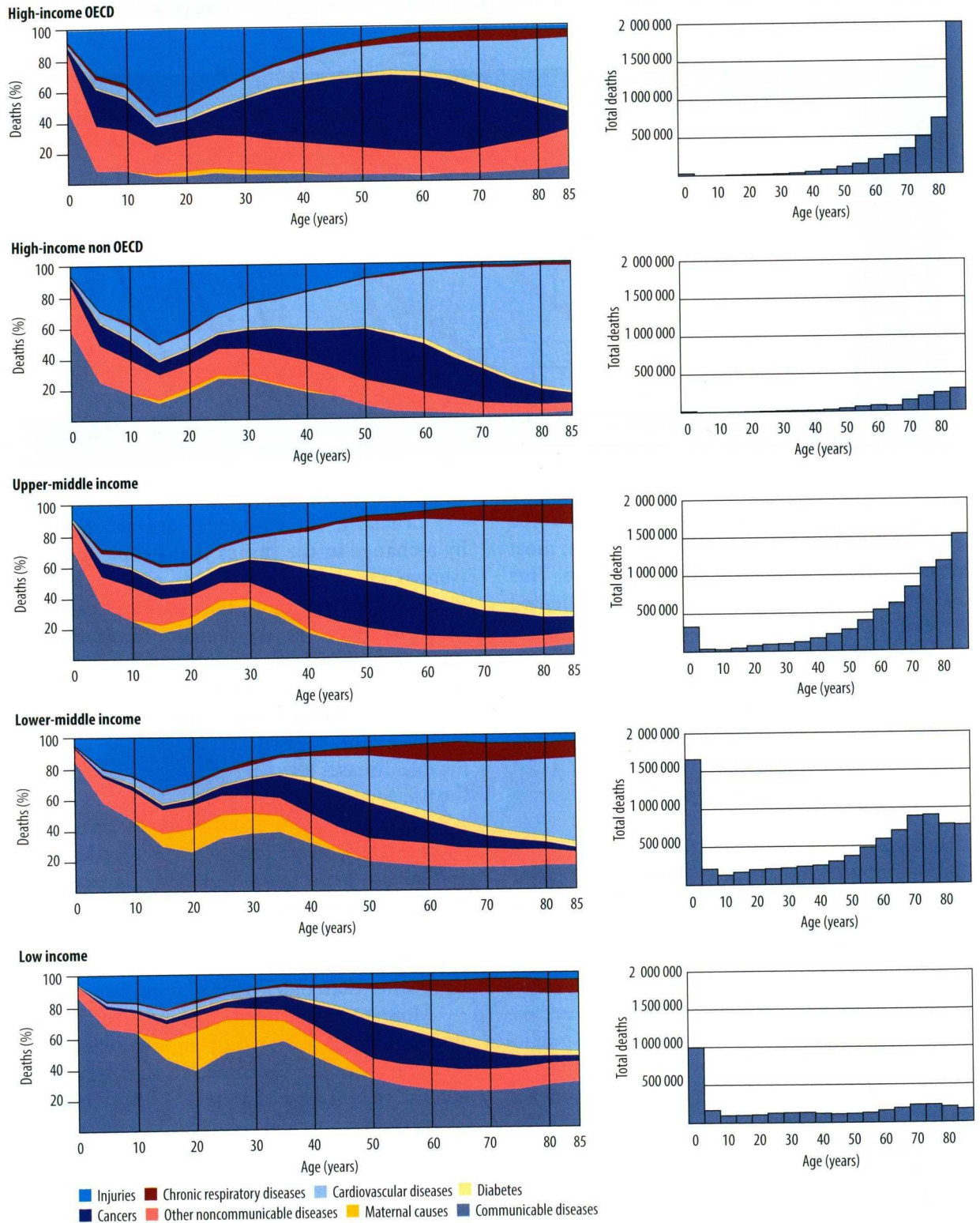
Fig. 3.4 and Fig. 3.5 show how strongly a country's level of socioeconomic development is associated with mortality patterns across the life course. The graphs on the right-hand side of Fig. 3.4 and Fig. 3.5 show the ages at which deaths occur in low-, middle- and high-income countries. Note that high-income countries that are members of the Organisation for Economic Co-operation and Development (OECD) are displayed separately from other high-income countries because their epidemiology is quite distinct. In lower-resource settings, death occurs most commonly in early childhood. Deaths are then evenly spread across the rest of life. As countries develop, better public health means that more people survive childhood, and the pattern of deaths changes to one in which people are more likely to die as adults. In high-income settings, the pattern of death shifts even more to old age, so that most deaths occur in people older than 70 years.

Crucially, these changes are accompanied by a change in the things that people die from (shown on the left-hand side of Fig. 3.4 and Fig. 3.5). In all settings, the dominant causes of death in older age are noncommunicable diseases, although deaths from these causes tend to occur earlier in low- and middle-income countries than in high-income countries. However, in both low- and middle-income settings, communicable diseases remain significant killers across the life course.

These shifts mean that as countries develop economically, more people live into adulthood and so life expectancy at birth increases. The majority of the increases in life expectancy seen around the world during the past 100 years (Fig. 3.6) reflect this reduced mortality at younger ages rather than older people living longer.

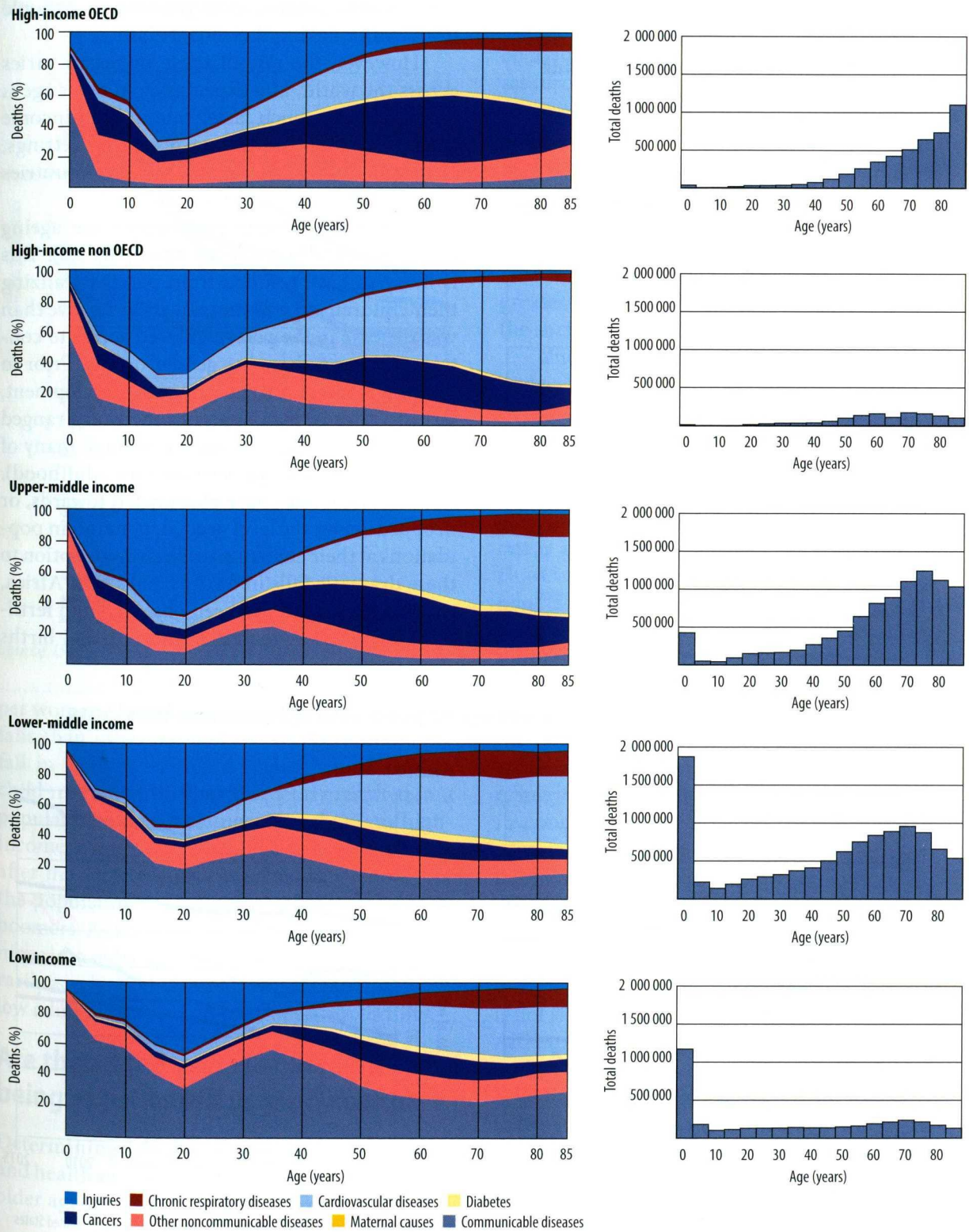
More recently, another trend has contributed significantly to increasing life expectancy, particularly in high-income settings: increasing survival in older age (3) (Fig. 3.7). Thus, in 1985 a 60-year-old woman in Japan could expect to live another 23 years. By 2015, this had increased to almost 30 years. This increase may reflect a mixture of better health care, public-health initia-

Fig. 3.4. Deaths among females at different ages in low-, middle- and high-income countries, 2012



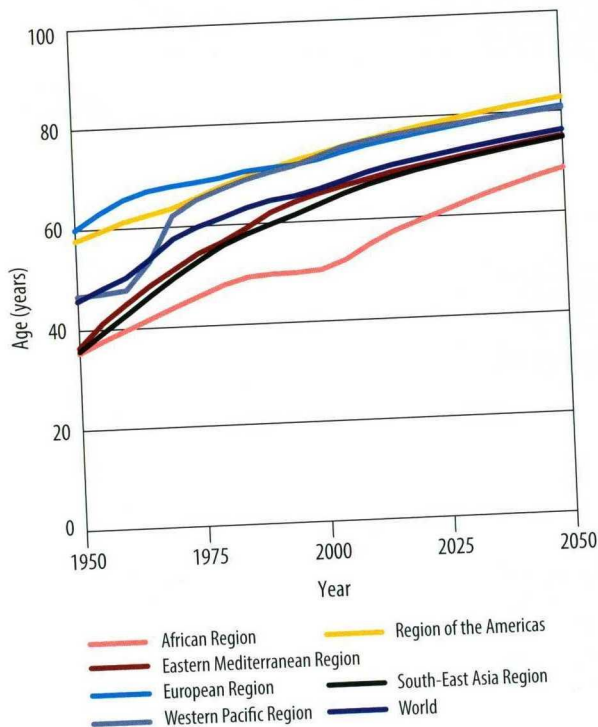
OECD: Organisation for Economic Co-operation and Development. *Source:* (2).

Fig. 3.5. Deaths among males at different ages in low-, middle- and high-income countries, 2012



OECD: Organisation for Economic Co-operation and Development. Source: (2).

Fig. 3.6. Changes in life expectancy from 1950, with projections until 2050, by WHO Region and worldwide

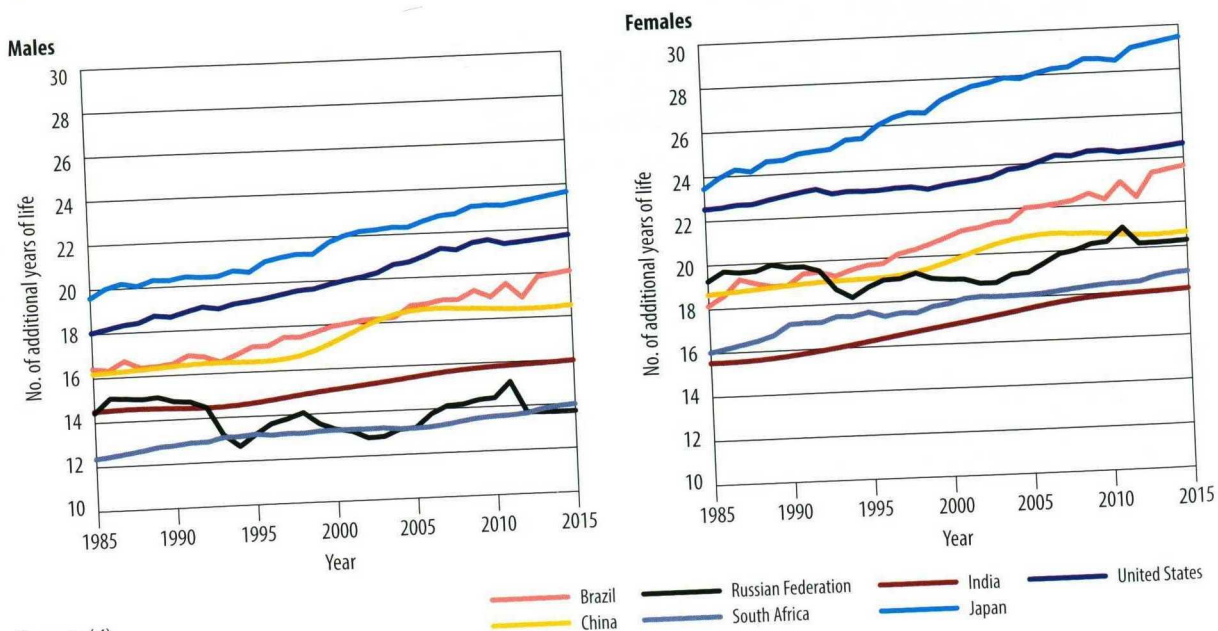


tives and the differences in the lives that people lived earlier during their life course.

However, the rate of these increases varies across the world. Life expectancy in older age is increasing at a much faster rate in high-income countries than in lower-resource settings, although this varies among specific countries and between males and females.

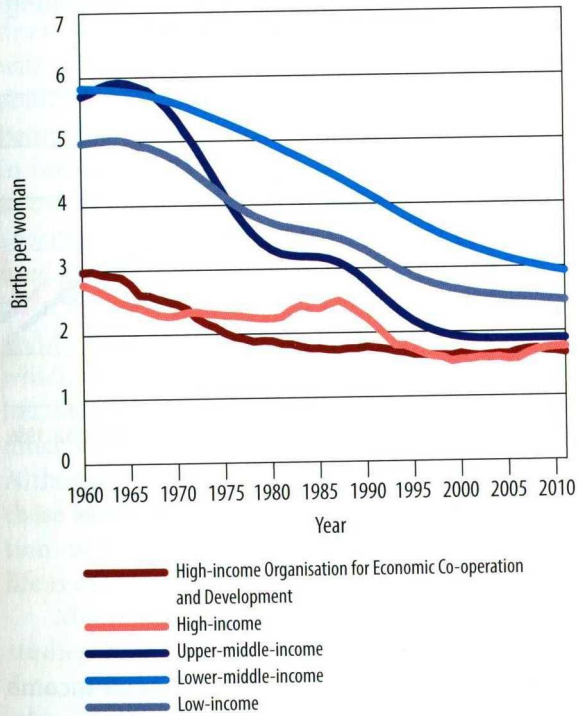
The second reason populations are ageing is because of falling fertility rates (Fig. 3.8). This is likely to have resulted from parents realizing their children are now more likely to survive than was the case in the past, increased access to contraception and changing gender norms. Prior to recent advances in socioeconomic development, fertility rates in many parts of the world ranged from 5 to 7 births per woman (although many of these children did not survive into adulthood). In 2015, these rates have plummeted towards, or dropped below, the level needed to maintain populations at their current size. The key exception to these dramatic falls in fertility rates is in Africa, where a slower fall has been observed and fertility rates generally remain at more than 4 births

Fig. 3.7. Male and female life expectancy at age 60 years, selected countries, 1985–2015



Source: (4).

Fig. 3.8. Fertility rates in low-, middle- and high-income countries, 1960–2011



Source: (5).

per woman. The Middle East has also seen slower falls than other parts of the world. Because the fall in fertility has often lagged behind falls in child mortality, this has frequently resulted in a population bulge in younger ages. In many high-income countries, this bulge occurred shortly after the Second World War and this segment of the population is commonly referred to as baby boomers. As the members of the population bulge move into older ages, population ageing is temporarily accelerated, especially when combined with low adult mortality and continued low fertility.

Are the added years in older age being experienced in good health?

Determining whether people are living longer and healthier lives, or whether the added years of older age are lived mainly in poor health, is cru-

cial for policy development. If the added years are lived in good health, population ageing will be associated with a similarly growing human resource that might be expected to contribute to society in many ways (for example, through a longer working life). This can be summed up in the saying “70 is the new 60”. However, if people are living longer but experiencing limitations in capacity at similar or higher levels to their parents at the same ages, this means demands for health care and social care will be significantly greater, and older people will be more limited in the social contributions they can make.

Understanding which of these scenarios is underway is crucial for prioritizing areas for policy action and for ensuring that any policy response is fair. For example, if everyone is living a longer and healthier life, one way of ensuring the fiscal sustainability of social-protection systems might be to increase the age at which someone is able to access a benefit such as a pension. However, if the added years are being lived in poor health, this might not be as appropriate because it may require people with significant limitations in intrinsic capacity to remain in the workforce. This may be unrealistic for the individual and less than ideal for the employer. Furthermore, if people of high socioeconomic status are living longer and healthier lives while people of low socioeconomic status are living longer but in poor health, the negative consequences of a generic policy response, such as increasing the pension age, will be shared inequitably.

Unfortunately, although there is strong evidence that older people are living longer, particularly in high-income countries, the quality of life during these extra years is quite unclear (6). This is not simply due to a lack of research in the area. Although there have been few studies in low- and middle-income countries, considerable analyses have been undertaken of data collected during the past 30 years in the United States and other high-income settings. However, the findings from this extensive research pool are inconsistent, with some studies suggesting falling levels

Fig. 3.9. Prevalence of limitations in instrumental activities of daily living by year of birth, 1916–1958 (after controlling for age and period) (16)

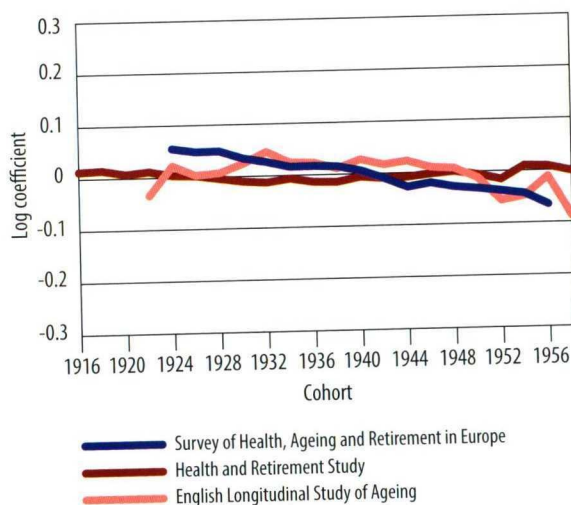
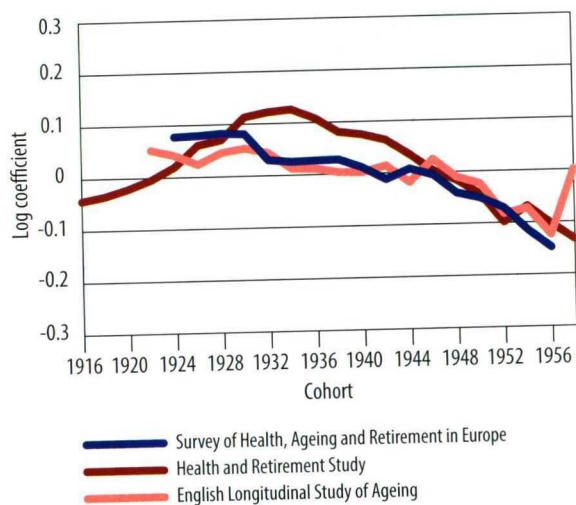


Fig. 3.10. Prevalence of limitations in activities of daily living by year of birth, 1916–1958 (after controlling for age and period) (16)



of severe disability in people older than 65 years, other studies in the same age group suggesting rising rates of chronic disease and comorbidity but steady rates of disability, and yet others suggesting an increasing prevalence of disability in 60- to 70-year-olds (7–10). One study that linked multiple data collections found increasing quality-adjusted life expectancy, albeit slowed down due to obesity and some decreases in capacity, while another observed that cohort-wide falls in the prevalence of disability reversed after adjustment for characteristics such as race, education, marital status, employment status, income and body mass index (11, 12).

These patterns may also vary geographically. Research in Europe suggests that health expectancies differ significantly among countries (13). For example, a multicountry assessment of patterns of milder disability in the OECD found that they had decreased in some countries, increased in others and remained the same in the rest (14). A pooled analysis by WHO in 2014 of large lon-

gitudinal studies conducted in high-income countries suggested that although the prevalence of severe disability (that is, a disability that requires help from another person to carry out basic activities such as eating and washing) may be declining slightly, no significant change in less severe disability has been observed during the past 30 years (15) (Fig. 3.9 and Fig. 3.10). Thus, the current evidence from high-income countries is confusing, but suggests there may be a small reduction in some forms of disability at a given age, although this is unlikely to be keeping up with the added years people are living.

This lack of clarity is exacerbated by several significant research limitations. First, disability is generally accepted to be a state determined by both the underlying characteristics of individuals (that is, intrinsic capacity) and the environments they live in (17). Unless researchers consider changes at both these levels, they will be unable to distinguish between them. For example, in the 1950s, individuals with arthritis of the hip may have found their

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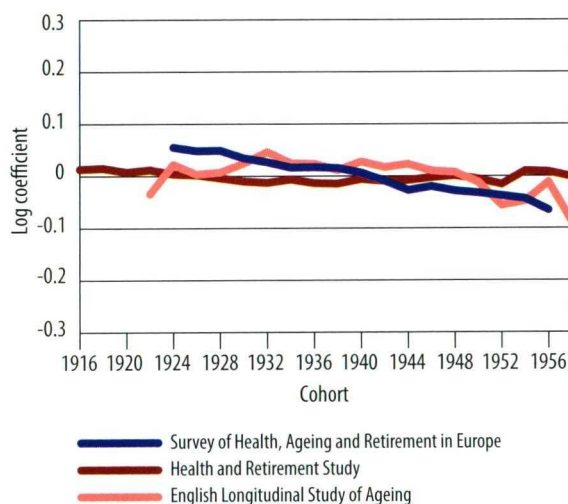
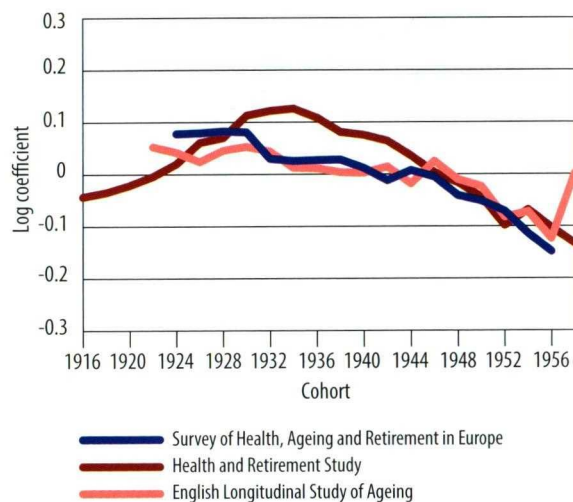


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ability to do the things that they needed to do to be compromised because there was a lack of transport options. In 2015, the same people may be able to draw on public transport that is accessible to people with disability and, thus, find that their functional ability is far better, despite the intrinsic capacity being the same. Distinguishing between trends in intrinsic capacity and environmental changes to better measure functional ability thus requires specific questions, yet the instruments commonly used generally do not make this distinction.

Furthermore, most of the data identify disability only at the severe end of the spectrum, which commonly occurs during the last years of life. Declines in intrinsic capacity generally start much earlier and are often initially very small. Although most older people are experiencing these more minor and subtle changes, information on trends in capacity during this phase of life is extremely limited.

Moreover, in high-income countries, most studies have drawn only on relatively recent data, which are largely limited to a period when the epidemiological transition outlined in Fig. 3.4 and Fig. 3.5 had already taken place. Increases in life expectancy in these settings are now largely due to increasing survival in older age, and this may be the result of prolonging the end-stage of life through medical treatments rather than of the broader public-health advances that are likely to have driven earlier epidemiological changes. These results may provide a fair comparison between our health and that of our parents, but it is possible that the trend between our parents and their parents was different entirely. One study that does capture trends during this earlier period is consistent with the health of older people being significantly better than that of their grandparents and great-grandparents (18). This found lower age-specific prevalence rates of specific chronic diseases in United States army recruits across the 20th century when compared with those recruited during the Civil War (18).

Finally, older populations are characterized by great diversity. Trends within different subclasses in each population may be quite distinct. In the United States, for example, the life expectancy of poorly educated African-American adults may have changed little since the 1950s (19, 20).

While the evidence from high-income countries is confusing, data from low- and middle-income countries are largely absent. One exception is China, where a comparison of large representative surveys conducted in 1987 and 2006 found significant increases in both physical and mental limitations during the past two decades, but significant decreases in limitations in vision, hearing, speech and intellect (21).

Low- and middle-income countries are currently experiencing the epidemiological transition shown in Fig. 3.4 and Fig. 3.5. Countries such as China are nearing the end of this transition, and the changing age-standardized disability rates described by this study reflect this, with falls in disability related to infectious diseases and marked increases in disability related to cerebrovascular disease and arthritis (which were included in the category of physical disabilities) (21). Population diversity is also obvious in these findings, with falls in disability largely observed in urban areas.

Low- and middle-income countries that are earlier in this transition continue to experience a double burden of disease, with high rates of both communicable and noncommunicable diseases, and many people in these countries face far higher exposures to environmental and occupational toxins, and stressors than people in high-income settings. It is possible that this combination of diseases and environmental stressors may impact in unpredictable ways on subsequent morbidity in older adults. Impacts could occur, for example, if these exposures enhanced “inflammaging”, which has been suggested as a possible driver of cardiovascular disease (22, 23). Therefore, it is not appropriate to simply extrapolate morbidity trends observed in higher-income countries to lower-income settings.

Health characteristics in older age

The remainder of this chapter explores in more detail some of the health-related characteristics of the second half of life and the impact they ultimately have on intrinsic capacity and functional ability. Given the complexity of these changes, the discussion does not attempt to summarize every condition and trend, but highlights key issues that can provide a frame for understanding health trends in older age.

Underlying changes

As described in Chapter 1, at a biological level, ageing is characterized by a gradual, lifelong accumulation of molecular and cellular damage that

results in a progressive, generalized impairment in many body functions, an increased vulnerability to environmental challenges and a growing risk of disease and death (24). This is accompanied by a broad range of psychosocial changes.

We summarize below some of the underlying changes that tend to occur to some degree in all humans as they age. Although there is marked diversity in how these changes are experienced at an individual level, general trends are seen when the population as a whole is considered (25). However, these losses in intrinsic capacity can be compensated for by adaptation, and are often accompanied by gains in experience and knowledge. This might explain why workplace productivity does not seem to fall with age (Box 3.1).

Moreover, it is difficult to disentangle the impact on functioning of these underlying trends

Box 3.1. Ageing and productivity

The effects of underlying age-related changes in intrinsic capacity on productivity in the workplace have only just begun to be studied. One reason why is that productivity is difficult to measure objectively, with ratings by peers and supervisors often representing stereotypical conceptions rather than the actual performance of older workers (26). Second, not all occupations lend themselves to the objective measurement of productivity. Because of this, the small amount of research that has been undertaken is often limited to workplaces that enable objective measurements, such as the number of errors or amount of sales.

Overall, productivity does not seem to fall with age, although it may decrease as time spent in a particular job increases, with routinization leading to falls in motivation, or overuse leading to physical harm (27). Thus, one study found that the number of errors committed by each team on the assembly line in a car factory fell slightly with age after controlling for downward selectivity (that is, early retirement, disability) and upward selectivity (that is, promotion). The authors concluded that "older workers are especially able to grasp difficult situations and then concentrate on vital tasks" (28).

This finding highlights the fact that age-related losses, such as a slowing of the speed of information processing or the loss of the ability to multitask, need not have negative impacts on work productivity because up to a certain point, they can be compensated for by the life and work experiences of older people. Furthermore, some declines in physical capacity may be delayed by occupation. For example, falls in grip strength that are observed at the population level may not be seen in subpopulations that have to use their hands for everyday work, although this difference may reverse in later life. Thus, after the age of 80 years, manual labourers have lower levels of physical strength than white-collar workers (29). This may reflect the accrual of physical damage in these occupations.

Age heterogeneity in work teams may also be a determinant of productivity. An intermediate amount of age diversity has been positively related to productivity, possibly reflecting the fact that age diversity has costs (in terms of communication and social integration) as well as benefits (in terms of having a larger knowledge pool to draw from for solutions). This effect was also moderated by the type of work task prevalent in a company. Companies emphasizing creative work profited from age diversity, whereas companies focusing on routine tasks did worse under conditions of age diversity (30).

from the consequences of the diseases individuals may also face across their life course. Thus, where trends across the life course are shown in this chapter for the general population, for example for grip strength and gait speed, these reflect both underlying trends in musculoskeletal functioning and the additional influences of patterns of activity and nutrition, as well as health conditions.

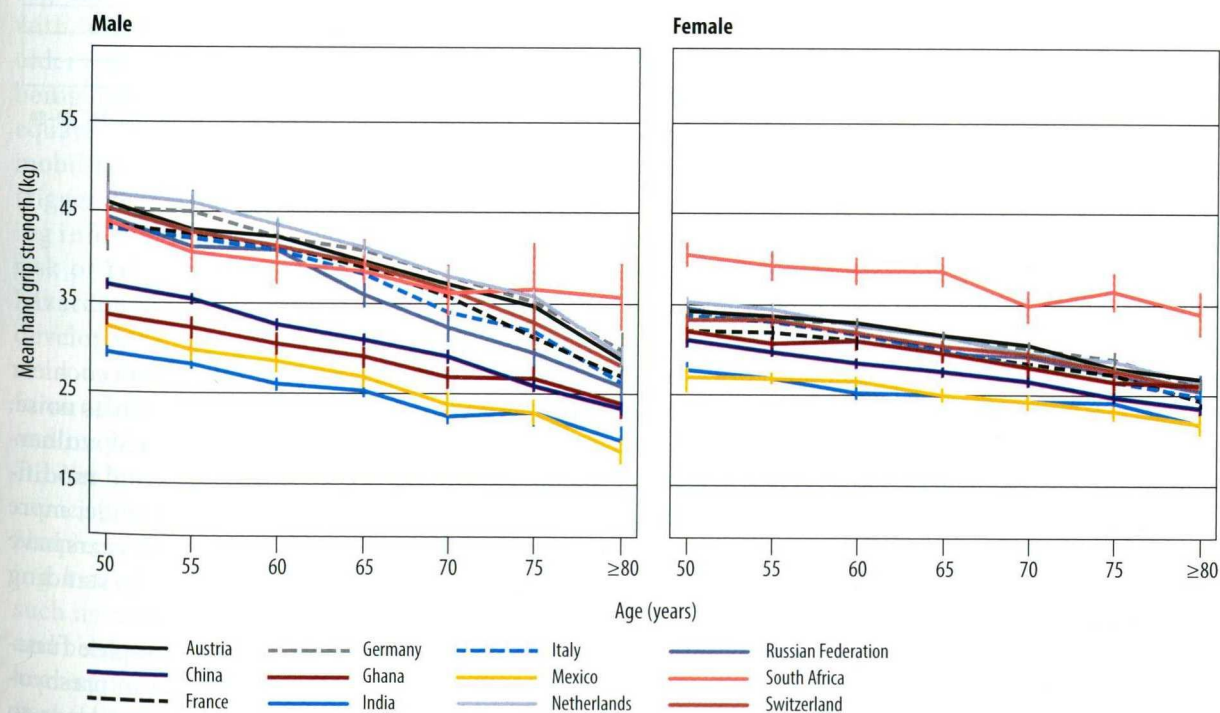
Movement functions

After a peak in early adulthood, muscle mass tends to decline with increasing age, and this can be associated with declines in strength and musculoskeletal function (31). One way of measuring muscle function is to measure hand grip strength, which is a strong predictor of mortality, independent of any disease-related influences (32, 33).

Age-related declines in average grip strength in countries included in SAGE and the Survey of Health, Ageing and Retirement in Europe (SHARE) are shown in Fig. 3.11. Women tend to have weaker grip strength than men, and for both sexes strength declines with increasing age. The rate of deterioration of grip strength was similar across most of the countries studied. However, the peak level reached varies markedly, with people in India and Mexico generally having lower strength across all ages and sexes. These differences may reflect a mix of genetics and early-life factors, such as nutrition.

Ageing is also associated with significant changes in bones and joints. With age, bone mass, or density, tends to fall, particularly among postmenopausal women. This can progress to a point where the risk of fracture is significantly increased (a condition known as osteoporosis), which has

Fig. 3.11. Hand grip strength, males and females aged 50 years and over



Note: The figure focuses on the fourth wave of SHARE (2010–2011) because the timing of project implementation coincided approximately with the first wave of SAGE (2007–2010). Data are not adjusted for height and weight.

Sources: (16, 34).

serious implications for disability, reduced quality of life and mortality. Hip fractures are a particularly devastating type of osteoporotic fracture, and as a result of population ageing they will become more common, reaching an estimated annual global incidence of 4.5 million in 2050 (35). The median age-standardized rates of fractures related to osteoporosis vary geographically, with the highest observed in North America and Europe, followed by Asia, the Middle East, Oceania, Latin America and Africa (36).

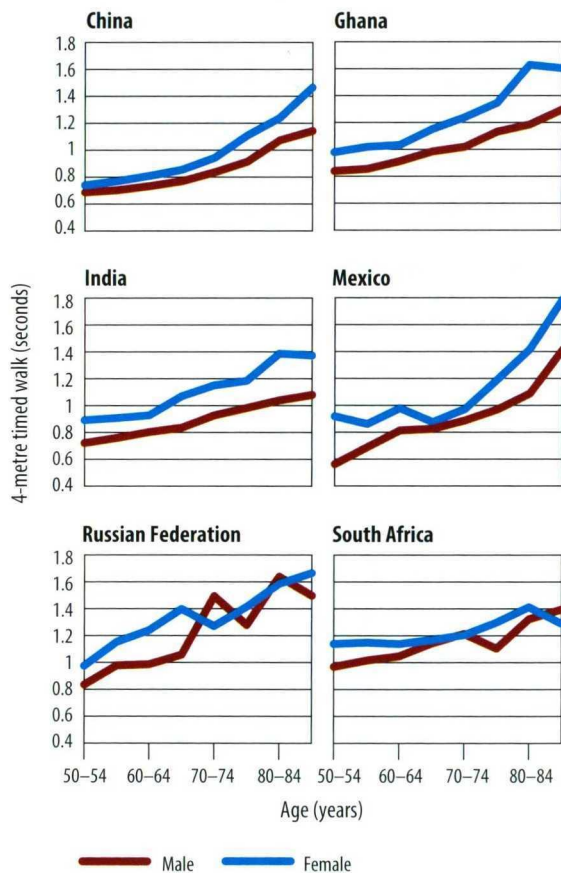
Articular cartilage undergoes significant structural, molecular, cellular and mechanical changes with age, increasing the vulnerability of the tissue to degeneration. As cartilage erodes and fluid around the joint decreases, the joint becomes more rigid and fragile (37). Although softening of the cartilage commonly occurs with age, this does not universally result in joint pain or the cartilage degeneration responsible for osteoarthritis, although the prevalence of this disorder is strongly associated with age (38). Furthermore, regular moderate physical activity has been shown to improve the biomechanical and biological properties of articular cartilage (37).

These and other age-related declines ultimately impact on broader musculoskeletal function and movement. This is reflected in a decrease in gait speed – that is, the time someone takes to walk a specified distance. Gait speed is influenced by muscle strength, joint limitations and other factors, such as coordination and proprioception, and has been demonstrated to be one of the most powerful predictors of future outcomes in older age (39). Fig. 3.12 demonstrates gait speed at different ages in the six SAGE countries, and shows a general slowing of walking speed with age.

Sensory functions

Ageing is frequently associated with declines in both vision and hearing, although there is marked diversity in how this is experienced at an individual level. Age-related hearing loss (known as presbycusis) is bilateral and most marked

Fig. 3.12. Gait speed (time needed to walk 4 metres), by age, sex and country



Source: (34).

at higher frequencies. It results from cochlear ageing; environmental exposures, such as noise; genetic predisposition; and increased vulnerability from physiological stressors and modifiable lifestyle behaviours (40). Worldwide, more than 180 million people older than 65 years have hearing loss that interferes with understanding normal conversational speech (41-45).

Age is also associated with complex functional changes in the eye that result in presbyopia, a decrease in focusing ability that leads to the blurring of near vision, which often becomes apparent in midlife (46). Another common change

associated with ageing is increasing opacity of the crystalline lens, which can ultimately result in cataract. The age of onset, rate of progression and level of reduced vision vary significantly among individuals, reflecting genetic patterns and environmental exposures (47). Ageing is also strongly associated with age-related macular degeneration, which causes retinal damage and leads rapidly to severe visual impairment; it is highly prevalent in people older than 70 years, and a leading cause of blindness in high-income and upper-middle-income countries.

These changes can have important implications for the everyday lives of older adults. Untreated hearing loss affects communication and can contribute to social isolation and loss of autonomy, with associated anxiety, depression and cognitive decline (48). The impact of significant hearing loss on an individual's life is often not appreciated by people with normal hearing, and slowness in understanding the spoken word is commonly equated with mental inadequacy, often causing the older individual to withdraw further to avoid being labelled as "slow" or "mentally inadequate" (49). Visual impairments can limit mobility, affect interpersonal interactions, trigger depression, become a barrier to accessing information and social media, increase the risk of falls and accidents, and make driving hazardous (50). Furthermore, as older people develop strategies to compensate for declining sensory functions, the ways in which they perform other cognitive tasks may also be altered and may be less efficient.

Yet these common limitations in intrinsic capacity can generally be managed effectively. Simple interventions and adaptations for hearing loss include environmental modifications, such as reducing interfering background noise, and behavioural adaptations for the person with hearing loss and for their communication partners (for example, using simple communication techniques, such as speaking clearly). Timely diagnosis and comprehensive eye care and

rehabilitation are extremely effective in reducing impairment. Environmental changes such as making improvements in lighting and signage (for example, using high contrast, matte backgrounds placed at eye level) can also help. Assistive technologies, such as listening devices and refractive lenses, are also widely used and effective. These need not be expensive. Even high-quality hearing aids can now be fitted at an affordable cost, and off-the-shelf reading glasses are widely available and generally adequate. Cataracts can best be managed by inexpensive high-quality surgery. Cochlear implants are also effective, but less accessible and affordable.

Cognitive functions

Cognitive functions vary greatly among people and is closely related to years of education. Many cognitive functions begin to decrease at a relatively young age, with different functions decreasing at different rates. As a consequence, functioning becomes increasingly heterogeneous with increasing age (51).

Some deterioration in memory and the speed of information processing is common, and complaints about it are frequently reported by older people. However, although ageing is associated with a decrease in the capacity to tackle complex tasks that require dividing or switching attention, it does not appear to reduce the capacity to maintain concentration or to avoid distraction.

Similarly, although ageing is associated with reductions in the capacity to learn and master tasks that involve active manipulation, reorganization, integration or anticipation of various memory items, there is little association with memory for factual information, knowledge of words and concepts, memory related to the personal past, and procedural memory (for example, for the skills needed to ride a bicycle) (52). Thus, not all cognitive functions deteriorate with age, and language features, such as comprehension, reading and vocabulary, in particular, remain stable throughout life.

The variation from person to person in the decline in cognitive functions with age is influenced by many factors, including socioeconomic status, lifestyle, the presence of chronic disease and the use of medication, suggesting there are opportunities for public-health interventions across the life course. There is also some evidence that normal age-related cognitive decline can be partially compensated for by practical competence and experience acquired through a lifetime (53), and reduced by mental training and physical activity (54).

Crucially, the subtle and heterogeneous changes in cognitive functioning that are observed in healthy older people are quite distinct from the changes associated with dementia.

Sexuality

Although the data on sexual activity in older age are limited, particularly from lower-income countries, population surveys repeatedly show that people often remain sexually active well into advanced old age. For example, in one longitudinal study, 73% of participants aged 57–64 years, 53% aged 65–74, and 26% aged 75–85 were sexually active. In the oldest age group, 23% of sexually active participants reported having sex once a week or more (55).

Sexuality in older age is influenced by numerous physiological changes that occur as part of the ageing process in both men and women, as well as by multiple psychosocial and socioenvironmental factors (56). Because older age is also a period of increased risk of disease, these underlying changes will often be complicated by the need to deal with diseases that may have physical effects on sexual function. These impacts may be either direct (for example, vascular disease resulting in erectile dysfunction) or indirect (for example, the medication required for an unrelated disease may cause decreased libido), or result from the psychosocial consequences of a disease or its treatment (for example, the changes in self-image in women that may occur after a mastectomy). Indeed, the challenges caused by

diseases may be more strongly associated with sexual problems than age itself (55).

In line with predominant sociocultural attitudes, the research on sexuality in older age frequently focuses on these vulnerabilities and sexual dysfunctions rather than on positive aspects of sexuality (57). Thus, a recent survey of middle-aged and older people in 29 countries identified the most common dysfunctions among women as a lack of sexual interest (21%), inability to reach orgasm (16%) and lubrication difficulties (16%) (58). Among men, the most common dysfunctions appeared to be difficulty in achieving or maintaining an erection (37%), lack of interest in sex (28%), climaxing too quickly (28%), anxiety about performance (27%) and an inability to climax (20%).

Despite these challenges, or with the assistance of widely available medical treatments, sexuality remains important in older age and takes many forms. Counter to cisgender stereotypes, the limited research that has been undertaken in this area suggests that higher levels of sexual functioning are important for relationship satisfaction both in older women and older men (although this association may operate in both directions), and physical intimacy involving kissing and cuddling may be even more important for older men than for older women (58).

One often overlooked subject is sexual functioning in older people living in a care home or institution (Chapter 4). This is a complex issue touching on both the rights of these older people to express their sexuality and the need to protect vulnerable individuals from predatory behaviour. Particular ethical dilemmas may arise in relation to sexuality and dementia (59). More research and better guidance on how to manage these delicate and complex situations are urgently needed.

Immune function

Immune function, particularly T-cell activity, declines with age (23, 60, 61). These changes mean that the capacity to respond to new infec-

tions (and vaccination) falls in later life, a trend known as immunosenescence (62). There is also some evidence that chronic stress (for example, the need to provide care) can reduce the immune response and the effectiveness of vaccines in older people, and an age-related increase in serum levels of inflammatory cytokines, known as inflammageing, has been linked to a broad range of outcomes, including frailty, atherosclerosis and sarcopenia (22, 23, 63–65). Although the precise association of these trends with the broader physiological changes associated with ageing is still open for debate, immune function clearly has an important role and may present opportunities for future interventions. This possibility has been reinforced by research in mice suggesting that the effective clearance of senescent cells, another role of the immune system, may delay many disorders related to ageing (66).

Functions of the skin

Skin suffers progressive decrements with age that result from damage caused by physiological mechanisms, genetic predisposition and external insults, particularly sun exposure (67, 68). Age-related changes at a cellular level can have numerous effects, including a fall in the skin's ability to act as a barrier (69). Furthermore, the loss of collagen and elastin fibres in the dermis can reduce the tensile strength of the skin, and progressive vascular atrophies can leave patients more susceptible to dermatitis, pressure ulcers and skin tears. Combined, these changes may result in older people having an increased susceptibility to many dermatological disorders (70). Moreover, the cumulative effects of environmental insults, particularly exposure to the sun, contribute to a marked increase in the risk of neoplastic disease.

The potential impacts of these changes are not just physical. Many skin conditions can affect individuals' emotional health or lead to changes in the way they are perceived by others; they may also cause withdrawal from social activity, thus

preventing full participation in communities and workplaces.

Health conditions in older age

Age increases the risk of many health disorders, and these can have significant impacts on intrinsic capacity beyond the trends described in the section on Underlying changes. However, it would be wrong to think that the presence of a disease in older age means that someone is no longer healthy (71). Many older adults maintain good functional ability and experience high levels of well-being despite the presence of one or more diseases.

Fig. 3.13 draws on data from the Global Burden of Disease project (2) to identify the common causes of years of healthy life lost due to disability in people older than 60 years; the data are presented for countries grouped according to their level of economic development. These data give an indication of both the incidence and severity of different conditions and the length of time an individual will, on average, be affected by them.

Using these data, the greatest burden of disability is estimated to come from sensory impairments (particularly in low- and lower-middle-income countries), back and neck pain, chronic obstructive pulmonary disease (particularly in low- and lower-middle-income countries), depressive disorders (Box 3.2), falls, diabetes, dementia (particularly in high-income countries) (Box 3.3) and osteoarthritis. The higher burden from dementia in high-income settings is likely to at least partly reflect the older average age in these countries and greater awareness and diagnosis of these conditions. The greater burden from sensory impairments in low- and lower-middle-income countries is likely to reflect many things, including greater exposure to noise and sun across the life course. Higher rates of chronic obstructive pulmonary disease in low- and lower-middle-income countries are likely a consequence of greater exposure to indoor and outdoor air pollutants across the life course.

Box 3.2. Depression and anxiety

Affective disorders, such as depression and anxiety, tend to recur throughout life in a vulnerable proportion of the population.

Episodes of affective disorders might be expected to be more prevalent in older age due to the increased risk of adverse life events. Instead depressive disorders appear to be a little less prevalent among older adults than among younger adults but still affect about 2–3% of older people living in the community (72); however, the prevalence among the most frail and vulnerable older adults living in long-term care facilities is considerably higher, at about 10% (73). Furthermore, compared with younger adults, older people more often suffer from substantial depressive symptomatology without meeting the diagnostic criteria for a depressive disorder. This condition is often referred to as subthreshold depression, and affects nearly 1 in 10 older adults (74). Subthreshold depression also has a major impact on the quality of life of older people, and is a major risk factor for a depressive disorder.

The estimated prevalence of anxiety disorders in the older population ranges from 6% to 10%, which is slightly lower than the estimated prevalence of anxiety disorders in younger adults but still represents a significant cause of disability (75). The prevalence of anxiety disorders in long-term care facilities has been shown to be somewhat lower, and is estimated to be around 5.7% (73). Anxiety disorders and depression often occur together. About 13% of older people with an anxiety disorder also have a depressive disorder, and 36% of older people with depression have a coexisting anxiety disorder (76). Although affective disorders are prevalent in older people, treatment is often effective, including cognitive behavioural therapy (77, 78) and the use of selective serotonin reuptake inhibitors (79).

Mortality patterns also provide an insight into the diseases that are important in older age. Fig 3.14 uses data from the Global Burden of Disease project to show the years of life lost among people older than 60 years with the data presented for countries grouped according to their level of economic development. This is a measure of the disorders that kill older people and the average

potential years of life that they will, on average, be deprived of by these disorders. The greatest burden of mortality in older people all over the world comes from ischaemic heart disease, stroke and chronic obstructive pulmonary disease. The burden from all these conditions is far greater in low- and middle-income countries than in high-income OECD countries. The exceptionally high burden of cardiovascular disease in high-income non-OECD countries is heavily influenced by high rates in the Russian Federation.

Combined, Fig. 3.13 and Fig. 3.14 show that regardless of where people live, the overwhelming disease burden in older age comes from non-communicable diseases. These are often thought of as diseases of affluence and something that poorer countries will need to give attention to as they develop. What these data show are that for older people, noncommunicable diseases are already causing grossly inequitable burdens in low- and middle-income countries.

Multimorbidity

As people age, they are more likely to experience multimorbidity – that is, the presence of multiple chronic conditions at the same time. This can lead to interactions among conditions; between one condition and the treatment recommendations for another condition; and among the medications prescribed for different conditions. As a result, the impact of multimorbidity on functioning, quality of life and risk of mortality may be significantly greater than the sum of the individual effects that might be expected from these conditions (81). Predictably, multimorbidity is also associated with higher rates of health-care utilization and higher costs (81). Although multimorbidity refers to the presence of two or more chronic conditions, there is no standard definition or consensus on which conditions should be considered. This makes international comparisons of prevalence, or comparisons between or among studies, difficult. Prevalence estimates also vary depending on the identification methods used (for example, self-report versus clinical

Box 3.3. Dementia

In 2015, dementia affected more than 47 million people worldwide. By 2030, it is estimated that more than 75 million people will be living with dementia, and the number is expected to triple by 2050. This is one of the major health challenges for our time. In one Australian study, it was estimated that around 10% of the expected increase in health-care costs during the next 20 years would come from demand for care for this condition alone (80).

Contrary to popular belief, dementia is not a natural or inevitable consequence of ageing. It is a condition that impairs the cognitive brain functions of memory, language, perception and thought, and that interferes significantly with the ability to maintain the activities of daily living. The most common types of dementia are Alzheimer's disease and vascular dementia. Evidence suggests that the risks of certain types of dementia may be lowered by reducing risk factors for cardiovascular disease.

The personal, social and economic consequences of dementia are enormous. Dementia leads to increased long-term care costs for governments, communities, families and individuals, and to losses in productivity for economies. The global cost of dementia care in 2010 was estimated to be US\$ 604 billion: 1.0% of global gross domestic product. By 2030, the cost of caring for people with dementia worldwide could be US\$ 1.2 trillion or more, which could undermine social and economic development throughout the world.

Nearly 60% of people with dementia live in low- and middle-income countries, and this proportion is expected to increase rapidly during the next decade, which may contribute to increasing inequalities among countries and populations. A sustained global effort is thus required to promote action on dementia and address the challenges it poses. No single country, sector or organization can tackle these alone.

The Call for Action by participants in the First WHO Ministerial Conference on Global Action Against Dementia, held in Geneva in March 2015, identified several overarching principles and approaches to guide global efforts. These include making efforts to balance prevention, risk reduction, care and cure so that while efforts are directed towards finding effective treatments, practices and risk-reduction interventions, continual improvements are made in caring for people living with dementia and providing support for their caregivers. The conference noted the incorporation of aspects of dementia prevention, care and rehabilitation in policies related to ageing. The conference emphasized the need to promote a better understanding of dementia and raise public awareness to foster the social inclusion and integration of people living with dementia and their families. In addition, it called for strengthening multisectoral action and partnerships, and increasing collective efforts in research, to accelerate responses to address dementia. As a next step, WHO plans to establish a global dementia observatory to better understand and monitor dementia epidemiology, policy responses, resources across countries, and research efforts to disseminate, advocate for and promote global and national efforts to decrease the burdens associated with dementia. Although this crucial topic will thus be central to any public-health response to population ageing, and care aspects are highlighted in Chapter 5, it is impossible to fully address the needs for improvements in the field of dementia in this report. Further information on dementia can be found in other WHO documents that focus specifically on this topic at <http://www.who.int/topics/dementia/en/>.

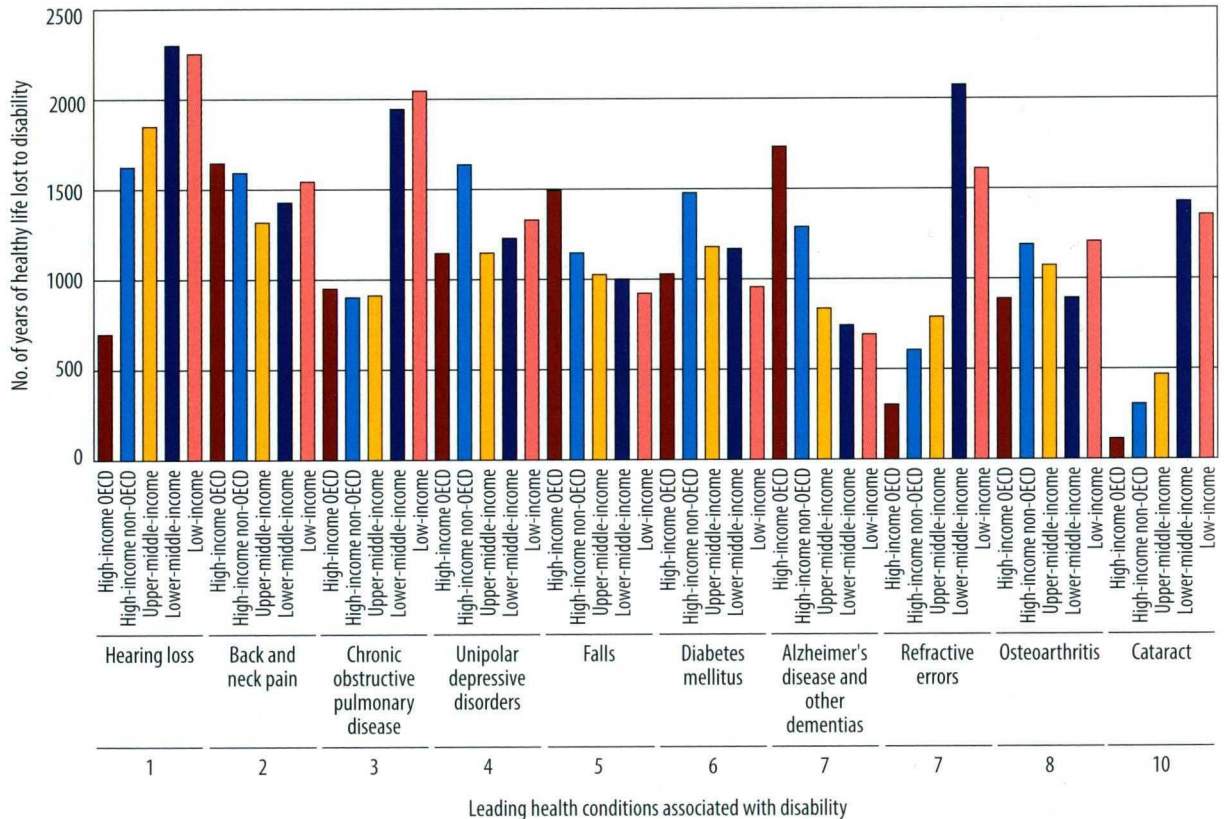
records) and study setting (for example, in the general population or a primary-care setting).

One large systematic review of studies in seven high-income countries concluded that more than half of all older people are affected by multimorbidity, with the prevalence increasing sharply in very old age (81). Additional studies in China and Spain yielded similar results, with more than one half of Chinese people aged 70 years or older, and one half to two thirds of

Spanish adults older than 65, having two or more chronic conditions (82, 83).

In high-income countries, the greatest increases in the prevalence of multimorbidity commonly occur in two periods: between the ages of 50 years and 60 years, and in advanced old age. This can be seen in Fig. 3.15 which shows the prevalence of multimorbidity in different European countries included in SHARE (note that the prevalences are lower than those dis-

Fig. 3.13. Number of years of healthy life lost due to disability (YLD) per 100 000 population, and top 10 health conditions associated with disability, in populations aged 60 years and older, 2012



OECD: Organisation for Economic Co-operation and Development.
Source: (2).

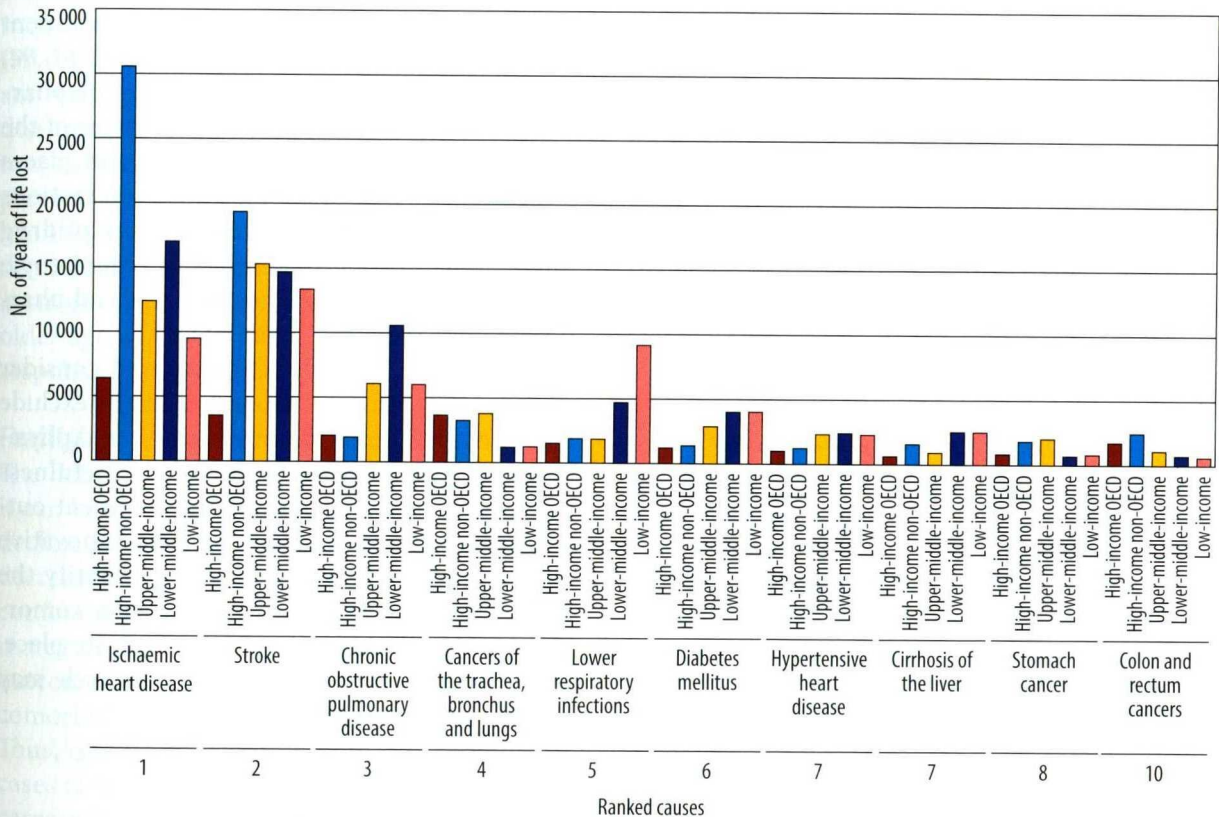
cussed above due to the exclusion of many conditions, including affective disorders).

However, one large study from Scotland found that the onset of multimorbidity occurred 10–15 years earlier in people living in the most deprived areas compared with the most affluent (84). Multimorbidity is also more prevalent in people with low socioeconomic status (81, 82, 85). This reinforces the theme repeated throughout this report that good health in older age is closely related to high socioeconomic position. Therefore, ensuring that systems are designed in ways that can equitably meet the needs of older people with comorbidities will be impor-

tant. Although the prevalence of multimorbidity is higher among older women than older men, studies of incidence have found similar rates in both sexes, suggesting that this difference in prevalence reflects a difference in survival rather than risk (86). Risk factors that have been identified in the few incidence studies include low socioeconomic status, a higher number of previous diseases, race or ethnicity, and age, although a large-scale historical cohort study in the United States found that a substantial proportion of multimorbidity begins before age 65 years (81, 86).

Evidence from low- and middle-income countries is limited. However, given the double

Fig. 3.14. Number of years of life lost to mortality (YLL) per 100 000 population for the top 10 causes of lost years, in populations aged 60 years and older, 2012



OECD: Organisation for Economic Co-operation and Development.
Source: (2).

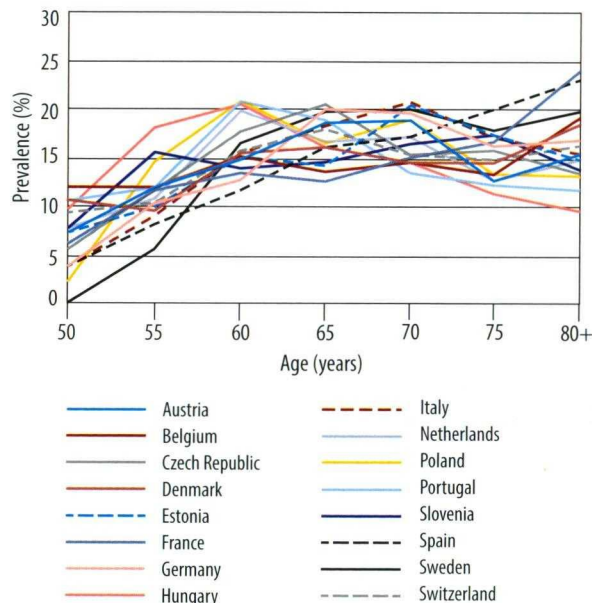
burden of communicable and noncommunicable diseases, and the heavier and earlier burden of common disorders described above (Fig. 3.4 and Fig. 3.5), multimorbidity is likely to be even more prevalent. This presents an even greater challenge in these settings, where there may already be difficulties dealing with individual conditions (87).

Furthermore, HIV infection also appears to increase the risk of multimorbidity. As survival improves and HIV infection becomes more of a chronic condition, populations living with HIV are ageing. Research in high-income countries suggests that people with HIV infection may have up to five times the risk of chronic dis-

eases, geriatric syndromes and multimorbidity, even people whose infection is well treated and managed (88, 89). This may be due to immune dysfunction, inflammation, or the cumulative toxicity of treatment, or some combination of these. Countries with a high prevalence of HIV infection may therefore face particularly complex health challenges as their populations age.

Multimorbidity has significant impacts in older age. As the number of chronic conditions increases, so does the risk of declines in capacity (81, 90). However, the impact of multimorbidity on functioning in older age is determined not only by the number of concurrent health conditions but also by the particular diseases involved

Fig. 3.15. Prevalence of multimorbidity among people aged 50 years and older, 2010–2011



Note: Multimorbidity is generally defined as having two or more chronic morbidities (72). The following health conditions were included in the study: ischaemic heart disease, high blood pressure, stroke, diabetes, chronic obstructive pulmonary disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease, and Alzheimer's disease and other dementias. Source: (16).

and how they interact. Furthermore, although the evidence is limited, it appears that comorbidity is not random, and certain conditions tend to occur together (91). This may be at least partly related to the immune changes associated with ageing (92). Some disease combinations have particularly adverse impacts on functioning, with, for example, depression showing a synergistic worsening impact in combination with heart failure, osteoarthritis and cognitive impairment (93).

Despite the large numbers of older people experiencing multimorbidities, most health systems are not equipped to provide the comprehensive care needed to manage these complex

health states. Clinical care guidelines typically focus on a single condition, rarely incorporating information on potential comorbidities, and frequently contradicting recommended treatment or lifestyle changes for other conditions (91, 94, 95). One common consequence is polypharmacy, which may be appropriate in terms of the individual conditions being treated, but places the patient at risk of adverse drug interactions and side-effects (94). However, the risk of drug interactions in comorbid and frail older people can limit the use of potentially beneficial pharmacological therapies (96).

Finally, most clinical trials fail to consider the impact of comorbidity, and generally exclude older people entirely, despite their altered physiology (97). This severely limits their usefulness in guiding care and optimizing treatment outcomes in patients at older ages (98). Innovative approaches are therefore needed to identify the best treatments for older people with comorbidities. Until these approaches are in place, improvements in postmarketing research may provide some guidance.

Other complex health issues in older age

Older age is also characterized by the emergence of several complex health states that tend to occur only later in life and that do not fall into discrete disease categories. These are commonly known as geriatric syndromes (99). They are often a consequence of multiple underlying factors and multiple organ systems, and the presenting complaint may not represent the pathological condition underlying it (100). For example, an older person may present with acute cognitive decline or delirium, but this may be a consequence of underlying causes as diverse as an infection or electrolyte disturbance. Similarly, a fall may be a consequence of many underlying characteristics, including drug interactions, environmental factors and muscle weakness.

There is still some debate as to which conditions may be considered geriatric syndromes, but they are likely to include frailty, urinary incontinence, falls, delirium and pressure ulcers (99, 101). These appear to be better predictors of survival than the presence or number of specific diseases (102, 103). Yet because of their multisystem nature that crosses many disciplines, they present challenges for traditionally structured health services and are often overlooked in epidemiological research. Innovative approaches to managing these comorbidities and syndromes of older age will need to be central to any societal response to population ageing.

Frailty

The definition of frailty remains contested, but it can be considered as a progressive age-related decline in physiological systems that results in decreased reserves of intrinsic capacity, which confers extreme vulnerability to stressors and increases the risk of a range of adverse health outcomes (104). Frailty, care dependence and comorbidity are distinct but closely related. Thus, one study found comorbidity in 57.7% of cases of frailty and care dependence in 27.2% of cases, with neither being present in 21.5% of frail cases (105).

A large European study estimated the prevalence of frailty at age 50 years to 64 years to be 4.1%, increasing to 17% in those aged 65 and over (106). This same study found the prevalence of being prefrail at these ages was 37.4% and 42.3%, respectively. However, both frailty and prefrailty varied markedly among countries, being more prevalent in southern Europe. These findings are consistent with estimates from Japan and the Republic of Korea, where the prevalence of frailty in both countries has been estimated at around 10% (107, 108). Frailty may be even more prevalent in low- and middle-income countries (109–112). Frailty is more common in women and in people with lower socioeconomic status (113–115).

The course of frailty varies markedly from individual to individual and appears to be reversible, although only a small proportion of frail individuals will return spontaneously to full robustness (116, 117). Because frailty comprises complex decrements occurring in several systems, one key clinical approach is the use of comprehensive geriatric assessments. These assessments, and the person-tailored interventions that derive from them, have been shown to prevent many major negative health-related outcomes, including shortened survival times and care dependence (118, 119). Interventions aimed at increasing physical activity have also been shown to be effective, and may be most effective in more severe cases of frailty (120, 121). Interventions aimed at improving nutrition may also be beneficial, but evidence is limited (122, 123).

Urinary incontinence

Urinary incontinence (that is, the involuntary loss of urine associated with urgency or with effort, physical exertion, sneezing or coughing) is a neglected problem in older people, and a strong predictor of a need for care (124, 125). Urinary incontinence is one of the most common impairments in older age, with the prevalence increasing with age and being much higher in women than men in all age groups (126). In one study conducted in rural China, the prevalence of urinary incontinence was 33.4% among people aged older than 60 years (127). Another population study reported a prevalence among older people with dementia of 19.1% in Latin America, 15.3% in India, and 36.1% in China, and found urinary incontinence to be independently associated with disability (128).

The impact of urinary incontinence can be profound on the quality of life of both older people and caregivers. Urinary incontinence has been associated with depression, care dependence and the self-rated health of older people (129), and it increases the strain and burden on caregivers (130).

Falls

Falls are a major health problem for older adults (131). Various reviews and meta-analyses have estimated that 30% of people older than age 65 (132–141), and 50% of people older than age 85, who live in the community will fall at least once each year. Falls are even more common in long-term care facilities, occurring annually in more than 50% of people older than age 65 (136, 141, 142). Overall, significant injuries occur in 4–15% of falls, and 23–40% of injury-related deaths in older adults are due to falls (133, 136, 137). Related injuries can range from minor bruises or lacerations to wrist or hip fractures (140–142). Falls are, in fact, the main risk factor for fractures and are even more important than decreased bone mineral density or osteoporosis (80% of low-trauma fractures occur in people who do not have osteoporosis and 95% of hip fractures result from falls) (136, 143).

There is an extensive evidence base demonstrating that many falls can be prevented by addressing a wide range of risk factors. These factors include (132, 134–141, 144–148):

- individual factors – such as age, gender, ethnicity, poor education and low income;
- health characteristics – such as postural hypotension, chronic conditions, medication use, excessive alcohol use, low levels of physical activity, insufficient sleep, increased body mass index;
- intrinsic capacity – such as declines in physical, emotional and cognitive capacity, and difficulties with vision, balance and mobility;
- environmental – such as inadequate housing (slippery flooring, dim lighting, obstacles and tripping hazards), poor stairway design, uneven streets and footpaths, lack of access to health and social services, improper use of assistive devices, lack of social interaction and community support, inappropriate footwear.

Intrinsic capacity and functional ability

Until this point, this chapter has generally reflected the common epidemiological approaches used to consider health in older age. These focus on causes of mortality and disease, and sometimes the multimorbidities that occur among them. It has also considered underlying physiological trends, as well as geriatric syndromes that are often not classified as disease or disability and so fail to feature in lists of the most significant disorders.

Viewed from the perspective of this increased risk of disease, and considering the major social changes and personal losses often experienced during the second half of life, it might be expected that this is a period of inexorable decline and misery. Yet this is not the case. Multiple studies into trends in subjective well-being across the life course suggest that in many countries overall satisfaction with life actually increases in older age (149, 150). There may be a range of explanations for this finding, but it is likely to partly reflect the potential for recovery, adaptation and psychosocial growth in older age.

However, these patterns are not universal, and in some countries older people report worse life satisfaction than younger adults. This highlights the role that environmental characteristics have in enabling people to experience older age in a positive way.

Furthermore, as described in Chapter 2, broad assessments of functioning are far better predictors of positive outcomes in older age than a single disease or even the extent of multimorbidities. This report argues that it is this holistic perspective that provides the appropriate entry point for a public-health response to population ageing.

Healthy Ageing frames this through the concepts of intrinsic capacity and functional ability. The next part of this chapter explores how these might be measured and what the data tell us about how these attributes change across the life course or vary among countries. Unfortunately,

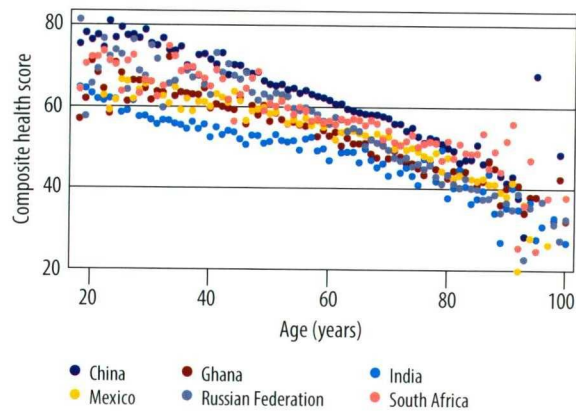
data and the methods used to collect this are limited. Disease-based surveillance and research frequently do not collect useful information on functioning, and there are no widely accepted instruments for this purpose, although instruments do exist for measuring specific components of capacity, such as cognitive function or severe limitations in capacity, such as the loss of the ability to perform activities of daily living. The following discussion, therefore, should be viewed as an exploratory exercise in how this significant gap might be filled.

Intrinsic capacity across the life course

The health characteristics and trends described above combine and interact to determine an older person's intrinsic capacity. At present, most information on intrinsic capacity comes from research into the period of life when significant losses in functioning are being experienced, often through the measurement of activities of daily living (ADLs) or instrumental activities of daily living (IADLs). These measures can be useful in identifying the need for social care, and in some longitudinal studies for identifying the predictive value of individual conditions or groups of conditions on functioning more broadly or on future care dependence. The use of ADLs and IADLs fits well with how systems are currently designed. However, these measures are limited to identifying people with serious losses of functioning. Furthermore, they generally assess performance in the real world, which implies some consideration of an older person's environment.

What is missing from this large body of evidence is guidance on the trajectory that may have preceded these significant losses of function or the factors that may have influenced it. As an example of how this trajectory might be constructed, by drawing on data from SAGE we have combined a range of measures, including physical and cognitive assessments and biometric measures, to develop a single vector that summarizes

Fig. 3.16. Changes in intrinsic capacity across the life course



Note: Data on physical and mental capacities were derived from the WHO Study on global AGEing and adult health (SAGE) 2007–2010 (wave 1) (34) and then a vector of capacity was developed. Higher scores indicate higher intrinsic capacity.

the key domains of intrinsic capacity (Fig. 3.16) (34). What this analysis showed is that for the six countries studied, there was a gradual decline in average capacity that extended across adult life. Of course, for most individuals this decline will not be smooth, but will comprise a range of intermittent setbacks and recoveries. But for the population as a whole, the average decline is gradual: there is no age when most people suddenly have less capacity and become old. Just as importantly, the observed patterns of capacity are different for each country. Measuring these more complex assessments of capacity allows us to ask: why?

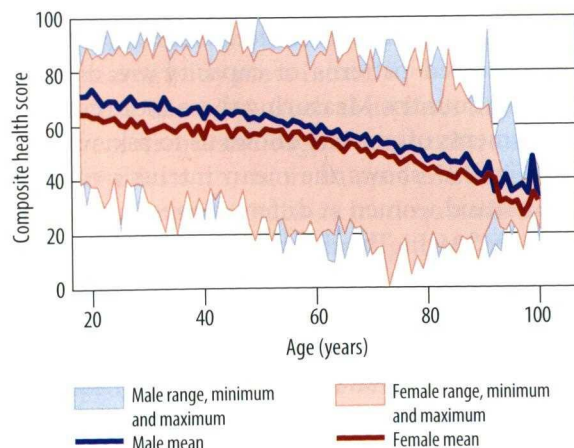
Fig. 3.17 shows the mean intrinsic capacity of men and women at different ages in all countries in SAGE. The shading around the means shows the range of capacity across all individuals at these ages. Although there is a distinct trend for intrinsic capacity to decline with age, there are some exceptional individuals aged 80 years or older who maintain intrinsic capacity at significantly higher than the mean level observed in young adults. The figure also highlights the fact that although capacity in early adulthood is, on average, higher, there are some individuals

with very low levels. In high-income countries it is likely that there would be significantly fewer of these younger adults with marked limitations in capacity (which thus explains the differences between Fig. 3.17 and Fig. 1.1).

As suggested in Chapter 1, this wide distribution of intrinsic capacity across the life course is not random. Fig. 3.18 uses aggregated SAGE data to explore the relationship between the vector of intrinsic capacity and socioeconomic status. This demonstrates that intrinsic capacity in someone with a low socioeconomic position peaks at a far lower level than it does in someone with a higher socioeconomic position, and this differential is maintained across the life course. This is consistent with the longitudinal data from the Australian Longitudinal Study on Women's Health shown in Fig. 1.19 (151).

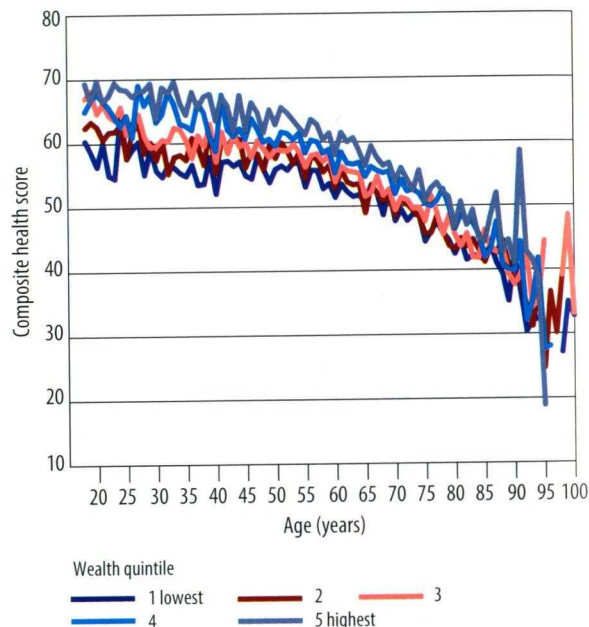
What explains these patterns? Around 25% of the diversity of intrinsic capacity in older age is explained by genetic factors (152). The other 75% of this diversity is largely the result of the cumulative impact of behaviours and exposures

Fig. 3.17. Range and mean intrinsic capacity of men and women in all countries in SAGE



Note: Data on physical and mental capacities were derived from SAGE and a composite health score was calculated. Higher scores indicate better health. Source: (34).

Fig. 3.18. Intrinsic capacity, by wealth quintile and age



Note: Higher scores indicate better health. Source: (34).

during a person's life course. Many of these experiences are strongly influenced by personal factors, such as the social position into which someone was born (153). Fig. 1.1, Fig. 3.17 and Fig. 3.18 thus reflect the powerful impact of these social determinants on functioning in older age.

Patterns of functioning in countries at different levels of socioeconomic development

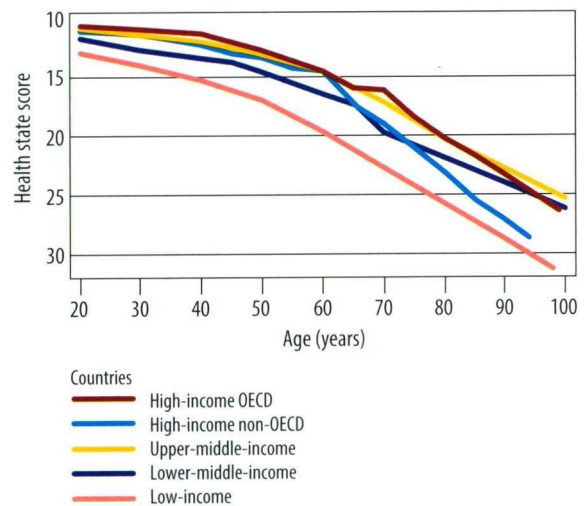
These analyses are possible because of the broad array of measures included in SAGE. Unfortunately, this comprehensive information is generally not available from population surveillance or even most research studies of older people. For these purposes, simple instruments are required that can be used in large samples and that can distinguish between the intrinsic

capacity of the individual and the influence of the environment they live in (that is, their functional ability).

Although there are no generally accepted instruments to measure these characteristics, several instruments that have been developed to estimate broad aspects of disability provide a useful starting point for further analyses. In the WHO World Health Survey conducted during 2002–2004, a set of questions across eight domains was used in each country to estimate the health state (Fig. 3.19) (154). These measured difficulties engaging in work or household activities, moving around, engaging in vigorous activities, washing or dressing, maintaining general appearance, concentrating or remembering things, learning a new task, maintaining personal relationships or participating in the community and dealing with conflicts. Thus, the health state score can be considered to reflect some aspects of both intrinsic capacity and functional ability. However, unlike the measure used as the basis for the analysis in Fig. 3.16, this instrument relies on self-reported health status and includes no biometric measures.

Fig. 3.19 shows the average scores for these items across the life course and how these vary among high-, middle- and low-income countries. The figure shows that in all but the low-income countries, average functioning remains relatively high until the age of 60 years, when an underlying slow rate of decline accelerates. The higher the level of socioeconomic development, the later this acceleration tends to occur. Individuals in high-income OECD countries tend to reach a slightly higher peak of functioning than those in low- and middle-income countries, and generally maintain this differential. This may reflect better nutrition and more supportive environments in high-income settings during childhood that allow a higher peak of intrinsic capacity to be achieved, while greater exposure to stressors and higher burdens of disease in low- and middle-income countries may result in a more rapid decline with age.

Fig. 3.19. Health state by age, 2002–2004



OECD: Organisation for Economic Co-operation and Development.

Note: The variables used in the analysis were difficulties engaging in work or household activities, moving around, engaging in vigorous activities, washing or dressing, maintaining general appearance, concentrating or remembering things, learning a new task, maintaining personal relationships or participating in the community and dealing with conflicts. A higher score implies higher disability.

Source: (154).

Fig. 3.19 shows an unexpected late drop for high-income OECD countries compared with upper-middle-income countries. This may reflect the absence of the most developed countries, such as Germany, the United Kingdom and the United States, from this analysis because not all questions were asked in all settings. The more rapid decline in scores for high-income non-OECD countries may reflect particular epidemiological patterns in the Russian Federation.

Significant loss of functional ability, and care dependence

The word dependence is widely used in relation to ageing, although there is neither agreement on what this term actually means nor whether it is a positive or negative state (155). Thus, although in economic discussions old-age dependence is

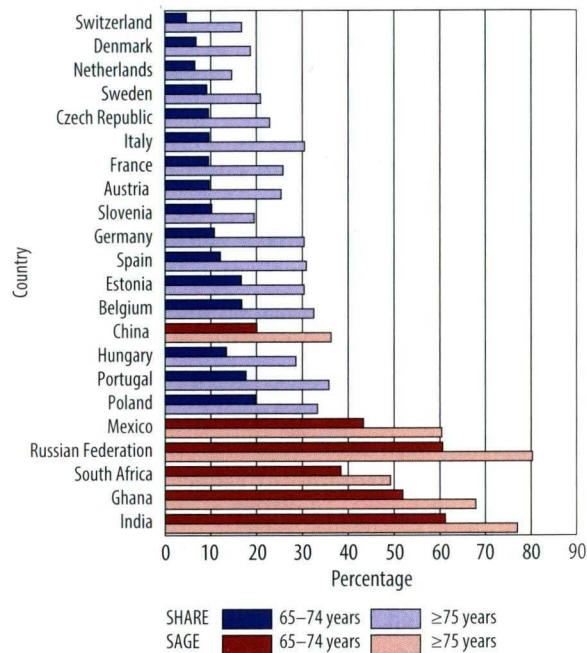
generally portrayed as a negative state resulting in the transfer of benefits from younger presumably more productive generations to older ones, others have suggested that the relationship between younger and older generations is better conceptualized as a two-way interdependency (156–158). In many Asian and other cultures this interdependency is viewed as a fundamental social good (159).

This report therefore limits the use of the term dependence to the concept of “care dependence”, which arises when functional ability has fallen to a point where an individual is no longer able to undertake the basic tasks that are necessary for daily life without the assistance of others. It is a reflection of decrements in capacity that cannot be compensated for by other aspects of the older person’s environments or the use of available assistive devices. The provision of this care increases functional ability to the point where these basic tasks can be achieved. Crucially, autonomy can be maintained despite dependence on care if individuals retain the ability to make decisions on matters that affect them and can direct the execution of these choices.

Care dependence has often been assessed using instruments that determine when an individual requires assistance with ADLs. These measure a range of basic domains of functioning, including urinary and faecal continence, and the ability to independently perform personal care activities (such as tooth brushing), using the toilet, feeding yourself, transferring (for example, moving to a chair), getting around the home, dressing, walking upstairs and bathing. Unfortunately, several variations of these instruments exist (for example, some require simple yes/no responses, others use scaled responses). This needs to be considered when making comparisons among studies or settings.

Fig. 3.20 summarizes information from SHARE and SAGE on the prevalence among older people of needing assistance with at least one of five ADLs (eating, bathing, dressing, getting in and out of bed, using the toilet). The figure

Fig. 3.20. Percentage of the population aged 65–74 years and aged 75 years or older with a limitation in one or more of five basic activities of daily living (ADL), by country



Note: The five basic ADL items included in the analysis were eating, bathing, dressing, getting in and out of bed, and using the toilet.

Sources: (16, 34).

shows there are marked differences among countries in the percentage of people requiring assistance with at least one basic ADL. It also clearly demonstrates the impact of age, with those aged 65 years to 74 years having far less need for assistance than those aged 75 years or older.

The marked difference among countries at the bottom of the list (where a higher percentage of the population has a limitation) and those higher on the list is likely to reflect both the economic situation in different settings as well as differences in the instruments used (the five countries at the bottom of the list are all from SAGE where the threshold for a positive response may have been lower). Furthermore, some of these varia-

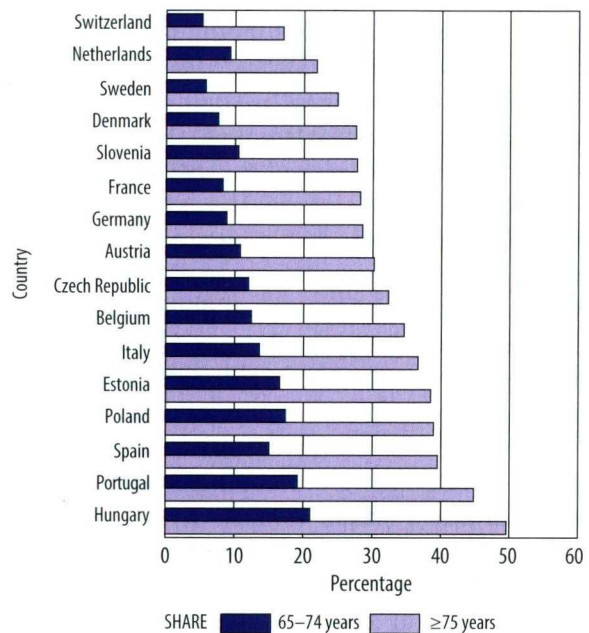
tions may be due to differing social expectations (and hence reporting) in different cultures and income settings. But it is likely that a significant proportion of these trends reflects genuine underlying differences in intrinsic capacity. This is important for two reasons. First, ADLs are used in many settings as indicators of eligibility for care services and they are likely to reflect a significant need for care. This need for assistance ranges from around 17% of people 75 years and older in Switzerland to well over 40% of people of the same age in Ghana, India, Mexico and the Russian Federation. Many of the countries with the highest need also have the least infrastructure and services in place to address this care dependence and default to relying on families to provide care. How this gap might start to be filled is expanded on in Chapter 4.

But these dramatic variations also raise the question: why? What are the factors that lead to a 65–74-year-old in China being three times less likely to require care than one in India? Why is a 65–74-year-old in Belgium almost twice as likely to require care as someone of a similar age in the neighbouring country of the Netherlands? Assuming some of this variation reflects real differences, identifying the answers can inform how we might develop a better public-health response to delay or avert this need.

Fig. 3.21 summarizes information about IADLs from SHARE (these domains were not considered in SAGE). The same increasing prevalence with age is seen, and the overall prevalence is somewhat higher. These individuals might not be care-dependent, but are at high risk of becoming so. In the approach this report proposes for long-term care, these older people would be potential recipients of interventions to improve their capacity and avoid care dependence.

Because care dependency increases with age, population ageing will dramatically increase the proportion and number of people needing social care in countries at all levels of development. This will occur at the same time as the proportion of people at younger ages who might be available to

Fig. 3.21. Percentage of the population aged 65–74 years and aged 75 years or older with a limitation in one or more instrumental activities of daily living, by country



Note: These activities include difficulties using the telephone, taking medications, managing money, shopping for groceries, preparing meals and using a map.

Source: (16).

provide this care will be falling, and the role of women, who have until now been the main care providers, is changing.

Key behaviours that influence Healthy Ageing

Because most of the disease burden in older age is due to noncommunicable diseases, risk factors for these conditions are important targets for health promotion. Strategies to reduce the burden of disability and mortality in older age by enabling healthy behaviours and controlling metabolic risk factors can therefore start early in life and should continue across the life course

(160). The risks associated with these behaviours and metabolic risk factors continue into older ages, although this relationship may attenuate (161–163). Strategies to reduce their impact continue to be effective in older age, particularly for reducing hypertension (164), improving nutrition (160, 165) and stopping smoking (166), although evidence in advanced old age is limited. Furthermore, there is some evidence that reducing exposure to cardiovascular risk factors can also reduce the risk of at least some types of dementia (167).

Yet despite this clear evidence of the importance of the need to continue to modify risk factors into older age, surveys of older populations suggest that behaviours that put older people at risk of cardiovascular diseases are widespread (Fig. 3.22) (168). The great variation among countries in the prevalence of these unhealthy behaviours suggests that many opportunities exist for intervention.

Moreover, there is growing evidence that key health-related behaviours, such as engaging in physical activity and maintaining adequate nutrition, may exert powerful influences on intrinsic capacity in older age that are quite separate from their action in reducing the risk of noncommunicable diseases. These broader impacts on intrinsic capacity have been less well

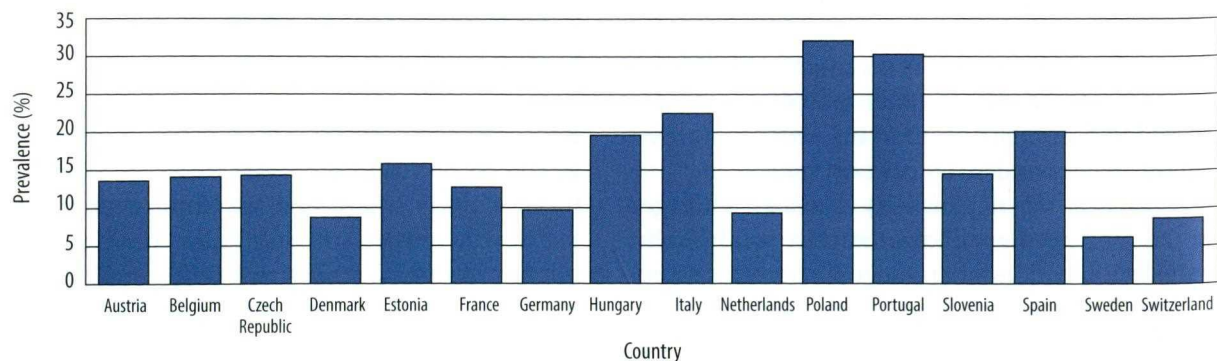
researched, but may be central to strategies to reverse or delay declines in capacity and even conditions such as frailty. This section explores in more detail the relationship between two of these behaviours and functional ability.

Physical activity

Engaging in physical activity across the life course has many benefits, including increasing longevity. For example, a recent pooled analysis of large longitudinal studies found that people who engaged in 150 minutes per week of physical activity at moderate intensity had a 31% reduction in mortality compared with those who were less active. The benefit was greatest in those older than 60 years (169).

Physical activity has multiple other benefits in older age. These include improving physical and mental capacities (for example, by maintaining muscle strength and cognitive function, reducing anxiety and depression, and improving self-esteem); preventing disease and reducing risk (for example, of coronary heart disease, diabetes and stroke); and improving social outcomes (for example, by increasing community involvement, and maintaining social networks and intergenerational links).

Fig. 3.22. Age-adjusted prevalence of physical inactivity in people aged 60 years and older, by country



Source: (16).

These benefits can be substantial. For example, both cross-sectional and longitudinal studies have suggested there is a 50% reduction in the relative risk of developing functional limitations among those reporting regular and at least moderate-intensity physical activity (170, 171). Randomized controlled trials have shown similar benefits (121, 170), and progressive resistance training may give independent benefits (172). Physical activity also appears to preserve, and may even improve, cognitive function in people without dementia (170, 173), reducing cognitive decline by around one third (174).

In addition, physical activity protects against some of the most important health conditions in older age. Physical inactivity may account for up to 20% of the population-attributable risk of dementia, and it has been estimated that 10 million new cases globally might be avoided each year if older adults met recommendations for physical activity (175). Similarly, stroke causes some of the greatest burden of disease in older age, and moderate physical activity may reduce the risk by 11–15%, and vigorous physical activity has even greater benefits, reducing the risk by 19–22% (176).

Yet despite the clear benefits of physical activity, the proportion of the population meeting recommended levels falls with age, and analyses of data from SAGE and the WHO World Health Survey suggest that around one third of 70–79-year-olds and one half of people aged 80 years or older fail to meet basic WHO guidelines for physical activity in older age (177).

However, since the prevalence of inactivity varies significantly among countries, this suggests that cultural and environmental factors that may be amenable to change are likely to be among the underlying drivers of these patterns. Furthermore, interventions at both a programmatic level and at a broad population level appear to be effective in improving levels of physical activity (178). Interventions to promote muscle strength and endurance have also been shown to be effective (172).

Essentially all domains of fitness – aerobic, strength and neuromotor (balance) – are important for older populations. Yet it is prudent to consider that strength and balance training should precede aerobic exercise, with new evidence showing that progressive resistance training has favourable effects not only on muscular strength, physical capacity and the risk of falls (172) but also that its benefits extend to cardiovascular function, metabolism and coronary risk factors (179) for those without or with cardiovascular disease. However, the benefits of aerobic physical activities, such as walking, which is the main mode of aerobic exercise among older adults, cannot be transferred to improving balance (180), have no effect on preventing falls (181, 182), and no clear benefit in relation to strength. Therefore, it is logical and possibly safer to suggest that older adults whose mobility is compromised start by increasing their strength and improving their balance before embarking on aerobic training.

Nutrition

Ageing is accompanied by physiological changes that can negatively impact nutritional status. Sensory impairments, such as a decreased sense of taste or smell, or both, may result in reduced appetite. Poor oral health and dental problems can lead to difficulty chewing, inflammation of the gums and a monotonous diet that is poor in quality, all of which increase the risk of malnutrition (183) (Box 3.4). Gastric acid secretion may be impaired, leading to reduced absorption of iron and vitamin B12. The progressive loss of vision and hearing, as well as osteoarthritis, may limit mobility and affect elderly people's ability to shop for food and prepare meals. Along with these physiological changes, ageing may also be associated with profound psychosocial and environmental changes, such as isolation, loneliness, depression and inadequate finances, which may also have significant impacts on diet.

Box 3.4. Oral health in older people

One crucial and often neglected area of *Healthy Ageing* is oral health. This is particularly important in relation to disadvantaged older people, regardless of whether they live in developing or developed countries. Poor oral health can have a profound bearing on general health and well-being, for example, through its influence on nutrition. Moreover, the experience of pain, and problems with eating, chewing, smiling and communicating due to missing, discoloured or damaged teeth have a major impact on functional ability and older people's daily lives.

Poor oral health among older people is reflected in high levels of dental caries (or tooth decay), a high prevalence of periodontal disease (or gum disease), tooth loss, dry mouth and oral precancer or cancer. Avoiding tooth loss is crucial for *Healthy Ageing*. Yet the complete loss of natural teeth is highly prevalent among older people all over the world, with severe dental caries and advanced periodontal disease being the major causes. Furthermore, although tooth loss is declining in many high-income countries, and older people are increasingly preserving their teeth in a functional condition, tooth loss may be increasing in low- and middle-income countries. This is reflected in the prevalence of reported problems with the mouth and teeth among older people ranging from 42% in low-income countries to 29% in high-income countries (184).

The major chronic diseases and oral diseases have risk factors in common. Unhealthy diets rich in sugars are a cause of dental caries and in addition to poor oral hygiene, periodontal disease is related to tobacco use, excessive consumption of alcohol, obesity and diabetes. The use of tobacco or alcohol, or both, are the key risk factors for oral cancer. Therefore, the prevention of chronic and oral diseases can be strengthened by integrating oral health into general health-promotion activities. As for other determinants of intrinsic capacity, disadvantaged older people have an increased risk of oral diseases, and they are largely underserved in terms of dental care.

Combined, these trends increase the risk of malnutrition in older age because although energy needs decrease with age, the need for most nutrients remains relatively unchanged. Malnutrition in older age interacts with the

underlying age-related changes described above, often taking the form of reduced muscle and bone mass, and increases the risk of frailty. Malnutrition has also been associated with diminished cognitive function, a diminished ability to care for oneself, and a higher risk of becoming care-dependent.

However, malnutrition in older age often goes undiagnosed, and thorough assessments of the global prevalence of the different forms of malnutrition are limited. The evidence suggests that worldwide a sizeable proportion of older people may be affected by malnutrition.

A thorough nutritional assessment of older people requires performing anthropometric measurements, clinical biochemistry and dietary assessment. One study from the United Kingdom using these comprehensive approaches showed that the risk of protein-energy malnutrition was between 11% and 19%, and found that it was accompanied by deficiencies of vitamins C and D, and low levels of carotenoids (185). In a study from the Philippines conducted among older people living in the community, energy intake was approximately 65% of the amount required based on total energy expenditure (186). A study from rural Malaysia identified problems related to both undernutrition and overnutrition, as well as low levels of thiamin, riboflavin and calcium (187). Furthermore, higher levels of malnutrition (15–60%) have been documented in many countries in older patients who are hospitalized, live in nursing homes or are in home-care programmes (188–191).

A questionnaire-based approach has been used in several studies to provide a simple assessment of older patients in outpatient clinics, hospitals and nursing homes (192). A study among older people living in rural areas of South India used this approach and found that more than 60% of the participants had low protein-energy intakes (192). A study from the Islamic Republic of Iran revealed a 12% prevalence of malnutrition among older people, with higher prevalence in lower socioeconomic groups (193).

As with other aspects of geriatric care, the management of malnutrition in older age needs to be multidimensional. Various types of interventions are effective in reversing these patterns of malnutrition, and have been shown to delay care dependency, improve intrinsic capacity and revert frail states (123). The nutrient density of food should be improved, particularly that of vitamins and minerals, but energy and protein intake are important targets. Individualized nutritional counselling has been shown to improve the nutritional status of older people within 12 weeks (194).

Key environmental risks

Emergency situations

Functional ability is determined by the intrinsic capacity of the individual, the relevant characteristics of their environment and the interaction between them. The influence of the environment may be particularly strong in the event of natural or technological disasters and human-induced conflict. Yet although responses to these events typically prioritize assistance to vulnerable or marginalized groups, the needs of older adults are frequently overlooked. This occurs despite a significantly elevated risk of death, injury, illness and loss of function among older people that may extend long after the event itself (195, 196).

This increased risk is reflected in data from five major natural disasters that show more than half of the deaths associated with these events occurred among people aged 60 years and older. For example, despite comprising only 23% of the general population, 56% of those who lost their lives during the 2011 Great East Japan earthquake were aged 65 and older (197). Furthermore, many of these deaths may have occurred after the event itself, reflecting failings in the emergency response.

The vulnerability of older people in emergency situations derives partly from the diminished intrinsic capacity generally associated with

ageing and partly from a greater reliance on environmental characteristics to maintain functional ability. As a consequence, mild deficits in intrinsic capacity that had been compensated for in various ways in an older person's normal environment quickly become a major burden.

At a physiological level, older adults may be more susceptible to dehydration, hypothermia and hyperthermia. Limitations in intrinsic capacity may be exacerbated by malnutrition or interrupted health care. Given the high prevalence of chronic disease and multimorbidity in older adults, interruptions in health care and access to essential medicines can have severe and life-threatening consequences. Yet chronic disease management is not typically part of the health response to humanitarian emergencies.

Furthermore, older people may be more susceptible to injuries and to communicable diseases, both of which are common risks in emergency situations. Mobility impairments may restrict the ability of older people to evacuate or to gain access to water, food, essential medicines and health services after a disaster. Sensory impairments may limit their ability to gain access to services or be aware of services that may be available, and many may have lost essential assistive devices, such as glasses or hearing aids, during the event.

One reason for the failure to prioritize the needs of older people during emergency situations may be that older people are often not visible due to mobility limitations and social isolation. For their needs to be identified and addressed, those responsible for emergency response must actively search for older people, and not assume that they will be cared for by family. More fundamentally, all data collected in emergency situations should be disaggregated by age and sex. However, it is wrong to assume that all older people are vulnerable or helpless. During times of disaster, many provide invaluable support to their families and communities. Indeed, many of those who volunteered during the response to the 2011 earthquake in Japan were older people.

Chapter 6 explores how the vulnerability of older people can be reduced and how responses in emergency situations can be better designed to meet the needs of older people.

Elder abuse

Older adults frequently find themselves mistreated in various ways by people they trust, with significant, lasting consequences. This is elder abuse: “a single or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust, which causes harm or distress to an older person” (198).

Elder abuse takes many forms including physical, sexual, psychological, emotional, financial and material abuse, abandonment, neglect and serious losses of dignity and respect. It occurs both within and outside a caregiving context – for example, between two spouses with high functional ability, or at the hands of an adult child who depends on the older person for housing or financial security (199). But it is distinct from interpersonal violence that is unre-

lated to close relationships, such as violent crime occurring in the community.

Elder abuse has severe physical consequences, including pain, injury and even death; psychological effects, such as stress and depression; and it increases the risk of nursing home placement and hospitalization (200–204). These impacts may be particularly significant in older people who have reduced intrinsic capacity and less resilience to cope with the physical and psychological injuries that may result from abuse. Although rigorous data are limited, particularly from institutional contexts, a background review commissioned for this report found that the prevalence of elder abuse in high- or middle-income countries ranged from 2.2% to 14% (205). According to the analysis, the most common types included:

- physical abuse (prevalence, 0.2–4.9%);
- sexual abuse (prevalence, 0.04–0.82%);
- psychological abuse, above a threshold for frequency or severity (prevalence, 0.7–6.3%);
- financial abuse (prevalence, 1.0–9.2%);
- neglect (prevalence, 0.2–5.5%).

Table 3.1. Risk factors for elder abuse and strength of evidence for the risk factor

Level	Risk factors	Strength of evidence
Individual (victim)	Gender: female	Low–moderate
	Age: older than 74 years	Low–moderate
	Dependence: significant disability	Strong
	Poor physical health	Strong
	Mental disorders: depression	Strong
	Low income or socioeconomic status	Strong
	Financial dependence	Low–moderate
	Race	Low–moderate
	Cognitive impairment	Strong
Individual (perpetrator)	Social isolation	Strong
	Mental disorders: depression	Strong
	Substance abuse: alcohol and drug misuse	Strong
Relationship	Dependence on the abused: financial, emotional, relational	Strong
	Victim–perpetrator relationship	Low–moderate
	Living arrangement: victim lives alone with perpetrator	Strong
Community	Marital status	Low–moderate
	Geographical location: socially isolated	Low–moderate
Societal	Negative stereotypes about ageing	Insufficient data
	Cultural norms	Insufficient data

Crucially, these rates exclude both older adults with cognitive impairments and those living in nursing homes or long-term care facilities. Yet these groups may be at particular risk of abuse. For example, one review found that psychological abuse of older adults with dementia ranged from 28% to 62%, and physical abuse affected 3.5% to 23% of older adults with dementia (203).

Victims of elder abuse are more likely to be female and to have a physical disability; be care-dependent; have poor physical or mental health, or both; have a low income; and lack social support (205, 206). The quality of close relationships and shared living arrangements also appear to affect risk. Family members who abuse older

people are more likely to have mental health issues, (for example, personality disorders) and substance abuse disorders, than family members or caregivers who do not abuse. Abusers are themselves often dependent on the abused person (199, 206). Table 3.1 summarizes the strength of the evidence for risk factors for elder abuse at the level of the older person, the perpetrator, the type of relationship between them, and community or societal factors. Although a public-health response to elder abuse is hampered by the almost complete absence of reliable evidence on the effectiveness of prevention programmes, Chapter 5 explores some of the options being considered across sectors.

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