FUTURE HEALTH

A POLICY AND AN INDIVIDUAL PERSPECTIVE

DAVID RAPPANGE

Future Health

A Policy and an Individual Perspective

David Rappange

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A policy and an individual perspective

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Chapter 1

General Introduction

1.1 INTRODUCTION

"La più grande ricchezza è la salute"
Virgilio

More than 2000 years ago, Virgil, one of the great ancient Roman poets, remarked that *"the greatest wealth is health"*. Today, a long life in good health is still considered one of the most important wishes in human life. Fortunately for the average person living in our age, the wealth of health has increased considerably compared to those living in the era of Virgil. Remarkable increases in longevity and quality of life have been achieved, especially during the past century.[1,2] While these increases were partly achieved through advances in public health, air quality and water and sewage systems, improved (access to) healthcare contributed significantly as well.[3] New healthcare technologies provided possibilities to prevent and cure diseases that were associated with high morbidity and mortality in previous centuries. An important example is the reduction in early age mortality caused by infectious diseases due to the discovery and use of antibiotics (such as penicillin).

These accomplishments also raise new challenges. In healthcare, an epidemiological transition is witnessed in which non-communicable rather than communicable diseases are increasingly important in explaining remaining morbidity and mortality. Lifestyle-related diseases, for instance, related to smoking or obesity, strongly add to this. The burden of such often chronic diseases entails a much wider range of negative health effects than death alone. Having a chronic disease or a disability affects people's quality of life for a longer period of time. This raises pressing questions on how to counter such diseases and thus further improve the '(future) health of nations'.

A longer life in good health requires delaying the onset of diseases or the prevention of diseases entirely. Achieving this goal requires (also) a focus on future health and action. First, at a policy level, those actions and interventions effectively and efficiently contributing to the promotion of a longer life in good health should be implemented in healthcare systems. Second, also given the impact of lifestyle-related diseases, at an individual level, awareness of the consequences of current health behaviours and changes in such behaviours for future health are required.

This thesis offers two perspectives on future health. It aims to further knowledge on the decision-making process at the policy level as well as at the individual level. Therefore, the main objective of this thesis is twofold. First, this thesis studies decisions regarding the investment in future health at a policy level. Second, this thesis explores individuals' consideration of the future consequences of their health behaviours and expectations about their own future health. Below, both perspectives on future health will be briefly introduced, including the questions addressed in this thesis.

1.2 PART I: A POLICY PERSPECTIVE

"Healthy citizens are the greatest asset any country can have"
Winston Churchill

Ageing populations and healthcare expenditure

Societies in which the number and proportion of older adults grow, may face a wide range of challenges in relation to the welfare state. One of these challenges relates to the future sustainability of the healthcare system, in terms of financing and planning.[4] Alongside the demographic trend of ageing populations, many developed countries face rising healthcare expenditures.[5] [1,2] While increased longevity is typically considered to be a desirable trend, the opposite holds for rising healthcare spending. Therefore, current as well as projected future rising healthcare expenditures, both in absolute and relative terms, is an important area of concern.

Investment in future health through prevention is sometimes put forward as a promising strategy to preserve people's health and increase longevity while containing the financial consequences of population ageing. The main rationale behind this is that many illnesses, as well as disabilities and premature deaths, may be avoided, mitigated or delayed. Indeed, a substantial part of the global burden of disease is related to modifiable (behavioural) risk factors or lifestyle, such as tobacco use, diet and physical (in)activity.[11-14] Hence, the claim is made that preventive strategies aimed at lifestyle modification, but also, for example, participation in early detection and vaccination programmes, can play an important role in improving health and alleviating the negative consequences related to ageing populations.[15-17] However, this view may be too optimistic. If disease prevention increases life expectancy, it may also increase the burden of other ('competing') diseases associated with old age during these additional life-years. These diseases cause additional healthcare costs.[18-20] Therefore, whether prevention leads to compression of disease (i.e., fewer years spent in poor health) and a reduction in healthcare expenditures is contestable and needs further study.

Moreover, whenever (effective) interventions allow the improvement of future health, the actual implementation of such preventive strategies and therewith the materialisation of their potential benefits, depends on the *willingness to invest* in future health. This willingness to invest is not self-evident from a policy point of view, as it requires a trade-off between short-term costs and long-

1 It should be noted that, in recent years, the trend in healthcare spending showed a more moderate (relative and absolute) growth in several OECD countries. In some countries, healthcare expenditures even declined.[5,6] Virtually all OECD countries had to face the consequences of the financial crisis (e.g., income decline). To what extent the healthcare cuts are related to the financial crisis, is still debated.[7,8]

2 The consequences of population ageing in terms of increased burden of disease, disability and healthcare expenditures have been extensively discussed elsewhere.[9,10]

term (sometimes uncertain) benefits.[3] Indeed, public expenditure on prevention and public health is still relatively low in many developed countries.[21] For example, in the Netherlands, in 2012 just 2.7% of healthcare expenditures was spent on prevention and public health programmes.[5] Moreover, spending on prevention has even decreased in the last decade,[5] despite important recommendations to increase investments in future health. Clearly, the debate on healthcare expenditures encompasses more than the actual *height* of healthcare spending. The *allocation* of available resources matters as well. In order to ascertain whether prevention is a preferable strategy and to set priorities appropriately, it is important (i) that the decision criteria to set priorities in this context are clear, transparent and justified and (ii) that good information on the costs and benefits of prevention is available. Therefore, in this thesis, the Dutch decision-making framework and (the operationalisation of) its criteria are discussed in relation to the costs and benefits of prevention.

The Dutch decision-making framework

The basic benefits package or 'health basket' contains the healthcare benefits that all socially insured citizens are entitled to. Its main aim is to secure access to predefined healthcare technologies and interventions for these insured citizens. It may be clear that the delineation of the basic benefits package can be an important cost driver (as well as benefit driver) in the healthcare sector. Limiting or expanding the package will affect access to care and healthcare expenditures and benefits accordingly. Therefore, the basic benefits package is also an important instrument that can address the challenges of rationalising healthcare provision and allocating the available resources. This applies particularly to healthcare systems that aim to ration demand rather than supply.[4]

Delineating the basic benefits package is by no means a straightforward matter. In fact, differences between European countries in terms of process and in terms of criteria are substantial.[22] However, its importance suggests the need for a transparent and clear decision-making framework that defines the entitlements included in the benefits package. Here, a decision-making framework can be viewed as a set of criteria and the decision rule based on those decision criteria to decide whether to include a technology in the basic benefits package. The Netherlands has a long tradition in thinking about such a decision-making framework, including the required decision criteria.[23-27] The criteria that currently constitute a central part of the Dutch decision-making framework are necessity, effectiveness and efficiency (or cost-effectiveness). These criteria were already proposed more than 20 years ago, in a publication of the Committee on Choices in Health Care (also known as the Dunning Committee).[23] However, their operationalisation and systematic use is still a much debated area. In chapter 2, the Dutch decision-making framework and the three main criteria are discussed in-depth. Several normative choices that are required in order to fully operationalise these criteria are highlighted. The emphasis here is on the implications for interventions aimed at modifying individual health lifestyle.

3 The same accounts for actors at the meso-level, like healthcare insurers, municipalities or hospitals, depending on the organisation of the healthcare system. This level is, however, not within the scope of this thesis.

4 Another instrument in a demand-driven healthcare system is that of co-payments, which normally means that people have to pay part of the expenses out of pocket.

Costs in economic evaluations

An important component of the Dutch decision-making framework is the economic evaluation of healthcare interventions. Economic evaluations of healthcare interventions assess the balance between the incremental costs and benefits of an intervention, in relation to some comparator.[28] Several types of economic evaluations exist, differing in the way the benefits are expressed. The type of evaluation that is typically used in the Dutch decision-making framework is cost-utility analysis (CUA). In a CUA, the costs are expressed in monetary terms, while the effects are expressed in terms of quality adjusted life-years (QALYs). A QALY is a generic utility measure comprising both length and quality of life, where every life-year is weighed for the quality of life during that year. The criterion of cost-effectiveness is usually expressed as incremental costs per QALY gained. This indicates how much costs one needs to incur in order to produce one additional healthy life-year (QALY) in relation to the chosen comparator. CUA is increasingly accepted and used in healthcare decision-making.[29-31] However, several (normative) methodological issues regarding the performance of CUA still lead to considerable debate. One area of much debate concerns the costs to be included in economic evaluations. Next to other (non-medical) cost categories, two types of medical costs can be distinguished: direct medical costs and indirect medical costs. Direct medical costs are directly related to the intervention under study (e.g., costs of diagnostic tests), whereas indirect medical costs are medical costs in life-years gained by a life-prolonging intervention. Usually, *related* indirect medical costs and *unrelated* indirect medical costs are distinguished. The first type of costs is directly related to the life-prolonging intervention (e.g., anti-rejection medication after a life-saving liver-transplantation). The latter type of costs is not (e.g., costs of a knee surgery in life-years gained because of the life-saving liver-transplantation). The inclusion of these unrelated indirect medical costs in life-years gained in economic evaluations is an important area of debate. Moreover, it is especially relevant in the context of life-prolonging preventive interventions. This issue is further discussed in chapter 2, while chapter 3 presents a review of the debate on these unrelated medical costs in life-years gained.

Saving costs?

The fact that spending on prevention is relatively low despite its potential benefits in terms of future health may indicate that prevention gets relatively low priority. This could be related to the current decision-making context and operationalisation of the three main decision criteria as highlighted above.

An alternative explanation could be that within the decision-making framework, prevention may be judged more stringently than curative interventions. In other words, the decision rule (i.e., some relevant threshold value of costs per QALY) used to decide upon the inclusion of an intervention in the

basic benefits package may differ according to the type of intervention (i.e., prevention, care or cure).[5] This could relate to the claim that prevention saves costs. If evaluations of preventive policies reject this claim, this may lead to a reduction in such investments, even though these strategies may well offer value for money.[33] Imposing the strict requirement of being cost saving on preventive interventions is difficult to explain if such a requirement is absent in the context of curative interventions.

This discrepancy and other important aspects in the debate regarding the funding of preventive interventions are discussed in more detail in chapter 4. In chapter 5, using the example of obesity - one of the major, modern public health threats - it is assessed to what extent prevention may actually induce cost savings. It is demonstrated that obesity prevention may indeed lead to cost savings in specific healthcare segments, while at the same time causing higher costs in other healthcare segments. This stresses the need for careful balancing of realistically estimated costs and benefits of all types of healthcare interventions.

The main research questions regarding part I of this thesis, focusing on the policy perspective with an emphasis on the Dutch context, can be summed up as follows:

1) How does the operationalisation of the primary decision criteria for delineating the Dutch basic benefits package influence the evaluation of lifestyle interventions?
2) Should unrelated medical costs in life-years gained be included in economic evaluations of healthcare interventions?
3) Should prevention save costs in order to be an attractive healthcare strategy?
4) What is the effect of obesity prevention on lifetime healthcare expenditure?

1.3 PART II: AN INDIVIDUAL PERSPECTIVE

> "*If I'd known I was going to live so long, I'd have taken better care of myself*"
> **Leon Eldred**

Future time perspective

Back in the 1930's, Lewin stated that "*persons at all ages are influenced by the manner in which they see the future*".[34] Many individuals will probably have some idea of what their future will look like. Indeed, in the context of health, most individuals will have some sort of expectation of whether they will grow old and *how* they will grow old. These future thoughts may vary across individuals.

5 In this context, a threshold value of €20,000 per QALY has been mentioned in the Netherlands, often in relation to preventive drug treatments (such as vaccinations). This value seems to originate from a Dutch clinical guideline for treatment and prevention of high cholesterol,[32] but it seems to lack a proper foundation. The cost-effectiveness of many curative interventions allowed into the basic benefits package would exceed this value.

Moreover, individuals also appear to vary in how important the future is to them and, as Lewin already recognised, the extent to which their present actions are influenced by their views of the future.[35] Depending on what definition is used, such notions as described above may be viewed as different conceptualisations of a broader construct called *future time perspective* (FTP). In absence of a consistently applied definition of FTP in the literature, various definitions have been used, including "personal time horizon"[36,37], "a generalised concern for future events and experiences"[38], "the consideration of future consequences"[35], and "future-orientedness"[39]. According to Sansone et al.[40] these diverse FTP constructs *"share a common emphasis on the way individuals consider temporal factors in order to explain behaviours that might have implications for health status and longevity.[41,42]"*.

The importance of FTP in the context of health-related behaviour is increasingly being demonstrated in research.[39-41,43-47] However, the operationalisation and measurement of future-focused thoughts and considerations has led to various debates and the development of valid and reliable instruments has been advocated. Therefore, in the second part of this thesis, two important conceptualisations of FTP and their measurement are explored in more detail: (i) the extent to which individuals consider the future (versus immediate) consequences of their decisions and (ii) individuals' beliefs about their remaining lifetime and health status at later stages in life. Moreover, both constructs are described in the context of different types of health investments, such as lifestyle choices.

Consideration of future consequences

Considerations of time frame may be of importance for individual decision-making. This particularly applies to health-related choices. In part, this is a consequence of the temporal component in the trade-off between the costs and benefits of certain unhealthy behaviours. For example, smoking may provide immediate benefits in terms of reduced stress (and relatively few immediate costs), but relatively high costs in the long-term in terms of chronic disease and mortality. Indeed, smoking may substantially decrease the chances of reaching a high age relative to not smoking. An important explanation why people start or continue smoking despite the well-known long-term risks, could be that people typically attach less weight to the future than to the present. Moreover, they may not take these long-term consequences into consideration when deciding upon smoking. In other words, the perceived short-term benefits outweigh the future disadvantages. This phenomenon may also be relevant for the explanation for other everyday lifestyle behaviours besides smoking, for example, physical inactivity and having an unhealthy diet.

The extent to which individuals consider the possible future outcomes of their current actions and the extent to which they are influenced by these outcomes, is often considered to be a stable personality trait. It is referred to as the *consideration of future consequences* (CFC).[35] The CFC construct is one of the most frequently used FTP constructs in social psychological research and can be measured using the 12-item CFC Scale proposed by Strathman et al.[35] Despite the relevance of the CFC construct, also

in the context of individual investments in future health, little empirical evidence is available about the exact properties of the CFC Scale in terms of factor structure, validity and reliability. Following the initial publication of Strathman et al.[35], Petrocelli[48] was the first to examine the properties (i.e., underlying factor structure) of the 12-item CFC Scale in a larger sample. Petrocelli[48] reported some instability of the CFC Scale. However, the study of Petrocelli[48] was performed in a highly selective convenience sample of academics, and thus it remained unclear how the scale would perform in other settings. This question is addressed in chapter 6 of this thesis.

Subjective life expectancy

Subjective expectations about the future are personal beliefs formed by individuals themselves. Such expectations may be relevant for individual behaviour and economic decisions regarding retirement, saving, pension plans, etcetera. Indeed, individuals' expectations about their longevity, i.e. their subjective life expectancy, are acknowledged as an essential variable for making decisions in these domains. For example, low length of life expectations (as perceived by individuals) may negatively influence long-term goal striving.[49] In recent years, attention for longevity expectations in the context of individual health behaviour has increased. The rationale behind this is that investments in future health may importantly depend on (the accuracy of) an individual's own predicted life expectancy. Moreover, subjective expectations may contain personally held information that is not incorporated in objective or actuarial life expectancies.[50] Examples of private information are the longevity of one's parents, one's lifestyle, etcetera. An important issue is how to obtain valid subjective longevity estimates.

Eliciting subjective expectations

In general, two elicitation formats for subjective expectations can be distinguished: the probabilistic and the non-probabilistic format. The probabilistic format, called subjective survival probability (SSP), assesses an individual's personal probability judgment of surviving to a certain (target) age. The use of such subjective survival probabilities in large household surveys and as input to econometric analyses has increased considerably. However, more knowledge is warranted on how individuals assess their own mortality risks, also in relation to unhealthy behaviours. In chapter 7 of this thesis, subjective survival probabilities across Europe are explored in-depth.

An important area of attention in this context is also whether people understand probabilities. In other words, whether they are able to express their personal beliefs using probabilities. This is still not well understood. A common, non-probabilistic approach for eliciting expectations is obtaining a point estimate of subjective life expectancy directly. In chapter 8, the advantages and disadvantages of both elicitation methods are discussed and empirical results are compared in a sample of the general public from the Netherlands.

Subjective expectations regarding future health-related quality of life

An area of research that has received very little attention thus far is that of subjective expectations regarding future health-related quality of life. While it is important to understand expectations regarding longevity (how old one becomes), expectations regarding future quality of life (how one becomes old) arguably are equally important. They remain understudied so far, however. Jung and Huynh[51] argued that expectations about future health are significantly different from expectations about future mortality, so that the latter are not a proxy of the former. Hence, more research into these expectations is warranted. They may be of particular interest in relation to investments in future health, for instance, in the context of interventions aimed at improving health behaviour. In chapter 9 subjective expectations regarding future health-related quality of life are explored in more detail.

The main research questions regarding part II of this thesis therefore are:

5) How reliable and valid is the original 12-item Consideration of Future Consequences (CFC) Scale?
6) To what extent do subjective survival probabilities differ across Europe, also in relation to lifestyle?
7) How do subjective survival probabilities relate to point estimates of subjective life expectancy?
8) How can subjective expectations regarding future health-related quality of life be measured and combined with subjective expectations regarding length of life?

1.4 OUTLINE OF THE THESIS

The remainder of this thesis is structured in two main parts. The first part addresses the policy perspective (chapters 2 to 5), while the second part addresses the individual perspective (chapters 6 to 9).

Chapter 2 provides a detailed insight into the Dutch decision-making framework that is used to delineate the basic benefits package. In particular, the operationalisation of the three main decision criteria 'necessity', 'effectiveness' and 'cost-effectiveness' is discussed, with a focus on several normative issues related to the operationalisation of the criteria. In addition, this chapter focuses on the extent to which these issues may influence the evaluation of lifestyle interventions.

An important tool in the context of delineating the basic benefits package is the economic evaluation of healthcare interventions. The debate about the inclusion of unrelated future medical costs in such economic evaluations is discussed in chapter 3. This chapter also reviews the current recommendations in several national guidelines for pharmacoeconomic research. What is more, an example of a smoking-cessation intervention is presented to demonstrate the consequences of different practices of accounting for unrelated future medical costs.

Chapter 4 extends the discussion in the previous chapters by addressing the evaluation and value of preventive interventions in relation to curative ones, arguing that fair comparisons of both are required.

In chapter 5, the effects of obesity prevention on annual and lifetime healthcare expenditure are estimated for different healthcare sectors. For this purpose, the Chronic Disease Model of the Dutch National Institute for Public Health and the Environment (RIVM) and Dutch Cost of Illness data are used.

The second part of this thesis starts with chapter 6 in which the properties of the CFC Scale are investigated in terms of reliability and validity. For this purpose, factor analysis is conducted on data of a sample of Dutch young adolescents to identify the factor structure of the 12-item CFC Scale. Next, the CFC Scale and the underlying factors are related to other measures of individuals' appreciation and expectations of the future, including subjective life expectancy, future health expectancy and different types of health investments (i.e., improving diet).

In chapter 7, subjective survival probabilities across Europe are studied, in particular in relation to unhealthy behaviour. Data on European elders from the second wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) is used for this purpose.

Chapter 8 explores how subjective survival probabilities relate to a point estimate of subjective life expectancy. To this end, a web-based survey aimed at investigating how Dutch people aged 18-65 years old think about future health and choices in healthcare is developed and administered. The questionnaire contains both elicitation methods.

Data from the same survey presented in chapter 8, is also used in chapter 9. In this chapter, the focus is on expectations regarding future health-related quality of life combined with subjective life expectations. The EQ-5D instrument[52] is used to elicit respondents' expected future health states and subjective life expectancy is expressed as a point estimate. Furthermore, the relation between expectations regarding length and future health-related quality of life and lifestyle is described.

Finally, chapter 10 discusses the main findings of this thesis as well as its main limitations. Implications of the findings for future research and healthcare policy are also addressed.

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PART I

A Policy Perspective

Chapter 2

The Evaluation of Lifestyle Interventions in the Netherlands

Based on:
Rappange DR, Brouwer WBF. The evaluation of lifestyle interventions in the Netherlands. ***Health Economics, Policy and Law.*** *2012; 7: 243-61*

2.1 INTRODUCTION

Chronic disease morbidity and premature mortality related to unhealthy lifestyles are now a major threat to public health worldwide.[1-3] Indeed, non-communicable diseases, of which its most important behavioural risk factors are related to tobacco use, diet, physical activity and alcohol consumption, accounted for almost two-thirds of all deaths, as well as a large part of the burden of disease globally.[3] Much evidence shows, however, that lifestyle interventions, for example, interventions aimed at smoking cessation, changing dietary behaviour and alcohol consumption or increasing physical activity, can be an effective and cost-effective strategy for counteracting such preventable morbidity, disability and mortality.[e.g., 4-12] In fact, some authors even argue that up to 50% of all current disease burden can be avoided,[13] although it needs noting that, due to competing diseases, the burden of other diseases would subsequently increase.[e.g., 14] In spite of the possible health gains and reduced time with disabilities from lifestyle interventions, spending on prevention constitutes only a relatively small share of total healthcare expenditures.[1] Apparently, prevention (still) does not receive much priority when allocating budgets.

Indeed, priority setting is inevitable in healthcare. Scarce healthcare resources and increasing medical expenditures force healthcare policy makers to make choices about allocating resources in order to preserve the (future) sustainability of healthcare systems.[e.g., 18,19] The inevitability of making such important choices suggests the need for a transparent, common decision-making framework. However, the design of such a decision-making framework, or put differently, the definition of the appropriate decision rule and its subsequent application in practice, have by no means proven to be a straightforward matter.[20] In fact, decisions on what interventions should be reimbursed from public money often rather seem to be the result of an implicit and inconsistent decision process, based on historical patterns or influenced by various stakeholders,[18,20] than based on the systematic application of a transparent decision rule.

The Netherlands has a long tradition of thinking about a decision-making framework for the allocation of healthcare resources. The National Healthcare Institute (ZiNL)[2], which is the primary advisor of the Dutch government regarding healthcare reimbursement decisions, has recently defined such a framework on the basis of previous initiatives.[21,22] [3] This framework includes explicit decision criteria, most prominently 'necessity' and 'cost-effectiveness'. Up until now, the decision-making framework has been infrequently applied and predominantly used in reimbursement decisions

1 Estimates of the proportion of the Dutch healthcare budget spent on prevention generally vary between 4.0% and 5.5%.[15-17] Spending on health promotion activities constitutes only a small part of these expenditures: 3% of spending on prevention. Spending on prevention is higher when expenditures beyond the healthcare budget are considered.[17]

2 The Dutch Healthcare Insurance Board (CVZ) became the National Healthcare Institute (ZiNL) on April 1, 2014. In this thesis, reference is made to CVZ for publications prior to that date, otherwise ZiNL is used.

3 The Dutch Council for Public Health and Care had a substantial role in the realisation of the current framework.[23,24]

about pharmaceuticals. The intention of ZiNL, however, is to extend its scope to all of the types of care that are eligible for inclusion in the basic benefits package covered under the Health Insurance Act. In other words, the ultimate aim is to create one comprehensive decision-making framework to facilitate decisions about which interventions – curative and preventive – should be reimbursed. This ambitious proposition raises a variety of questions, one of which is whether the use of such a common framework is likely to result in a higher priority for – and therefore more spending on – preventive interventions than is currently the case. Moreover, using the framework to evaluate preventive lifestyle interventions involves some important challenges regarding the operationalisation of the different decision criteria. It is important to investigate how preventive or lifestyle interventions will be evaluated using the proposed decision criteria within the Dutch context, especially since the (previous) Dutch government expressed the intention to dedicate more resources to prevention and especially lifestyle interventions.[25]

In this chapter, we focus on the main criteria used in the decision-making framework used in the Netherlands. With the decision-making framework, we mean here a set of important criteria and the decision rule based on those criteria. In particular, we highlight several important normative issues that need attention when operationalising the criteria used in the framework, which are especially relevant for lifestyle interventions. The remainder of this chapter is structured as follows. First, we briefly discuss the proposed decision-making framework in the Netherlands. Then, we highlight some of the normative choices required to make the criteria 'necessity', 'effectiveness' and 'cost-effectiveness' fully operational. Then, we focus on how these choices may influence the evaluation of lifestyle interventions. We end this chapter with a short conclusion.

2.2 THE DUTCH FRAMEWORK

The decision-making framework adopted in the Netherlands may be viewed as the result of a long-lasting process. The 'Dunning Report (1991)' of the Committee on Choices in Healthcare – better known as the Dunning Committee – importantly spurred the debate in this area.[26] The Dunning Committee proposed a framework, depicted as a funnel with sieves, consisting of four explicit selection criteria to be used in funding decisions: necessity, effectiveness, cost-effectiveness (or efficiency) and own responsibility/payment. The first three criteria of Dunning – necessity, effectiveness, cost-effectiveness – are still used as such by ZiNL and constitute the central part of the first phase in the decision-making process: *the assessment phase*. The fourth criterion of the Dunning Committee, 'own responsibility/payment', appears to have a less-prominent role now but is incorporated, to some extent, in the 'necessity' criterion.

In the assessment phase, a quantitative evaluation on the basis of the three main decision criteria takes place. This addresses the question of whether an intervention should, in principle, be reimbursed (by uptake within the basic benefits package). Although the ZiNL model does not include the fourth criterion of the Dunning Committee, it does include a different fourth criterion in the assessment phase – the so-called 'feasibility criterion'. The feasibility criterion considers whether implementing an intervention is feasible in terms of available resources, accessibility, legal restrictions, moral restrictions, etc. It thus considers the current and future impact on the sustainability of the healthcare system. This criterion is clearly important, although, to date, it is less developed than the first three. One may view the criterion as, on the one hand, investigating whether an intervention would fit the legal, ethical, organisational and financial boundaries the healthcare sector is faced with. This can be viewed as (partially) preceding all other considerations. On the other hand, it also considers more practical issues related to the successful implementation of interventions. We do note that elements of feasibility can be particularly important, especially for lifestyle interventions. For instance, questions may be raised regarding the 'medicalisation' of health problems caused by unhealthy behaviour and regarding the desirability of having solidarity when healthcare expenditures are made because of 'consciously chosen' habits. Especially, as many of these considerations are intervention specific, and as the criterion of feasibility remains less developed, we focus here on the other criteria of necessity, effectiveness and cost-effectiveness. This choice is also motivated by the fact that the 'decision rule' used in the assessment phase, highlighted below, only includes these three criteria.

The assessment phase involves the collection and assessment of information on the four above-named criteria and culminates in a preliminary decision (based on effectiveness, cost-effectiveness and necessity) about whether the intervention should be included in the basic benefits package. This phase is followed by the so-called appraisal phase, where more qualitative arguments for or against reimbursement (including those related to feasibility) can be weighed against the preliminary conclusion reached in the assessment phase. We will now first highlight the three most prominent criteria in the assessment phase, after which we discuss the appraisal phase.

The assessment phase: three main decision criteria

First, the necessity criterion embodies the question whether the disease or required care justifies a claim on solidarity.[21,22] [4] Within the Dutch context, necessity is commonly operationalised in terms of a particular definition of disease burden: *proportional shortfall*.[21-24,27-29] [5] Proportional shortfall has been proposed as combining two important existing equity concepts: fair innings and prospective health. The fair innings approach argues that every individual is entitled to a certain amount of health over his or her entire lifespan.[e.g., 30] Priority is given to people who are further away from achieving this 'fair

4 Note that there is no hierarchy among the criteria. Usually the effectiveness of an intervention is determined first.

5 Note that ZiNL distinguishes two incongruent dimensions within this criterion: 'disease burden' and 'necessity to insure'. The latter dimension importantly relates to the height of the costs and whether these justify insurance of the treatment.

share' of health. Prospective health, on the other hand, can be viewed as looking at the prospective health (gain or loss), rather than considering prior health consumption as well. Stolk et al.[29] point out that "*proportional shortfall has in common with fair innings that the size of the health gap is relevant, but it agrees with severity of illness that also the remaining no-treatment QALY expectation should be taken into account*". It must be noted that Stolk et al.[29] use the term 'severity of illness' here rather than prospective health. Their definition of severity of illness is prospective health, which implies a narrower view of the concept severity of illness than proposed elsewhere.[e.g., 31] In fact, in a broader definition, proportional shortfall can be seen as a severity of illness measure. For the current study, such definitional issues are less important than the operationalisation of the necessity measure in practice. Proportional shortfall aims to prioritise on the basis of the fraction of remaining quality adjusted life-years (QALYs) or health in the normal lifespan that will be forgone if a condition remains untreated. In other words, proportional shortfall determines the worse-off not by looking at absolute health achievements, but rather by looking at health achievements in relative terms – see equation 1[28,29,32]:

$$\text{Proportional shortfall} = \frac{\text{QALYs lived without disease} - \text{QALYs lived with disease}}{\text{QALYs lived without disease}} \quad (1)$$

The nominator in equation 1 shows the loss of QALYs in case of no treatment (normal QALY expectancy minus QALY expectancy with disease but without treatment), whereas the denominator contains the remaining QALY expectation without the disease (usually based on gender and age-specific quality of life data). The range of proportional shortfall varies from 0 (no QALY loss) to 1 (total loss of remaining QALYs). For example, consider a 40-year-old man who suffers from acute heart failure, which will lead, without treatment, to immediate death. If without heart failure he would live until 80 years of age (for simplicity, all these years are lived in full health), he may lose all 40 remaining QALYs (healthy years). In this case, the proportional shortfall will be 100% or 1 (40 QALYs/40 QALYs). If instead he would suffer from a non-life-threatening illness, living until 80 years in a health state that is valued at 0.5 QALY so that each year counts for 0.5 QALY and therefore that 40 x 0.5 or 20 QALYs are lost, the proportional shortfall will be 0.5 (i.e., 20/40). By now, proportional shortfall has been calculated for numerous diseases.[e.g., 23]

The other two criteria are effectiveness and cost-effectiveness, where the latter criterion comprises the former, obviously. Information on the (cost-)effectiveness of an intervention is usually acquired through a cost–utility analysis, a specific type of economic evaluation.[33] The effectiveness criterion is the most accepted and explicitly applied criterion of the three main decision-making criteria. It is well accepted that an intervention should at least result in a desired effect. In other words, care should reduce a healthcare need or prevent it from increasing.[6] Within a cost-effectiveness study, effects are

6 Note that besides this more clinical effectiveness, ZiNL also refers to effectiveness in a broader sense that comprises, among other things, safety and user-friendliness.[21]

typically expressed in terms of QALYs. This is a quantitative utility measure, which captures both length and quality of life. Every lived life-year is weighted for the quality of life during that year. QALY scores usually range between 0 (death) and 1 (perfect health), although they may take negative values as well for very poor health states, which are evaluated to be 'worse than dead'.

When the effects of an intervention, in terms of QALYs gained relative to some comparator, are established, they may subsequently be confronted with the costs of that intervention (again relative to the comparator). Cost-effectiveness is increasingly becoming an important and accepted decision criterion in healthcare decision-making.[e.g., 34-36] Given the societal perspective advocated in the Netherlands, the costs should comprise all relevant societal costs, including for instance productivity costs and costs of informal care. Thus, an incremental cost-effectiveness ratio (ICER) is determined, which divides the QALYs gained by the incremental societal costs incurred.

The provisional decision

Once information on both the necessity and the cost-effectiveness of an intervention is gathered, this can be used to reach a (preliminary) decision on the desirability of the intervention to be included in the basic benefits package. The common decision rule used in this context is to evaluate the ICER in relation to some relevant threshold value of costs per QALY.[e.g., 37,38] This threshold is a much-debated topic. Not only is there discussion about what the threshold should represent (some social value of a QALY or rather the marginal cost-effectiveness of current spending in the healthcare sector[34] [7]) but also the height of the threshold.[39-41] However, in the Dutch context, the threshold appears to represent the social value of a QALY,[42] the height and nature of the threshold are not yet clear. Often mentioned threshold values in the Dutch context were €18,000 and €20,000 per QALY. These values, however, lacked a proper foundation.[42] Moreover, increasingly it was acknowledged that having one threshold value for the costs per QALY was incompatible with the full decision framework, which links the necessity criterion to that of cost-effectiveness. The final decision rule is based on the assumption that society might be willing to spend more per QALY in case of interventions that target a disease that imposes a higher disease burden. This implies that higher costs per QALY are accepted when the disease causes a higher burden, that is, has a higher proportional shortfall (see Figure 2.1). Stolk et al.[28] show that this equity-weighted cost-effectiveness threshold may better explain past reimbursement decisions than a fixed threshold value. They also provide normative arguments in favour of such a 'flexible' threshold.

To apply the decision framework and rule, ZiNL and the Dutch Council for Public Health and Healthcare Council (RVZ) tentatively argue that a maximum threshold value of €80,000 may be considered appropriate.[22,23] Moreover, they argue that for those illnesses where the disease burden

7 In relation to a fixed budget, that represents the health forgone by allowing the intervention under study in the package. All other things equal, allowing something in the package with a more favourable ICER will then result in more health gained with the budget, otherwise, the total amount of health produced will drop.

may be considered minimal, a very low (or even zero) societal willingness to pay per QALY may be applicable (hence the dotted starting point of the threshold line in Figure 2.1). Nevertheless, there is no consensus on the exact form of the relationship between proportional shortfall and cost-effectiveness (here drawn as a linear line), as well as the starting point and end point of the line. The currently mentioned threshold values lack a sound empirical basis.[42] [8]

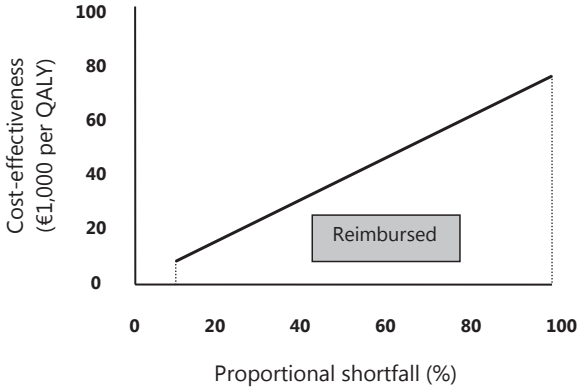

FIGURE 2.1 The decision framework for the assessment phase: a shifting threshold according to necessity

The appraisal phase

Despite the importance of decision criteria, it is also increasingly recognised that strict adherence to a rational, non-contradictory set of criteria may not be feasible, as important normative, 'unquantifiable' judgments may then be disregarded. Therefore, the assessment phase is followed by an appraisal phase. The appraisal phase constitutes a societal verification of the preliminary decision reached in the assessment phase by an independent committee of experts with different societal roles. This committee reviews the material gathered in the assessment phase and then decides whether to include the technology in the basic benefits package, after taking the preliminary decision and other aspects (feasibility, ethical, societal, etc.) into consideration. The meetings are open to the public and the minutes of the meeting are available to all. The inclusion of this appraisal phase was intended to increase public support for conclusions about reimbursement drawn by ZiNL. When this second phase is completed, advice regarding reimbursement of the intervention is presented by ZiNL to the Minister of Health, Welfare and Sport.

8 Note that, indeed, regarding the latter, RVZ argues in favour of withholding treatment from funding for which the disease causes only very low disease burden; according to RVZ, this boundary could be set at a loss of 10% or less of total remaining health as shown in the figure.

2.3 THE DECISION FRAMEWORK AND LIFESTYLE INTERVENTIONS

In this section, we will further address the different elements and phases in the decision-making framework in relation to lifestyle interventions.

Necessity

Two (underexplored) issues regarding the use of proportional shortfall as operationalisation of necessity may be of particular relevance to the measurement of proportional shortfall regarding lifestyle interventions: the (sub-)group in which proportional shortfall is measured and the moment that the measurement of proportional shortfall begins.[9]

Regarding the first issue, consider some preventive treatment for a group of 100 individuals who all have high cholesterol. Suppose now that only 10 of them will incur health losses when untreated and thus will benefit from this treatment. Two options for measuring proportional shortfall may be distinguished.[28] First, one may include only those people who would actually incur health losses as a consequence of high cholesterol (i.e., only 10 out of the 100 people) or, alternatively, one may include all individuals undergoing treatment, including the ones for whom treatment is unnecessary, as they would not experience any health losses without prevention. Not surprisingly, average proportional shortfall will be much lower in the latter case, as 90 individuals will have a proportional shortfall of 0.

Stolk et al.[28] offer several arguments in favour of measuring the average proportional shortfall only in the subgroup that actually experiences the health losses for which treatment is considered. First, cost–utility analyses of preventive interventions include the costs of all individuals undergoing the preventive intervention, including the costs for those individuals who do not benefit from the treatment (as it is usually impossible to identify *a priori* only those people who actually benefit from the treatment). Although few will contest this practice, the logical result is a less-favourable cost–utility ratio (more costs but same effects). Doing the same when measuring proportional shortfall may be considered 'double counting', as the intervention is blamed twice for the same characteristic (i.e., lack of identification of individuals who actually benefit). Thus, individuals in need of this preventive intervention who already face a higher cost–utility ratio, would then also be confronted with their condition receiving a lower equity weight.

A second argument is that an equity measure is concerned with the worse-off, and therefore it is important to consider on what condition we base our assessment of the worse-off, that is, the specific health losses the treatment is trying to prevent. In our example, treatment is obviously aimed at

9 Note that these two issues are also relevant when using other equity concepts. Moreover, note that equity here refers especially to the situation of patients on a micro level, as opposed to a macro level. This distinguishes it from burden of illness approaches where prevalence is important. For the calculation of current equity weights, prevalence is irrelevant.

avoiding health losses (in terms of quality of life or life-years) as a consequence of coronary heart disease and not high cholesterol itself. Stolk et al.[28] argue that it would be appropriate to perform the equity measurement only on those individuals who incur heart disease (instead of on all those who have high cholesterol). Then the equity measurement would be "*independent of the prevalence of cardiovascular events in a particular group, and of diagnostic accuracy in identifying the patients at the highest risk*"[28]. In other words, who we consider to be worse-off is then independent of the success, in terms of health gains, of a treatment.

A second important issue in measuring proportional shortfall is when to start calculating the shortfall. Think of a 40-year-old patient with high cholesterol who will die after heart failure at the age of 60 without preventive treatment (with treatment he would live in perfect health to become 80 years old). A first option is to measure proportional shortfall at the point when the preventive intervention is given (at age 40). Alternatively, measurement could start when the potentially prevented health problems would actually occur (at age 60). In case of the latter option, a shorter time frame is considered (20 years instead of 40 years), and therefore proportional shortfall will be higher (losing 20 years out of 20 years makes a proportional shortfall of 1, while losing 20 years out of 40 years makes 0.5). Stolk et al.[28] argue in favour of starting the measurement of proportional shortfall at the time of the treatment instead of the moment the illness actually occurs. This argument is based on the concept of urgency. People may prefer treatment among those in danger of imminent, severe health loss or immediate death, than treatment among those who face a similar fate in 20 years time (and now are still healthy).[43]

It is clear that the priority given to lifestyle interventions may be strongly affected by these inherently normative choices. In practice, both methodological choices mentioned above may indeed result in more than significant differences in outcome.[28] Stolk et al.[28] explicitly call for more debate and research in this area, stating that "*… it is insufficient to scrutinise just the general ideas behind an equity concept and … just as much attention should be directed to the methodological choices in adopting each one of them*". To date, however, it remains unclear how necessity should be exactly operationalised, but still it is operationalised (when used at all) along the lines proposed by Stolk et al.[28] [10]

Effectiveness

An important problem arising when applying the decision criteria in practice is that high-quality data or evidence on effectiveness is often lacking.[22] For example, Stolk et al.[36] argue that for medical specialist care this problem often arises. This is also true for lifestyle interventions. When establishing

10 Note that there are other normative choices regarding the measurement of proportional shortfall. One that does not especially affect the evaluation of preventive treatments, but deserves mentioning, is the use of additional age weights. According to the proportional shortfall approach, treatment of two persons may be deemed equally necessary, even though their ages differ remarkably. However, society may prefer treatment among the young over the old. To correct for this, additional age weights may be used to reflect society's preferences.[28,32]

the (cost-)effectiveness of an intervention, Randomised Controlled Trials (RCTs) are considered to be the state of the art, by ZiNL. However, for preventive interventions, especially those aimed at lifestyle changes, such evidence may be hard to come by, also in pragmatic trials. There are several possible explanations why this is the case. First, a well-designed RCT requires a controlled setting in which possible confounding factors are neutralised so that any significant effects can be adequately ascribed to the intervention. As RCTs of lifestyle interventions are often pragmatic and situated in the 'real world', it may be more difficult to rule out confounding in investigating the effectiveness of such interventions,[44] especially when it is difficult to randomise. Second, long follow-ups are often required for the evaluation of lifestyle interventions, as the effects will usually only show many years later. This is often problematic. Third, effectiveness of lifestyle interventions are often reported in intermediate health outcomes, such as weight loss.[44] Although such outcome measures may indeed result in increased health, and may have some clinical meaning themselves,[33] policy makers in charge of allocating healthcare resources may be more interested in final health outcomes. Final outcomes may, among other things, increase the comparability of different types of treatment. Thus, when intermediate outcomes are used, a link needs to be made to final health outcomes using decision modelling based on epidemiological data.[33] This is, however, not an easy task, nor may it always be considered as 'high-quality evidence'. Finally, in contrast to, for instance, the pharmaceutical sector, it is unclear who will provide for and finance evidence regarding necessity and (cost-)effectiveness when applying for funding of an intervention in the context of the basic benefits package. Although pharmaceutical companies commonly have to provide the evidence themselves, funding for such research is often not (automatically) available in other areas.

In the area of lifestyle interventions, these difficulties regarding data collection may have important additional implications. Lifestyle interventions often consist of drugs, behavioural support (e.g., consultations) or a combination of both. The lack of data may lead to the impression that the behavioural or combined interventions are not (cost-)effective. The drug option might receive priority, although it may be the less-optimal solution. Hence, more effort is advocated to resolve the difficulties associated with gathering evidence for lifestyle interventions.[22]

Cost-effectiveness

Three issues that may particularly influence the cost-effectiveness of lifestyle interventions are discussed next: the perspective of the analysis, the inclusion of unrelated medical costs in life-years gained and discounting of costs and effects. ZiNL offers guidance on how to deal with these issues.[21] Several methodological issues are, however, still subject of considerable debate in the international literature. Moreover, in some instances, the guidelines seem to lack a proper theoretical foundation.

The Dutch guidelines currently promote the use of a societal perspective in economic evaluations.[21] From a societal perspective, several cost categories can be distinguished: direct medical costs, direct non-medical costs, indirect non-medical costs and indirect medical costs.[45] Direct medical costs are directly related to the intervention under study (e.g., costs of tests, medication, etc.). Direct non-medical costs are also directly related to the relevant intervention or condition, but do not fall within the formal healthcare sector. Examples are costs of informal care and patients' travel costs and time costs. Indirect non-medical costs are predominantly related to the changes in the productivity of individuals as a consequence of an intervention.[e.g., 46] Finally, indirect medical costs are medical expenditures in life-years gained because of a life-prolonging intervention. These costs refer to medical costs incurred in gained life-years and are usually further broken down into related and unrelated costs. The related indirect medical costs are related to the intervention (e.g., anti-rejection medication after a life-saving long transplant), whereas the unrelated indirect medical costs are not directly related to the life-prolonging treatment (e.g., costs of a hip surgery in life-years gained because of the life-saving long transplant).

Adopting the societal perspective implies that all relevant costs and benefits should be considered in an evaluation, regardless of where they fall. For example, if preventive lifestyle interventions involve activities in the education sector, the costs incurred there should not go unnoticed in an economic evaluation. Doing so would result in a misrepresentation of the cost-effectiveness of such an intervention.

Nevertheless, surprisingly, the Dutch guidelines for economic evaluation explicitly recommend the exclusion of one particular type of costs, that is, unrelated medical costs in gained life-years.[21] This is despite the fact that the literature appears to argue strongly in favour of inclusion of these costs for reasons of consistency and optimality (for a review, see Rappange et al.[47]). It has been argued that it would be inconsistent to ignore these unrelated medical costs in life-years gained, as the denominator of the cost–utility ratio (i.e., the benefits side expressed in terms of QALYs) implicitly assumes normal care consumption in these life-years gained.[48] In addition, Meltzer[49] argues that excluding these costs would lead to a non-optimal allocation of healthcare resources. The consideration of unrelated medical costs in life-years gained in the economic evaluation of healthcare interventions may have several important implications for cost-effectiveness results and subsequent decision-making.[50] Including these future costs worsens the cost-effectiveness of life-prolonging interventions relative to quality of life improving interventions, thus potentially re-allocating resources away from life-prolonging intervention towards quality of life improving interventions. Furthermore, van Baal et al.[50] show that including these costs may favour interventions targeted at the young over those targeted at the elderly, as the former incur these future additional unrelated medical costs further in the future and are therefore discounted relatively more. Given that preventive lifestyle interventions may indeed importantly prolong life (e.g., smoking cessation), current guidelines result in biased cost-effectiveness

results. This point is compounded by the fact that non-medical costs in added life-years are typically ignored as well, which reflects the considerable controversy around these costs in the international literature.[e.g., 48,51-54]

A final issue that may importantly affect the cost-effectiveness of lifestyle interventions is discounting. Applying discount rates for future costs and effects is widely accepted and a common practice in economic evaluations.[33] However, more controversy exists on the height of the discount rates for costs and effects. Preventive interventions often incur immediate costs, yet yield health effects (far) in the future. Hence, applying higher discount rates will generally make the cost-effectiveness ratio of a preventive intervention less favourable, especially compared with curative interventions. Recently, arguments have been put forward in favour of differential discounting – using two distinct discount rates, one for costs and one for effects. The main argument for this is that if the social value of health increases over time (which seems uncontroversial but is not accounted for in common cost–utility analyses), this may be corrected for by using a lower discount rate for effects relative to that for costs.[e.g., 37,55-57] In the Netherlands, such differential discounting is currently prescribed: 4% for costs and 1.5% for health effects.[21] Opponents of differential discounting normally indicate that using two distinct discount rates would be inconsistent[e.g., 58] or would lead to infinite postponement of interventions, as postponing the intervention results in more favourable ICERs the longer the postponement lasts when the discount rate for costs is higher than that for effects[59]. However, these arguments have been countered in the literature[e.g., 37,56] and it appears that it is increasingly accepted that there is no inherent need for equal discount rates for costs and effects[57]. More attention for the (intergenerational) equity aspects of discounting seems warranted as well. People may weight health gains in different generations differently for equity reasons, for instance, giving lower weight to gains in generations with a relatively high life expectancy.[e.g., 60]

Using a lower discount rate for effects than for costs (as commonly advocated by proponents of differential discounting), which thus implicitly implies attaching more weight to future health benefits, may substantially lower – thus more favourable – ICERs for preventive interventions. Further, when judged against some (more or less) fixed threshold or compared with more curative interventions, the choices regarding discount rates may directly influence the chances of an intervention to be implemented. The issue of discounting is still subject of much debate, yet the current discount rules applied by ZiNL in an international context are favourable for prevention.

Decision rule and appraisal phase

In terms of the decision rule, it is clear that the decision framework is not completely operational yet. There is no clear consensus regarding the appropriate threshold for costs per QALY or how that exactly should vary with severity of illness. The debate on appropriate thresholds is increasing, internationally as well. Both the nature of the threshold (what it should represent) and, related, the

appropriate height of the threshold (in different contexts) are matters of debate and study.[e.g., 19,40,57] It will be crucial to further set appropriate thresholds in order to be able to use the framework in practice. In that sense, it is not only clear that internationally very little is known regarding the value of QALY gains[61] and even less so about how this varies with specific disease contexts,[62] but also that the underpinning of the currently proposed threshold range (from €10,000 to €80,000) is very weak[42]. It is important to have better justified thresholds for QALY gains if aiming to apply the decision-making framework in practice.

One of the interesting questions in this context is whether the thresholds should be equal for curative and preventive interventions. Especially for preventive interventions where it is unclear which person exactly benefits from the intervention (i.e., have a more anonymous, statistical nature), although beneficiaries of curative interventions are identifiable, it is interesting to note that it has been argued that the value of a statistical life is lower than that of an identifiable life. Like Dranove[63] noted: "*There is no reason to expect that the value of a statistical life would equal the value of an identified life*". This obviously is rather relevant for evaluating preventive interventions. However, although this discrepancy in values may be observable in empirical studies, it is rather questionable whether a government would want to apply different thresholds for these situations. The normative grounds for this distinction are unclear. Moreover, when considering an example when choosing between a preventive action today that tomorrow will reduce the occurrence of an acute disease for which a curative intervention exists, the inconsistency of having two thresholds becomes obvious.

Nevertheless, even with better knowledge of the threshold, it is clear that besides an assessment phase, an appraisal phase remains necessary. Several considerations enter this phase that may be of particular interest in case of lifestyle interventions. One of these considerations concerns the culpability and own responsibility argument. This is related to the question whether a specific intervention should be paid from individuals' own pocket (which was prominent in the fourth Dunning criterion). Clear criteria for when something can be left to an individuals' own responsibility are lacking. Moreover, interventions targeting the consequences of (consciously) taking health risks (e.g., smoking, drinking and not exercising) may be viewed differently than those targeting illnesses that are not related to lifestyle. In case of the former, the degree of solidarity that society has with the involved individuals may be less than otherwise. It seems, however, that such arguments not only use a notion of responsibility that may be debatable (e.g., given the overrepresentation of smokers in low socio-economic groups), they are also not always used consistently. For instance, more emphasis seems to be placed on culpability in case of lifestyle interventions than in case of curative interventions (e.g., smoking vs. lung cancer). Moreover, it is important to note that current Dutch law prohibits denying reimbursement on the grounds of culpability.

It is important to avoid arbitrariness in the appraisal phase and to make all considerations explicit and use them as consistently as possible. The fact that some arguments cannot be quantified should not result in inconsistencies in or lack of transparency of the appraisal phase.

2.4 TOWARDS IMPROVED EVALUATION OF PREVENTIVE LIFESTYLE INTERVENTIONS

The search for the decision criteria that should play a role in healthcare priority setting has been a longstanding process. Recently, as discussed, a healthcare decision-making framework was developed and proposed in which the criteria 'necessity' and 'cost-effectiveness' play a central role. Many normative choices, however, need to be made explicit to make these decision criteria, and thus the decision framework operational, transparent and legitimate. In this chapter, we have indicated that this operationalisation process is by no means trivial and that many issues remain open.

The success of the decision-making framework will, to a large extent, also depend on whether the scope of applying the decision criteria can be extended to all types of healthcare interventions and technologies. An important barrier in this context regards the collection of evidence for interventions such as preventive lifestyle interventions. The question of how to deal with 'lower' levels of evidence for such interventions is important. Moreover, when considering necessity, the way in which the necessity score is being calculated requires more public attention than it received so far. The same holds for normative choices underlying the measurement of cost-effectiveness, for example, regarding discounting and the inclusion of controversial costs. It seems that many challenges remain before the decision-making framework and its criteria can be successfully applied in practice.

Moreover, it requires a consistent use of the framework itself. For instance, ZiNL recently evaluated a smoking cessation programme, combining therapeutic and drug therapies, for uptake within the basic benefits package. Regarding the 'necessity' criterion, ZiNL concluded that smoking results in a high disease burden.[64] Interestingly, disease burden is expressed in disability adjusted life-years (DALYs) instead of proportional shortfall, and thus, here, refers to an absolute measure of overall disease burden rather than severity of illness. The effectiveness of the combined smoking cessation treatment has been assessed before (success rates varying between 8% and 20%) and is anchored in a recently updated clinical guideline.[65] The ICER was relatively favourable (compared with the current standard, i.e., only therapeutic therapy), that is, €19,000. This ICER did include the indirect medical costs (although guidelines advice not to) and adopted a discount rate of 4% for both costs and effects (whereas guidelines advice a 1.5% discount rate for effects). ZiNL argues that the ICER would be much lower (reducing the ICER by some 50%) if a lower discount rate for effects would have been used. The cost-effectiveness study took a healthcare perspective rather than the prescribed societal perspective, and therefore excludes important costs such as those related to productivity changes.[64] Therefore, it

seems that ZiNL currently does not strictly adhere to its own decision-making framework. Although there may be reasons for this, both general ones (e.g., the lack of clarity on the exact height and shape of the threshold line) and particular ones (e.g., availability of good studies taking the preferred societal perspective, etc.), attempting to be as consistent as possible in using the framework is crucial.

Therefore, to obtain sound evaluations of lifestyle interventions, it is important to further develop and justify the current decision-making framework and examine its current operationalisation, as well as consider the specific aspects of interventions such as lifestyle interventions. These interventions need to be evaluated using the same decision-making framework in order to ensure consistency, but it needs to be ensured that the (operationalisation of the) framework is suitable for this purpose. Currently, the Dutch healthcare system is (still) characterised by relatively low investments in programmes promoting healthy behaviour. Clearly, current investments in such interventions are at variance with the increased impact of unhealthy behaviour on population health, that is, preventable disease burden. Whether spending more money on prevention is justified can only be determined by comparing interventions (curative and preventive) within a similar framework, which comprises all aspects considered relevant.[66] In this context, it is important to realise that choices on how to operationalise the decision criteria need not be made such as to promote prevention, but such as to arrive at an appropriate, consistent and transparent framework for setting priorities.[19,66] This indeed should be high on the priority list.

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Chapter 3

Unrelated Medical Costs in Life-Years Gained
Should They be Included in Economic Evaluations of Healthcare Interventions?

Based on:
Rappange DR, van Baal PHM, van Exel NJA, Feenstra TL, Rutten FFH, Brouwer WBF. Unrelated medical costs in life-years gained: Should they be included in economic evaluations of healthcare interventions? ***PharmacoEconomics.*** *2008; 26: 815-30*

Also appeared as:
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3.1 INTRODUCTION

Economic evaluations are usually used to inform policy makers about the costs and benefits of a given change in resource allocation (e.g., introducing a particular healthcare intervention). The general idea behind such evaluations is that a particular intervention should only be introduced if the associated benefits are found to outweigh the associated costs. Therefore, it is obviously important to determine which costs and benefits should be included in an economic evaluation. The theoretical welfare economic answer is simple: if we really want to know whether the benefits outweigh the costs, we need to include all the costs and benefits, and neither exclude anything relevant nor count anything twice. However, in practice, the issue of what to consider in economic evaluations of health technologies has been and remains an area of much controversy. Some[1-3] promote a broad societal perspective that theoretically should comprise all relevant costs and effects. Others[4] suggest a narrower perspective, most notably a healthcare perspective, as being most relevant in the context of healthcare decision-making. If the latter option is chosen, costs (and effects) falling outside of this perspective are systematically ignored and deemed irrelevant for the healthcare decision-maker. For example, the inclusion or exclusion of productivity costs depends on the perspective chosen,[1,5,6] as they do not fall under the healthcare budget, but do represent real societal costs.

Unrelated future medical costs are a potentially important yet often ignored cost that is relevant in both these perspectives. These costs, also referred to as indirect medical costs or survivor medical costs, are an indirect result of an intervention that has successfully prolonged the life of an individual. During these added years of life, this individual, just like any other person, may fall ill and consume healthcare. This healthcare consumption may be termed either related or unrelated to the life-saving intervention. For example, Bob is a 60-year-old male with acute heart failure. Immediate treatment, involving bypass surgery, has prevented Bob from dying. He recovers completely, although he does require lifelong medication for his heart condition. Bob will now live on to the age of 80 years; however, at age 75 years, Bob trips over and breaks his hip. After a total hip replacement and much therapy, Bob is mobile again. When calculating the cost-effectiveness of the bypass surgery that prolongs Bob's life by 20 years, we normally take into account the related costs during these added life-years (i.e., the costs of the required medication). The unrelated medical costs are those related to the hip replacement. Should they be included in the analysis of the heart surgery as well?

The answer may be considered straightforward. Indeed, since all medical consumption during the gained life-years would not have occurred if the initial intervention (i.e., the bypass surgery) had not taken place, and since it represents actual medical resource use, the inclusion of these costs seems required in order to reach optimal and informed funding decisions. But while this inclusion of related costs in gained life-years is uncontroversial,[7] the inclusion of unrelated costs is still very contentious. Using the example above, some would argue that the bypass surgery should be judged 'in isolation' and that it cannot be blamed for subsequent decisions or interventions such as hip replacement.[8]

Others have argued that inclusion is irrelevant so long as the practice of inclusion or exclusion is consistently executed, since it would only entail adding a constant to cost-effectiveness ratios, which does not alter the relative efficiency of different interventions and, therefore, does not affect subsequent prioritisation of interventions (or decision-making).[9] However, arguments in favour of inclusion of these costs as being real healthcare costs are increasing, and practical ways to do so have been explored.[10-13] This controversy is persistent and many guidelines for economic evaluations of health technologies either instruct analysts to exclude these costs or leave inclusion up to the discretion of the analyst. For instance, the Dutch guidelines for pharmacoeconomic evaluations[14] explicitly state that unrelated medical costs in life-years gained should be excluded from the analysis. Indeed, excluding these unrelated medical costs is common practice in most economic evaluation studies.[15-17]

However, recent arguments in favour of including such survivor costs of unrelated medical care appear to be gaining support.[10-13,18,19] [1] One of the main arguments in favour of including unrelated future medical costs has been labelled the internal consistency argument.[11,13] This argues that what is being projected as gains (benefits) in an economic evaluation needs to be consistent with what is being counted as costs in that same evaluation. Since most projections of QALY gains (e.g., based on average healthy life expectancy in the population) implicitly assume normal medical care consumption during added life-years (without which the healthy life expectancy cannot be attained), it would be inconsistent to exclude the associated costs. For example, if we calculate the QALY gain for Bob due to the bypass surgery by using the actual predicted health level until the age of 80 years, achieving this health level requires the hip replacement. Projecting the gain due to the hip replacement but not the associated costs would thus be inconsistent. Another crucial argument, most forcefully put forward by Meltzer[18] is that ignoring future medical costs is not consistent with lifetime utility maximisation. Thus, ignoring these costs does not result in optimal decision-making.

Therefore, it appears timely to reconsider the current practice of ignoring unrelated medical costs. This will especially change the outcomes of economic evaluations of interventions that substantially prolong life, for example, in the curative sector (i.e., neonatal surgery) and in the preventive sector (i.e., reducing risk factors such as obesity or smoking).[21] We provide an overview of the literature so far and highlight the consequences of different practices of accounting for costs and effects in cost-effectiveness analyses, using a preventive intervention example based on a recent study by van Baal et al.[13]

The structure of this chapter is as follows. Section 3.2 provides a brief description of different cost categories that can be distinguished in economic evaluations; section 3.3 highlights the debate about unrelated future medical costs as well as some current recommendations regarding their inclusion

1 However, it must be noted that the debate does continue.[20]

in US, Dutch, UK and Swedish guidelines. Section 3.4 presents some recent developments in the literature and in section 3.5, we use an example of a smoking-cessation intervention[13] to present four different cost-utility ratios to demonstrate the consequences of different practices of accounting for unrelated future medical costs. Finally, section 3.6 concludes this chapter by drawing some lessons for the inclusion of these controversial costs in economic evaluations.

3.2 ECONOMIC EVALUATIONS AND COST CATEGORIES

Economic evaluations in healthcare compare the costs and effects of a given medical intervention with the costs and effects of a relevant alternative (comparator). Health effects are usually valued in some common denominator (e.g., QALYs). The ratio of additional monetary costs to QALYs gained (i.e., the incremental cost-effectiveness ratio [ICER]) can then be calculated. Ideally, the ICER enables the investigator to judge whether the incremental health effects of the intervention justify its incremental monetary costs. In calculating costs, it is important to distinguish different types of costs. A common categorisation of costs is shown in Figure 3.1, which presents the different types that are directly required as input in the intervention (direct medical and non-medical costs) or are indirectly induced by the intervention (indirect medical and non-medical costs).[7]

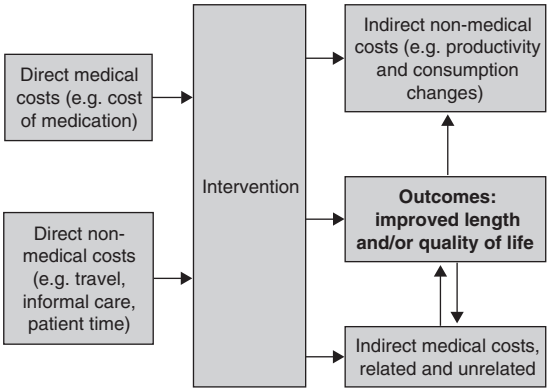

FIGURE 3.1 Different costs in economic evaluations as input in and resulting from an intervention

As Figure 3.1 shows, the direct costs relate to resources that directly contribute to the intervention. Indirect costs (which can also be savings, e.g., when productivity changes) can best be viewed as consequences of the intervention and the related health improvement. Whether or not these different costs are deemed relevant in an intervention is partly determined by the given intervention (e.g., small health changes may not be associated with changes in productivity) and, importantly, influenced by the perspective chosen for the analysis.

A societal perspective implies the inclusion of all relevant costs and effects of a medical intervention regardless of whether they fall within or outside the healthcare sector, and, in principle, all these costs are relevant. When a healthcare perspective is used, the non-medical costs are normally deemed irrelevant.[2] We discuss these different cost categories further in the following sections.

Direct medical costs

Direct medical costs are usually defined as those that directly relate to the intervention or condition under study and fall within the formal healthcare sector. They occur in normal years of life (i.e., the years that a patient would have lived with or without the treatment).[7] All costs falling within the formal healthcare sector that are related to the intervention or condition (e.g., formal caregivers' time, costs of diagnostic tests, drugs and other hospital materials) belong to this category independent of who is financing these costs. This cost category is a central part of any cost-effectiveness analysis, whether performed from a societal or a healthcare perspective.[3]

Direct non-medical costs

Direct non-medical costs are costs that are directly related to the intervention or condition under study, but that fall outside the formal healthcare sector. For example, such costs can include patients' travel costs, costs related to patient time in receiving treatment, and informal care costs, but may also involve costs incurred due to necessary adjustments in a patient's living environment. From a societal perspective, these costs should be included in economic evaluations since they are a direct input into the total treatment. These types of costs can be considered irrelevant when a narrower perspective is adopted (e.g., the healthcare perspective, which is largely the reference case in the UK).

Indirect non-medical costs

Indirect non-medical costs are societal costs or savings that occur as a result of changes in a patient's productivity level. These so-called productivity costs occur when an illness leads to absenteeism, presenteeism (reduced productivity at work), disability or premature death in a productive person, whether paid or unpaid. Other costs may include, for example, those that occur outside the healthcare sector, such as costs for special education or, in cases of addiction, police or legal costs. There is, at least from a societal perspective, general theoretical consensus that all costs belonging to this cost category should be included. However, there continues to be much discussion on how to estimate these costs.[1,6,23-30]

2 While we do not wish to fully address here which perspective is most appropriate, it is clear that some costs may be more relevant for healthcare decision-makers than others.[22] On the other hand, simply and completely leaving certain costs out of an economic evaluation may still be considered a short-sighted strategy.

3 Those costs in normal life-years unrelated to the intervention are normally excluded from the analysis, since these costs are independent of changes in length and quality of life (QOL) due to the intervention under study. Therefore, these costs are generally the same for all treatment strategies and cancel out.

Another type of cost that may be considered as indirect non-medical costs is currently receiving considerable attention in the literature: costs of non-medical consumption (net of production) in life-years gained (e.g., costs of food, housing and clothing). From a full societal perspective, there appears no valid reason to exclude these future non-medical costs. However, inclusion is uncommon and exclusion has been advocated for feasibility reasons[7] and for consistency between the cost and effect sides of the cost-effectiveness ratio.[11] Consensus on how to handle these costs has yet to be achieved.[9-11,20] From the healthcare perspective, indirect non-medical costs can be readily ignored (although the line between these costs and future medical costs is somewhat vague – i.e., the costs of food and housing of people who are institutionalised can be seen as 'medical costs').

Indirect medical costs

Indirect medical costs usually describe medical costs that result from care consumption in life-years gained. These costs are relevant when an intervention prolongs the life of a patient, and include costs that would not have occurred without the life-prolonging intervention. Moreover, these costs are relevant from both a societal and a healthcare perspective, as they involve real societal costs that fall under the healthcare budget. These costs are often further described as 'related' and 'unrelated' indirect medical costs.

Related indirect medical costs are related to the life-prolonging intervention. In our earlier example, these would be the costs of Bob's heart condition medication. Another example would be the continued use of anti-rejection medication after a life-saving liver transplantation. This care consumption is directly related to the intervention that was required for the condition in the first place. The inclusion of these related indirect medical costs is normally advocated in an economic evaluation.[7]

Unrelated indirect medical costs are a result of consumption of medical care in added life-years, but are unrelated to the intervention that was required to treat the initial condition (e.g., the costs of Bob's hip replacement). Obviously, these costs would not have occurred if the patient's life had not been extended, but other than that, these medical consumption costs are unrelated to the intervention under study. The inclusion of these costs remains a matter of much debate,[13] and in the remainder of this chapter we focus on the inclusion of these costs.[4]

4 It should be noted that the cost categorisation outlined here is common but certainly not perfect or complete. For example, during life-years gained, people may also require informal care, which would be something like 'indirect direct non-medical costs', etc. It appears to becoming more common to use less aggregate cost categories (e.g., productivity costs, informal care, travel costs, etc.) with more meaningful labels.

3.3 UNRELATED INDIRECT MEDICAL COSTS

The debate on the inclusion of unrelated medical costs in life-years gained in economic evaluations is not new. Weinstein et al. [31] argued that this cost category is often unjustly excluded, "… *if treatment results in prolonged life because a condition has been cured or early disease has been avoided, then the cost of treating later disease that would not otherwise have risen must be considered.*" In contrast, Russell[8] argues that an intervention should be judged on its own 'merits' if the aim of the evaluation is to establish whether an intervention produces good value for money. She claims that it would be incorrect to attribute additional costs in life-years gained to an intervention just because it is successful in prolonging a patient's life. Russell[8] maintains that "*When the question is … simply whether the proposed programme is a good use of society's resources, its indirect effects on medical expenditures are no more relevant than its indirect effects on expenditures for food, clothes, or housing.*" Indeed, the latter type of costs (i.e., survivor consumption costs) is not usually included in economic evaluations; however, this is another matter that is also being fiercely debated.[18,32-36] In practice, the viewpoint of Russell[8] appears to have received quite some support. For instance, Mushlin and Fintor[37] evaluated nine cost-effectiveness studies of breast cancer screening and found that none of the studies had included unrelated medical care in life-years gained. The authors concluded that the studies"… *all avoided the nonsensical conclusion that it is almost always more cost-effective to do nothing than to screen and attempt to cure.*" It must be noted that while statements such as this are sometimes tempting, especially in the pursuit of getting effective screening programmes established, it is rather nonsensical to perform a cost-effectiveness analysis in which real costs are deliberately ignored, in an attempt to attain the desired results. Obviously, excluding certain costs while keeping the effects constant will result in more favourable cost-effectiveness ratios, but then the ultimate strategy would be to ignore all costs. Rather than such nonsensical strategies, studies should be performed in a way that is methodologically sound and that results in relevant and complete information for the decision-maker. But what should be the role of unrelated medical costs in gained life-years in that context?

Garber and Phelps[9] tried to shed some light on this issue. They showed that, under certain strict assumptions, the inclusion or exclusion of survivor medical costs will not affect the ranking of cost-effectiveness ratios and that, therefore, they can be safely omitted from the analysis. They claimed that if the unrelated future healthcare costs are truly conditionally independent of prior expenditures (i.e., independent of the expenditures of the intervention under study) and the practice is consistently executed, including these costs would only add a constant figure to all cost-effectiveness ratios. Thus, although the cost-effectiveness ratio will increase, the ranking of the ratios remains unaltered.

However, some have questioned these results. First, the US Panel[2] argued that this would only hold if interventions were compared that were intended to treat people with similar personal characteristics, such as age. Interventions aimed at different age groups and thus adding life-years in different life phases would most likely entail different costs per additional life-year. In that case, the inclusion or

exclusion of these age-specific future costs would indeed matter and, therefore, the ranking of the cost-effectiveness ratios could be influenced.[2] Second, the important assumption in the model of Garber and Phelps[9], that future unrelated medical costs are costs that are conditionally independent of prior expenditures, would probably not hold in practice.[2,18] In this respect, the Panel[2] argued that *"It is fair to ask whether the pattern of future expenditures is ever truly unaffected by an intervention that has a large impact on longevity."* Finally, related to this point, the Panel[2] claimed that if standard practice would be to exclude unrelated medical costs in life-years gained, it would seem almost impossible to achieve exclusion in a consistent and comprehensive manner since there "… *are practical and conceptual problems in disentangling the 'related' and 'unrelated' components of costs for 'related' diseases* …" Likewise, Weinstein and Manning[19] illustrated the difficulty in separating unrelated costs from related costs: "*In the analysis of a heart disease programme, for example, one would need to include future induced costs that are affected (conditionally upon survival) by the intervention, but exclude all heart disease costs that are conditionally independent.*"

Meltzer[18] directly addressed the questions and doubts raised by the Garber and Phelps[9] model. Using a more general model than Garber and Phelps[9], and relaxing some of their assumptions, he reached a completely different conclusion: that both the absolute and relative outcomes of cost-utility ratios of interventions are significantly altered when future unrelated medical costs are included and that their inclusion is required in order to reach optimal decisions.[5]

In areas of so much debate, guidelines can play an important role in advocating uniform studies and harmonising the applied methodology. However, guidelines in different jurisdictions differ remarkably in important aspects, including how they handle unrelated medical costs in gained life-years. We briefly describe how these costs are handled in guidelines from the US, the Netherlands, UK and Sweden.[2,4,14,38]

Guidelines for pharmacoeconomic research

The influential US guidelines[2] most comprehensively addressed the issue of unrelated medical costs in gained life-years, but ultimately left the decision of whether to include them or not up to the discretion of the analyst. On one hand, the US Panel[2] wrote that including these costs seems self-evident, since medical care consumption in added life-years is only possible because of the treatment under study; ignoring these future costs would not be an adequate reflection of an intervention's true cost to society. However, on the other hand, the Panel pointed out the large amount of support for excluding these costs, reasoning that it seems politically inappropriate to consider unrelated medical consumption in life-years gained. They claimed that living longer entails additional consumption costs, including medical consumption. If these costs would be accounted for, then it would make sense to consider all consumption costs, which is uncommon. This reflects the argument of Russell[8].

5 Note that Meltzer[18] extends the discussion by also arguing in favour of including all future non-medical costs, such as survivor consumption and survivor earnings.

Alongside these theoretical considerations, the US Panel[2] also highlighted several practical issues surrounding the inclusion of unrelated medical costs in life-years gained. The first is the aforementioned difficulty of distinguishing between related and unrelated medical care, which makes complete exclusion of unrelated medical costs extremely difficult. Another practical issue that might hamper the inclusion of unrelated medical costs is the lack of comprehensive data of future unrelated medical care and the uncertainty of how to estimate the associated costs. Finally, the Panel argued that, if unrelated medical care costs are to be included, then so should all costs in added life-years, in line with Meltzer's argument.[18]

In short, the US Panel[2] recommended omitting this cost category if it is small and the influence on the cost-effectiveness ratio can be considered negligible. However, if inclusion is expected to have a significant effect on the cost-effectiveness ratio, the Panel[2] recommended that a sensitivity analysis should be conducted. The difficulty of reaching firm recommendations in this controversial area is illustrated by this recommendation within the US guidelines, which also prescribe the use of a broad societal perspective and argue for a clear reference case – a standard set of methodological practices. Leaving the decision of whether or not to include these costs up to individual analysts can interfere with this societal perspective and lead to incomparability between studies if analysts make different decisions from each other.

Like the US guidelines[2], the Dutch pharmacoeconomic guidelines[14] advocate use of a societal perspective. However, while this implies that the Dutch guidelines are inclusive regarding most types of costs, the guidelines explicitly state that unrelated indirect medical costs should be excluded from the analysis. It appears that the controversy in the literature as well as the aforementioned practical difficulties in recommending otherwise have probably resulted in this guidance,[39] which may, nonetheless, be considered rather restrictive and disappointing in the advocated societal context.

The guidelines of the National Institute for Health and Clinical Excellence (NICE) adhere to a narrower perspective than that of the US[2] and Dutch[14] guidelines. NICE recommends the use of a healthcare budget allocation perspective, where only the costs that fall within the UK NHS and Personal Social Services are taken into consideration. In the *Guide to Methods of Technology Appraisal*[4] that was published recently, it is explicitly stated that "*Costs related to the condition of interest and incurred in additional years of life gained as a result of treatment should be included in the reference case analysis. Costs that are considered to be unrelated to the condition or technology of interest should be excluded,*" while these costs clearly fall under the NHS budget.

In contrast, the Pharmaceutical Benefits Board (LFN) in Sweden has published guidelines[38] in which the societal perspective and the inclusion of all relevant costs are advocated. In these guidelines, "*All relevant costs associated with treatment and illness should be identified, quantified and evaluated. … If*

treatment affects survival, then the costs for increased survival – total consumption less total production during gained life-years – should be included."

Current guidelines thus largely encourage ignoring unrelated medical costs in gained life-years, either by requiring researchers to exclude these costs from the analysis or by leaving it up to the analyst to decide whether to include them.[6] Both the theoretical controversy and the practical problems associated with including these costs seem to have contributed to this current situation. In terms of the latter, the practical issues may not be easy to solve. For example, Meltzer and Johannesson[10] agree with the US Panel[2] that the lack of adequate data to estimate future unrelated medical costs is still troublesome. However, they also claim that "*In any case, it seems difficult to argue that including an implicit estimate of zero by omitting these costs would be preferable to an imprecise estimate, especially with appropriate sensitivity analysis.*" Moreover, it is important to note that there is progress in this area. The recent literature on healthcare costs of ageing, demonstrating that healthcare costs are not merely dependent on age and sex but importantly on time to death, can also be of use here (van Baal et al., unpublished data).[40-43] In terms of the more theoretical debate on inclusion of unrelated future medical costs, new arguments in favour of including these costs appear to be gaining support, as will be highlighted in section 3.4.

3.4 RECENT DEVELOPMENTS IN THIS DEBATE

The influential US guidelines[2] have spurred debate in the literature regarding the inclusion of unrelated medical costs in gained life-years. For instance, Meltzer and Johannesson[10] address the different arguments put forward by the US Panel[2] for not firmly advocating inclusion of these costs. Regarding the more political argument (that it would not be acceptable to include these types of costs in economic evaluations) they acknowledged that it may seem that including unrelated medical costs will aggrieve the elderly, but argue that these costs are still real. Moreover, inclusion of these real costs does not automatically result in these interventions no longer being cost-effective (unlike the suggestion of Mushlin and Fintor[37]). On the other hand, exclusion of these costs may lead to favouring interventions that extend life among the elderly, rather than improve quality. Furthermore, Meltzer and Johannesson[10] use a simple example to demonstrate that, even if the assumption of conditional independence holds (so that future spending, conditional on survival, is not influenced by current medical consumption) and interventions are aimed at patients of one single age (so that the stream of future costs is identical across interventions), excluding unrelated future costs still leads to biased outcomes in practice, simply because one QALY can be gained by prolonging life for 1 year in perfect health or for 2 years in a health state valued at 0.5 QALY, resulting in 1 or rather 2 years of unrelated future spending.

6 The latter would normally result in more work and a less favourable ICER, which casts some doubt on whether researchers have incentives to include these costs when it is not a requirement.

In a reaction to Meltzer and Johannesson[10], Garber[44] argued that "*… the Panel in effect recommended calculating such costs except when they are known to be small or equal among the various alternatives …*" and therefore the criticism about the recommendation regarding unrelated medical costs seems only "*… a matter of emphasis.*" Finally, important arguments have been presented against the point raised by the US Panel[2] that if one includes unrelated medical costs in gained life-years, one should include all costs in gained life-years, including costs of other consumption, the inclusion of which would be in line with Meltzer's argument.[18] [7]

In a recent influential paper, Nyman[11] proposed a different set of inclusion principles that should serve as a practical guide for deciding which costs and effects to include in cost-effectiveness analysis. According to Nyman[11], the set of criteria should result in cost-utility ratios that are – what has been labelled by van Baal et al.[13] – internally consistent, also sometimes referred to as a symmetry rule.[36] One of the crucial criteria put forward by Nyman[11] is "*Include in the analysis the costs of those resources that directly produce the utility that is being measured in the denominator of the cost-utility ratio.*" [8]

Application of this criterion has important implications, particularly regarding the issue of how to account for unrelated medical costs in life-years gained. In respect of this, Nyman[11] wrote, "*The key, as Meltzer[18] correctly points out, is recognising that these unrelated medical costs are not simply costs, but costs that are incurred to obtain an expected real benefit in the form of an increase in the probability of survival or an increase in health-related QOL. In many existing cost-utility analyses, these benefits are already accounted for in the QALYs, therefore, including their costs in the numerator would only be consistent.*" Thus, application of Nyman's criteria[11] leads to inclusion of unrelated medical costs in life-years gained whenever the associated health gain is captured as projected health gains.

The internal consistency argument put forward by Nyman[11] was subsequently used by van Baal et al.[13] to discuss its practical implications in the example of a cost-effectiveness analysis of a smoking-cessation programme. They estimated four cost-utility ratios, each differing as to what costs and effects were included. These four ratios were assessed not only in terms of internal consistency but also in terms of the implicit underlying objectives and budget responsibilities of the decision-maker. Van Baal et al.[13] also addressed the difficulty of separating related and unrelated future costs and showed that the line between what is considered related and what is not becomes fuzzy and hazy, especially for primary prevention aimed at risk factors affecting many chronic diseases. More importantly, they pointed out that it is unclear why a distinction between related and unrelated medical costs would be relevant at all for a decision-maker trying to make optimal use of scarce healthcare resources. In the

7 We do not wish to dwell on this point here, but some have argued that since the utility measure (i.e., the QALY) in health economic evaluations is defined rather narrowly, one might argue that a more narrow consideration of costs would also be appropriate.[11,36]

8 The two other criteria are "*Exclude the costs of those resources that produce utility that is not being measured in the denominator, even though the costs are causally associated with the intervention*" and "*Include the costs of those resources consumed that are causally related to the intervention, but that have no countervailing utility gains.*" [11]

following section, we outline the four different strategies used to account for costs and effects in the analyses used by van Baal et al.[13] to highlight the importance of the current debates.

However, before doing so, a very recent paper deserves mention. Contrary to much of the recent literature, Lee[20] argued against inclusion of all unrelated future costs. His article followed directly on from the theoretical work of Garber and Phelps[9] and Meltzer[18]. Using Meltzer's model[18], but with a different budget constraint, Lee[20] reached the conclusion that unrelated medical costs should not be accounted for in economic evaluations. The debate in this area will surely continue,[45,46] if only because the budget constraint used by Lee[20], which is pivotal for reaching his conclusions, has been criticised before in the literature[47] and basically assumed that prolonging life is always associated with increasing income. Thus it avoids allocation decisions related to (increased) scarcity – the very reason to perform economic evaluations.[9] While this may be a reasonable assumption from the individual perspective, it is highly questionable whether it is also reasonable to assume this from a societal or healthcare perspective.

3.5 DIFFERENT COST-UTILITY RATIOS: AN EXAMPLE

Van Baal et al.[13] demonstrated the consequences of different practices of including costs and effects using an example of increased implementation of a smoking-cessation intervention.[48] They estimated the cost-effectiveness of a smoking-cessation programme in two scenarios, which only differed with regard to the age groups to which the intervention was offered: in scenario 1, smokers aged between 25 and 44 years were targeted; in scenario 2, smokers aged between 45 and 64 years were targeted. In both intervention scenarios, 25% of the smokers received minimal counselling by a GP and/or a GP's assistant in combination with nicotine replacement treatment for 1 year (see Silagy et al.[49] for more details). For ease of interpretation, non-medical costs and savings were excluded from the cost-utility ratios, adopting a healthcare perspective.[10] Related diseases were distinguished from unrelated diseases in that the intervention changed only the prognosis and/or the (age- and sex-specific) incidence rate of related diseases. This example considered a preventive intervention targeted at the risk factor 'smoking', thus only those diseases for which smoking was a risk (relative risk >1) were considered.

Table 3.1 presents the four cost-utility ratios related to the smoking-cessation intervention, as well as the appraisal by van Baal et al.[13] The appraisal of each cost-utility ratio is based on whether the ratio complies with the internal consistency criterion and whether it relates to a meaningful underlying decision-maker's problem. The latter is important since economic evaluations are intended to provide

9 As was pointed out by one of the anonymous reviewers of our article on which this chapter is based on, scarcity may also enter the equation via the use of utility functions including leisure.[18]

10 As mentioned previously (section 3.2), the issue of inclusion of unrelated medical costs is largely independent of the perspective adopted.

the decision-maker with a complete and helpful tool to guide decisions regarding resource allocation, in order to achieve objectives (e.g., maximisation of total health) given restraint resources.

TABLE 3.1 Overview of different cost-utility ratios and results of smoking-cessation intervention scenarios 1 and 2[13]

Cost-utility ratio	What does it include?	Formula	Result (€ per QALY)		Appraisal
			S1	S2	
1	Only intervention costs divided by all QALY gains	$\frac{Ci}{QALYr+QALYu}$	€3,500	€3,400	Inconsistent and incomplete
2	Intervention costs and related costs only divided by all QALY gains	$\frac{Ci+Cr}{QALYr+QALYu}$	€1,500	€900	Inconsistent and incomplete
3	Intervention costs and related costs only divided by QALY gains only attributable to related costs	$\frac{Ci+Cr}{QALYr-QALYu}$	€2,900	€1,900	Consistent but incomplete
4	Intervention costs, related costs, and unrelated costs divided by all QALY gains	$\frac{Ci+Cr+Cu}{QALYr+QALYu}$	€4,400	€6,600	Consistent and complete

Note. Intervention scenarios are compared with current practice: a combination of all current initiatives to stop smoking and willpower alone.
Ci= intervention costs; **Cr**= healthcare costs of medical care of related diseases; **Cu**= healthcare costs of medical care of unrelated diseases; **QALYr**= QALYs gained due to related diseases; **QALYu**= QALYs gained due to unrelated diseases; **S1**= intervention scenario 1; **S2**= intervention scenario 2.

The first cost-utility ratio in Table 3.1 is internally inconsistent because the numerator of the ratio only accounts for the intervention costs, while the projected effects in the denominator result from both related and unrelated medical care. Moreover, this ratio is incomplete and implies that the decision-maker aims to maximise health effects given a disease-specific budget constraint that only includes the costs of the intervention. This limitation is clearly not very realistic, since the ratio ignores both related and unrelated future medical costs associated with the intervention, while these would normally be accounted for when such a disease-specific budget is applied.

The second cost-utility ratio is also internally inconsistent. Costs of related medical care are now included together with the intervention costs, but possible costs incurred due to unrelated medical care in added life-years are ignored. However, the denominator comprises all future effects, due to both related and unrelated medical care. This practice is currently implicitly recommended in the Dutch guidelines[14] (as distinguishing effects from related care as opposed to unrelated care is uncommon and difficult). The fact that lower ratios were found for cost-utility ratio 2 compared with cost-utility ratio 1 can be explained by savings in terms of related costs (Cr) due to a lower incidence of smoking-related diseases (i.e., Cr in cost-utility ratio 2 is negative). In terms of the underlying budget allocation problem, this ratio is still fairly limited since the available budget is only intended for care

related to a specific disease, risk factor or preventive programme. Therefore, results from this ratio appear to be meaningful only for healthcare decision-makers with a very narrow focus.

In cost-utility ratio 3, the costs of the intervention and related medical care are included in the numerator, while the denominator contains only the QALY gains produced by the costs listed in the numerator (i.e., effects caused by unrelated medical spending in gained life-years are subtracted from the total gains). In absence of empirical data regarding exactly how unrelated medical care affects health, the assumption was made that 50% of the gains were attributable to related costs. This yielded cost-utility ratios of €2,900 and €1,900 per QALY gained for scenario 1 and 2, respectively.[11] Cost-utility ratio 3 is internally consistent, since only those effects that are a direct consequence of the included costs are considered. However, this approach requires knowledge on the length and QOL of patient groups when not receiving any unrelated medical care during gained life-years. Such knowledge is hard to come by and its informative value for the decision-maker has been questioned,[13] although in some instances such a breakdown might still be interesting (e.g., in the case of disease-specific budgets). More specifically, excluding health gains due to unrelated medical care in gained life-years from the objective function of a decision-maker seems rather nonsensical and, therefore, the underlying budget allocation problem of this ratio cannot be considered very meaningful.

Finally, the fourth cost-utility ratio is similar to the second ratio, except that now, besides the costs of the intervention and related medical care, the costs of unrelated medical care (Cu) are also included in the numerator. Although costs are saved because of a decrease in smoking-related diseases (so that Cr is negative), these savings are offset by Cu because of costs of unrelated medical care consumption in the gained life-years. As a consequence, the fourth cost-utility ratio yields the least favourable results. This ratio is not only internally consistent but also relates to a meaningful budget allocation problem since the denominator and objective function comprise the total health effects and the numerator and budget constraint consider all healthcare costs.[13]

The four cost-utility ratios highlight the different options to deal with related and unrelated future medical costs. It is not surprising that including all costs and effects in the cost-utility ratios as compared with only some costs and all effects results in a higher estimate of the costs per QALY gained. The reason for this is simple. Living longer brings about competing diseases that result in healthcare expenditures (which in turn yield health). Thus, when unrelated medical costs in life-years gained are included in the analysis, interventions aimed primarily at improving QOL become relatively attractive compared with life-prolonging interventions. Moreover, the smoking-cessation example showed that treatment among the younger group of smokers proved more cost-effective than treatment among the older group when costs of unrelated medical care were included. Van

11 Note that the percentage of QALYs gained attributable to unrelated medical care depends on both the intervention and population.[13] Varying this percentage from 25% to 75% resulted in ratios ranging from €5,800 to €1,900 per QALY gained in scenario 1 and from €3,700 to €1,200 per QALY gained in scenario 2.

Baal et al.[13] argued that this can be explained because, for the younger smokers, *"… the high costs of unrelated medical care occur farther away in the future and are, thus, more heavily discounted."* [12] Besides this example of a smoking-cessation intervention, several other studies have demonstrated empirically that the cost-effectiveness ratios significantly change when the costs of unrelated medical care are included.[50,51] Gyrd-Hansen et al.[50] concluded that including the costs of unrelated medical care – as a function of age – favours intervention among relatively younger groups. These findings suggest that different practices of accounting for costs and effects lead to significant differences in cost-effectiveness ratios. If we assume that the results of such economic evaluations are considered by healthcare policy makers in their decisions, the inclusion or exclusion of these costs may directly affect the allocation of healthcare resources.

3.6 TIME TO CHANGE THE GUIDELINES?

In summary of the above, we conclude that the dominant argument in the recent literature appears to be that unrelated future (medical) costs need to be included in economic evaluations of healthcare programmes. Therefore, it is immediately clear that most current economic evaluations do not give a full picture of the cost-effectiveness of healthcare interventions. While the controversy is not (yet) completely resolved,[20,45,46] it seems that a majority of recent papers[10,11,13,46] argue in favour of including these costs. From a decision-maker's viewpoint, would it not make perfect sense to look at all costs brought about by an intervention, directly and indirectly, knowing that the projected health effects would not be realised without incurring these costs?

In that context, two types of consistency are important in economic evaluations: (i) internal consistency as put forward by Nyman[11]; and (ii) what we will label *external consistency*. The former is clear: as long as the projections of gained QALYs (implicitly) incorporate normal medical care consumption during added life-years, it is inconsistent not to include the costs of this care consumption. While it is theoretically possible to produce cost-effectiveness estimates that exclude both the costs and the effects of this unrelated care, in practice it proves very difficult to accurately estimate health gains in absence of this unrelated care consumption. Van Baal et al.[13] had to make rather bold simplifying assumptions in order to estimate the health effects of the intervention without any further unrelated future care consumption. Equally important, the result of such an exercise is not very meaningful to decision-makers.[29] Therefore, the *external consistency* argument requires that the results of an economic evaluation address a meaningful decision-maker's budget allocation problem (i.e., are consistent with the problem addressed). Economic evaluations can only serve their purpose if that requirement is met. As van Baal et al.[13] argued, without using the term external consistency, only the fourth cost-utility ratio appears to satisfy both types of consistency.

12 In the smoking-cessation example, discounting was applied according to the recommendations in the Dutch guidelines for pharmacoeconomic research[14]: costs were discounted at a rate of 4%, while effects – in terms of QALYs – were discounted at 1.5%.

We therefore claim that the preferred ratio is that which includes both the unrelated costs and the associated projected health gains. In terms of consequences, ignoring costs of unrelated medical care in life-years gained improves the cost-effectiveness ratio of interventions such as smoking-cessation programmes that increase length of life relative to interventions that primarily increase QOL. When interventions are judged on the basis of their ICER, and a more or less fixed threshold is used as benchmark, including more costs may then cause an intervention to become a less likely candidate for funding. Moreover, when economic evidence is used to formulate more precise medical practice guidelines, including the costs of unrelated medical care can lead to other treatment profiles and to including or excluding certain age groups from treatment, as the smoking-cessation example[13] highlights. But note that *excluding* costs also has distributional consequences! Apart from this, systematic exclusion of unrelated medical costs does not necessarily enhance the comparability of economic evaluation results because "*The costs to include in a CUA [cost-utility analysis] … is often determined by the type of intervention and the target disease(s) of the intervention, because this determines what medical care is related*"[13], which can result in strange and arbitrary lines between related and unrelated medical care. Therefore, the matter is not trivial and a reconsideration regarding the exclusion of these costs seems warranted.

In view of the current debates in the literature, we feel that a strong case can be made for including unrelated future medical costs in gained life-years. The major problem in advocating this may perhaps be the practical issue of *how* to find reliable estimates of these costs. But not only do we agree with Meltzer and Johannesson[10] that a reasonable although imprecise estimate is better than an unreasonable estimate of precisely zero, the progress in this area allows more reasonable estimates to be made. Gandjour and Lauterbach[12] highlight the use of estimates of future medical care corrected for time to death in economic evaluations, and van Baal et al. (unpublished data) recently proposed a further refinement of these estimates. Moreover, a clear directive to start including these costs will undoubtedly increase developments in this area. In terms of standardisation and facilitation of inclusion, national institutes such as NICE in the UK or the National Healthcare Institute (ZiNL) can play an important role. For example, the Swedish LFN offers analysts assistance in this respect. Therefore, it seems timely to move forward by including these costs, whenever relevant, in economic evaluations of healthcare technologies, and to include recommendations for their inclusion in guidelines for economic evaluations.

We acknowledge that this raises the question of where to draw the line. Unsurprisingly, the article by Nyman[11] provoked a (new) round of debate regarding whether survivor non-medical costs (consumption and production) should also be included in an economic evaluation.[32-35] If a healthcare perspective is taken, these consumption and production costs are deemed irrelevant by definition, while the inclusion of future medical costs would still very much be relevant. This makes it relatively easy to advocate inclusion of these costs (without further debate) from a healthcare perspective.

However, from a societal perspective, matters are more complex. It has been convincingly argued that, from a welfare economic perspective, such survivor consumption costs should not be ignored. [18] Others have argued that the choice for a narrow (i.e., health-related) outcome measure on the outcome side, would also limit the costs to be included on the cost side of an analysis.[11,29,36] [13] The adoption of a complete societal perspective therefore requires capturing all other relevant costs and effects separately, including broader utility gains. It seems crucial to recognise the tension between the perspective of the decision-maker that the economic evaluation is designed to assist and the broad societal perspective. We would argue that, although the healthcare perspective may be a natural one from the viewpoint of a healthcare decision-maker, *"… completely losing sight of the societal perspective is undesirable as well."*[13] Ignoring certain costs or effects cannot only result in suboptimal allocation of resources, but it also seems unlikely that a healthcare decision-maker would want to be left completely ignorant of the non-healthcare consequences of his/her spending. Lifting such ignorance requires the calculation and reporting of different costs, but does not necessarily require the equal treatment of all costs.[13] Regardless, it seems inappropriate to exclude future medical costs from economic evaluations just because we have not yet resolved the question of whether non-medical costs should be included. This particularly holds since this controversy seems to be strongly related to the broader controversy regarding the appropriate perspective, which, one could say, is even at the heart of how we design our evaluations. For instance, even the choice of the narrow health-related utility outcomes appears a deliberate attempt to stay close to the perspective of the relevant decision-maker.[52]

Conclusions

The inclusion of unrelated medical costs in life-years gained in economic evaluations has long been controversial. However, there appears to be growing support for incorporating all future medical costs. While some controversy may remain, it must be noted that this also holds for many other cost categories (e.g., productivity costs) and methodologies (e.g., discounting). If we only included those things for which a complete consensus exists, it is likely that no economic evaluation would be performed. Strong theoretical arguments, regarding both optimality,[10,18] and internal and external consistency,[11,13] all point towards the inclusion of unrelated future medical costs. The practical possibilities for estimating these costs appropriately are also increasing (van Baal et al., unpublished data), facilitating their inclusion.

This is not a trivial issue, as the impact of including these costs can be substantial. Furthermore, inclusion is consistent with both a healthcare and a societal perspective. Good practice in economic evaluations is essential in order to provide policy makers with valuable and meaningful information about the relative efficiency of health technologies. It seems timely that the inclusion of unrelated

13 This issue is part of a broader discussion about the welfare theoretic foundation of QALYs, i.e. whether QALYs can be interpreted as utilities.[36]

medical costs in added life-years in economic evaluations, whenever relevant, should be the new standard. Guidelines should recommend including these costs rather than excluding them.

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Chapter 4

Lifestyle Intervention
From Cost Savings to Value for Money

Based on:
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4.1 INTRODUCTION

It has been suggested that preventive lifestyle interventions targeted at lifestyle-related risk factors, such as smoking and obesity, have the potential of not only increasing public health but at the same time lowering healthcare expenditures.[1,2] These suggestions have led some policy makers to embrace preventive lifestyle interventions. For instance, in the most recent US election campaign, the Obama Administration proposed an ambitious healthcare reform plan, in which prevention plays an important role: "*Devoting more of our healthcare funds to prevention will save tens of millions of dollars and improve millions of lives*".[3] Such expectations regarding prevention may importantly influence healthcare reforms, as was recently debated in the US context as well.[4-8]

An important problem then is, that although prevention may indeed increase the health of populations, these interventions, unfortunately, are, in general, unlikely to result in lower expenditures.[5,9] While preventive interventions may reduce illnesses and expenditures related to risk factors, especially when they successfully prolong life, they will increase illnesses and expenditures unrelated to those risk factors primarily in gained life-years. The costs of these unrelated illnesses have been demonstrated to outweigh the savings on related illnesses for the important risk factors of smoking and obesity.[10,11] In spite of this, the suggestion that prevention is cost saving remains persistent both in the academic field as well as in healthcare policy making. For many, it remains counterintuitive that a healthy lifestyle results in more rather than in less lifetime healthcare expenditures. This is problematic as it may result in inefficient use of healthcare resources based on overly optimistic assumptions regarding lower healthcare expenditures due to prevention, and thus may cause disappointment (among policy makers) when prevention fails to meet these expectations.

Unfortunately, current health economic evaluations, which are intended to inform decision-makers about the most optimal use of scarce healthcare resources, may strengthen these unfounded expectations regarding lifestyle intervention programmes, because they normally ignore the costs of unrelated illnesses in life-years gained in many jurisdictions including the UK[12] and the Netherlands[13], or leave inclusion up to the analyst's discretion in case of the US guidelines[14] and the WHO Guide to Cost-Effectiveness Analysis[15]. This results in too favourable estimations of cost-effectiveness of preventive measures prolonging life and indeed sometimes even in estimated cost savings.[16-18]

In order to improve this and create realistic expectations, it is important to judge preventive lifestyle interventions within the same framework as other healthcare interventions. In this chapter, we elaborate on this framework, thus shifting the focus from the question whether prevention should save money towards the proper question of whether prevention offers value for money. Indeed, preventive interventions do not necessarily have to alleviate the financial burden on healthcare systems in order to be eligible for funding, but rather, like other interventions, have to demonstrate good value for money.[19] Such a relatively favourable cost-effectiveness of preventive interventions

can only be asserted comprehensively when all associated costs are included in the analysis. Such assessments of all future healthcare costs and benefits will provide a better understanding of the true value for money provided by lifestyle interventions compared with curative interventions, which eventually should result in more optimal use of healthcare resources in terms of increasing social welfare and thus in better policy making.[20]

In this chapter, we highlight this topic further, focusing in particular on the issue of the inclusion of unrelated medical costs in life-years gained when asserting the cost-effectiveness of preventive interventions. (As discussed in chapter 2 of this thesis, note that this is only one of the pressing issues regarding the methodology of economic evaluations of healthcare interventions. Other controversies are discounting, the perspective to adopt for the analysis (usually healthcare perspective versus societal perspective) and related to that the incorporation of certain cost categories such as productivity costs, etc. Some of these issues may also influence cost-effectiveness ratios, in particular those of life-prolonging interventions. We will return to this briefly in the discussion of this chapter.) This topic is especially relevant here since excluding this cost category may strengthen the wide-spread yet mistaken impression that prevention is cost saving or, worse still, should be cost saving in order to be attractive. Since assessing value for money also requires attention for the value of preventive interventions, we will also briefly highlight some considerations regarding the value of health gained through preventive action.

4.2 COSTS OF PREVENTION AND PRIORITY SETTING

The prevalence of important risk factors, such as obesity and smoking, is still high, and, for the former, even increasing. It is generally acknowledged that these risk factors have a substantial impact on the general burden of disease, and there are no signs that this impact will attenuate in the near future. These risk factors thus cause illnesses, which in turn do not only reduce public health but also cause healthcare consumption, which translates into healthcare expenditures. Eliminating the risk factors would therefore avoid not only illnesses but also the related care consumption and expenditures. More health, less costs, therefore. The line of reasoning behind this suggestion is temptingly straightforward indeed.

Obesity and smoking, however, do not only cause morbidity but may also reduce life expectancy. Preventive interventions may thus reduce this risk of premature death caused by such risk factors and subsequently extend life. During these life-years gained, as a consequence of other, unrelated diseases, people may consume additional healthcare. To put it in the illustrative words of late former Dutch minister of health, Dr Els Borst: "*Dementia is something we witness in people of ages normally not reached by smokers and obese*". These additional expenditures due to unrelated diseases in these life-years gained may offset savings from avoiding risk factor-related diseases.[10,11,21] In the end, therefore, effective preventive interventions may increase rather than decrease healthcare costs.[5,10,11]

However, while the rhetoric underlying investments in prevention in some countries may prove to be false, the investments themselves may still be worthwhile. Prevention, like other care, does not have to be cost saving in order to be attractive.[22] Such a requirement would implicitly hold prevention "*to a higher standard of cost-effectiveness than other medical care*".[5] Prevention, however, may be a relatively cost-effective means of improving public health. In this respect it is important to reiterate the obvious: saving money is not the primary aim of healthcare.[23] Rather, the aim is to optimally enhance health with the available resources. Exclusively focusing on the input side of the balance between costs and benefits may be considered a rather restrictive view, "*as it ignores the value of the output of prevention and healthcare and may consequently lead to underinvestment in these areas*".[24] Effectively increasing healthcare expenditures while achieving something valuable, i.e. increased public health, can be completely rational.[19,24] There is no reason why this should not apply in case of preventive interventions. Thus, as Goetzel[25] succinctly puts it: "*Instead of debating whether prevention or treatment saves money, we should determine the most cost-effective ways to achieve improved population health*... ".

The most relevant policy implications of this assertion are twofold. First, prevention should not be primarily seen as a cost-containment tool and second, costs and benefits of preventive interventions need to be traded-off explicitly in common economic evaluations.[26] Economic evaluation, most commonly performed as a cost-utility analysis when evaluating healthcare interventions, is a useful way to identify the costs and consequences of different policy alternatives and compare them accordingly. In other words, economic evaluations demonstrate what value [in cost-utility analysis usually expressed as quality adjusted life-years (QALYs)] is produced for the money spent. The role of economic evaluation is therefore indispensible in the allocation of scarce healthcare resources. It would simply be impossible to set rational priorities when no insight is gained in the incremental costs and incremental benefits of a healthcare technology if the aim is to optimally improve health with available resources. Moreover, economic evaluation can also be helpful in deciding where in the chain of lifestyle and disease an intervention is most efficient. Hence the increased use of economic evaluation in the process of deciding on national public funding in many jurisdictions.

4.3 EVALUATING PREVENTIVE INTERVENTIONS

Evidence on cost-effectiveness of preventive measures is increasingly becoming available. More involvement of institutes such as NICE in the UK are helpful in this respect as they evaluate prevention as well as other types of healthcare in a similar decision framework. However, the fact that prevention may increase lifetime expenditures due to an increase of unrelated diseases in life-years gained is currently not adequately reflected in such evaluations, hampering good comparisons and decision-making. Preventive interventions may indeed offer good value for money when, for instance, judged against a threshold of some £20,000 to £30,000 per QALY like often mentioned in the UK setting.[27]

However, studies demonstrating this normally do not account for the costs of unrelated diseases in life-years gained. (Note that this is relevant for any life-prolonging intervention, preventive or curative.) For example, NICE recently investigated the cost-effectiveness of several smoking cessation interventions and concluded that many interventions result in cost savings.[28] This conclusion was reached, however, by ignoring the unrelated medical costs in life-years gained. If these costs would be included, the interventions may not be cost saving anymore, although, in spite of this, may still be considered worthwhile. (It is also important to realise that preventive interventions may have additional consequences from a societal perspective. Then, broader costs and effects should be considered as well. We return to this issue in the discussion of this chapter. Note that this point is completely independent of whether a societal perspective is adopted for the evaluation or a narrower healthcare perspective.)

Guidelines on pharmacoeconomic research play an influential role in how economic evaluations are performed, but differ in many aspects across jurisdictions, including regarding how to handle unrelated medical costs in life-years gained. Interestingly, both the NICE guidelines and for instance the Dutch guidelines for economic evaluations in fact *prescribe* ignoring these additional costs of unrelated diseases in life-years gained (without a clear motivation), while the US guidelines and the WHO Guide to Cost-Effectiveness Analysis leave this decision to the discretion of the analyst. These differences seem to reflect the different positions in the literature, with some authors strongly arguing against inclusion of these costs and others equally strongly advocating the opposite. Regarding the former position, for instance Russell[29], argued against the inclusion of unrelated medical costs in gained life-years because of the fact that an intervention should not be 'punished' simply because it is successful in prolonging life. She argued that in order to assert whether an intervention produces value for money, medical costs in life-years gained are irrelevant, just as expenditures for food, housing and clothing are irrelevant. (Note that the inclusion of these latter type of expenditures, also referred to as survivor consumption costs, is currently also an area of much debate.[30-34]) This argument was later also mentioned by the US Panel[14], but that Panel also provided arguments in favour of including future unrelated medical costs, which is indicative for the general lack of consensus on how to handle these costs (at that time). Garber and Phelps[35] showed that these costs can be excluded from an economic evaluation since their inclusion, under stringent assumptions, will not affect the relative rankings of interventions (and therefore decision-making will not be influenced). However, subsequently, it has been convincingly argued that the model and assumptions they used have rather serious limitations and will fail to reach optimal decisions.[14,16] Meltzer[16], using a more suitable model, convincingly demonstrated that excluding unrelated medical costs in life-years gained is at variance with lifetime utility maximisation. Another key argument in favour of including unrelated medical costs in life-years gained is that of *internal consistency*. Since the projections of the effects (gained QALYs) of prevention will often implicitly assume normal care use in life-years gained, it is inconsistent not to include the associated medical costs.[36] A recent overview of the literature indicates that majority of the more recent literature argues in favour of inclusion of the unrelated medical costs.[18]

It seems, therefore, that including unrelated medical costs in life-years gained is becoming the new standard, at least in the theoretical literature. The practical uptake of this dawning consensus obviously also requires the availability of sound estimates of additional medical expenditures in gained life-years. Fortunately, these practical difficulties in estimating and therefore including these future medical costs are increasingly being overcome, facilitating their inclusion.[20,37] Despite this, the guidelines of the Swedish Pharmaceutical Benefits Board are currently one of the few examples of guidelines advocating the inclusion of these future unrelated medical costs.[38]

In order to illustrate that prevention can still be an efficient way to produce health, in spite of the additional costs in life-years gained, Table 4.1 displays the cost-effectiveness ratios of four preventive interventions; two targeted at obesity and two promoting smoking cessation, both including and excluding unrelated medical costs in life-years gained.

TABLE 4.1 Cost-effectiveness (CE) ratios (costs per QALY)

Risk factor	Preventive intervention	True CE ratio	CE ratio (excluding costs unrelated medical care)
Obesity	Low calorie diet[47]	€17,900 or $24,340	€12,100 or $16,460
	Intensive lifestyle program[48]	€7,400 or $10,060	Cost saving
Smoking	Tobacco taxes increase[49]	€2,500 or $3,400	Cost saving
	Minimal counselling by GP (or GP assistant) in combination with nicotine replacement[17]	€4,400 or $5,980	€1,500 or $2,040

Note. Costs discounted at 4% and the effects discounted at 1.5%. Dollar price level 2009 (07/01/09: 1 euro = 1.36 dollars).

The – non-representative – examples in Table 4.1 are illustrative for the fact that excluding future unrelated medical costs alters the cost-effectiveness ratios, making them more favourable, and even cost saving for the tobacco tax increase and the intensive lifestyle programme for obesity. For other examples (not included in the table), excluding these costs may make a cost-ineffective programme seem cost-effective when judged against some fixed threshold. The cost-effectiveness ratios in Table 4.1 serve as a demonstration of what happens to the ratios when unrelated medical costs are either included or excluded and to indicate that prevention may still be an attractive investment, even when these future costs are accounted for.

The main point here is that, within a more common decision-making framework, it is not about whether an intervention saves money, but whether a preventive intervention produces value for money, i.e. whether it yields health gains at a reasonable price (that is, whether it is cost-effective), just like a curative intervention should produce value for money. In order to reach optimal decisions, one needs to be complete in assessing costs and effects. This implies that a, also and sometimes especially in the context of preventive interventions influential cost-category should not be omitted from an

economic evaluation. Moreover, it is worth noting that ignoring these additional future medical costs, which may, occasionally, result in prevention appearing to be cost saving as shown above, may strengthen the unfounded idea that prevention should save costs in order to be an attractive option. Therefore, the additional costs induced by successfully extending life should not be ignored. Only then, well-informed choices can be made between (curative and preventive) interventions. In such choices, besides the costs and the health gains, also the values of these health gains play a crucial role, as highlighted below.

4.4 THE VALUE OF PREVENTION

While cost-effectiveness ratios similar to those shown in Table 4.1 may normally be expected to be considered favourable by policy makers, this need not necessarily be the case with regard to preventive interventions. It has been noted that prevention appears to be judged more stringently than curative care.[5] This may also have to do with the value we attach to health gains created through prevention relative to that generated through curative interventions. Especially for health policy, it is important to have knowledge of such value judgments and sentiments. Not only may they be used in normative decisions regarding the funding of different programmes, but they may also (partly) explain why, in general, prevention is low on the priority list in many countries, given that only 3% of total healthcare spending on average in the OECD countries is targeted at prevention.[2] Obviously, one may also think of other reasons why spending on prevention is low. For example, policy makers may be rather short-sighted when setting priorities since they generally govern for only relatively short periods of time. Then, preventive interventions, which incur costs now while its effects may only become apparent in the future, can be an unattractive policy option when alternative (curative) solutions are available (even though at higher costs!).

First, prevention may be less appreciated simply because it falls short of the created expectation of being a cost saving solution. In that respect the unrealistic expectations, which may have been created to stimulate prevention, may now backfire. Second, preventive interventions are often targeted at statistical lives – lives of unidentified individuals who benefit from the intervention. As Jenni and Loewenstein[39] indicate "*society is willing to spend far more money to save the lives of identifiable victims than to save statistical victims*". And Dranove[40] similarly states: "*There is no reason to expect that the value of a statistical life would equal the value of an identified life*". This may be partly explained by the fact that withholding an identifiable person some treatment will have immediate and visible consequences, while this is normally not directly the case for statistical victims. Such preferences result in less priority for (primary) prevention. Third, preventive actions are targeted at people who are not (yet) sick. The urgency of such actions may be perceived as low, while for instance the 'rule of rescue'[41] emphasises the need to help those most urgently at risk of severe health loss. Society may be willing to devote more money to improve the health of someone in great and immediate need than of someone in lesser and

more distant need.[42] Fourth, the uncertainty surrounding the costs and effects of specific preventive interventions may be relatively large, since controlled trials may be difficult to perform, time horizons to observe final outcome may be relatively long and new intervention strategies may be developed over time. Finally, societal support for collectively funding preventive (lifestyle) interventions may be low, since lifestyle may be perceived to be individuals' own choice and responsibility and, therefore, the related health *and* cost consequences to be self-inflicted. This argument of culpability (whether or not considered to be applicable) may decrease the degree of solidarity society will show with the involved individuals. For some reason (perhaps related to the above-mentioned urgency and identifiability), this culpability question appears less relevant in case of curative care.

Whether or not the above-mentioned preferences and attitudes, some of which appear somewhat inconsistent or irrational, should be used in policy making is obviously open for debate, yet they may help to explain why prevention may be judged against a different threshold than curative care. If indeed a(n implicitly) lower value is, on average, attached to health gained via preventive interventions relative to curative interventions, this may also partly explain the focus on cost savings in this area.

4.5 DISCUSSION

Life-prolonging prevention is less likely to result in cost savings than often hoped, expected or even calculated, especially in the long run. It is important to stress this, since politically prevention is still sometimes seen as a means to reduce healthcare spending.[3] However, additional costs due to unrelated diseases in life-years gained in the long run may offset savings in related diseases in the shorter run. These additional costs are often ignored in policy making regarding prevention. While this may result in perhaps desirable investments in prevention, this may change when prevention does not result in the planned savings. If the expected savings are required to finance other healthcare (reforms), the consequences of the over-optimistic view on prevention may be far-reaching.[8] It is therefore unfortunate that also in most current economic evaluations of life-prolonging interventions the additional medical costs in gained life-years are largely ignored. Changing national guidelines for economic evaluations in this respect will result in more realistic estimations of cost-effectiveness of lifestyle prevention. Theoretical arguments warrant this amendment, while practical difficulties do not appear to inhibit inclusion of these costs.[18] An interesting area of research is the value of health gain in different contexts. If this is believed to be context dependent, the relative value of health gain through prevention also needs to be considered in order to completely judge whether prevention yields value for money.

It is important to note that the economic impact of preventive interventions is likely to vary across different jurisdictions. When only considering the impact on the healthcare sector, differences in healthcare financing systems between countries, among which the extent to which entitlements include coverage of different types of long-term care and social services, are obviously influential.

Also, the definition of healthcare costs used for estimating the cost consequences of an intervention may differ, leading to difficulties in comparisons between countries. A commonly used definition (internationally), is the OECD's System of Health Accounts (SHA). This definition of healthcare costs accounts for direct medical costs (diagnosis, treatment and nursing). However, some types of expenditures regarding long-term care or social care are excluded.[43] If prevention will prolong life and additional expenditures in these additional life-years are incurred, these are likely to be largely related to increased use of long-term care and social care.[44] Using the SHA definition may thus underestimate the costs of prevention, but if different definitions are used in different jurisdictions to account for differences in healthcare systems and financing, comparability of results is hampered and similar life-prolonging interventions may have different impacts across countries in terms of healthcare spending. (For example, in the Netherlands two additional definitions are used: the Dutch Health and Social Care Accounts used by Statistic Netherlands (CBS) and the Budgetary Scheme of Care used by the Dutch ministry of Health, Welfare and Sport. While the first definition is the most complete definition, also including several types of welfare costs, the latter is more restrictive.)

Comparisons may be even more difficult when also costs and savings beyond the healthcare sector are considered. In this chapter, we have discussed an important controversy regarding the methodology of economic evaluation of healthcare interventions, i.e. the inclusion of unrelated medical costs in gained life-years. Other major issues in this context, with clear relevance to the current debate, are, for instance, the perspective to adopt for the analysis and what discount rate to apply for future costs and, especially, effects.

The choice of perspective largely determines which costs and effects to include in an economic evaluation. A broad societal perspective normally takes into account all relevant – medical and non-medical, within and outside the healthcare sector – costs and all relevant effects of an intervention. In contrast, a more restrictive healthcare perspective in general focuses purely on those costs falling on the healthcare budget. In case of the latter perspective, some cost categories, such as costs of informal care, and productivity costs, are excluded from the analysis.[14,26] Although from a healthcare decision-maker's point of view one may argue in favour of adopting the narrower perspective, from a welfare economic viewpoint a broad perspective including all relevant societal costs and effects is normally advocated. The choice of perspective may influence the analysis of preventive interventions in several ways. Prevention may for instance sometimes be initiated and funded in other sectors than the healthcare sector, e.g. the education sector. Moreover, some lifestyle interventions may

require much time-input from the participants, which represents real societal but not healthcare costs. Performing economic evaluations from another (i.e., more restrictive) perspective than the societal one, may thus underestimate the societal costs associated to such interventions. Moreover, life-prolonging programmes may cause other, societal costs and savings related to the consumption and productivity level of an individual. Healthy ageing populations may result in additional societal savings in terms of increased productivity, less need for informal care or social services, and the delay of pension age and so on.

On the other hand, additional societal costs should also be considered, such as survivor consumption costs, such as those related to housing, clothing and food.[16] How these different (societal) cost categories will influence the evaluation of life-prolonging interventions should be investigated. If a healthcare perspective is adopted (like for example is currently prescribed in the UK[12]), such broader consequences are usually ignored, as falling outside the scope of the analysis. Note that the issue of how to handle unrelated medical costs in life-years gained is relevant in both perspectives.

The issue of discounting is also of particular interest for the economic evaluation of prevention. Although discounting of future costs and effects in economic evaluations of healthcare is widely accepted and standard practice, it remains an area of much controversy. Not only does the height of the discount rates for costs and effects differ between countries, there is also a continuing debate about whether costs and effects should be discounted at the same rate. Setting specific discounting rules may have a profound effect on the final cost-effectiveness ratios, especially for interventions that incur immediate costs and future health benefits, such as prevention.[45] In general, using higher discount rates for health effects (that is, attaching lower weight to future health) will worsen the cost-effectiveness ratios of interventions, especially those interventions that incur current costs and distant effects (like some types of prevention). It is more recently advocated that attaching more weight to future health effects (thus using a lower discount rate for health effects), which may substantially improve the cost-effectiveness of preventive interventions, may be justified in order to account for the growing value of health gains over time.[45]

Clearly, some of the methodological choices we have to make in order to perform economic evaluations of healthcare technologies may have important consequences for healthcare decision-making, especially regarding interventions that extend life more than increase quality of life. However, the main objective of this chapter was not to discuss the consequences of methodological choices in general, but to focus on the realistic expectations and calculations of the costs and savings related to life-prolonging interventions and a fair judgment of these interventions. Prevention, in that respect, should be evaluated within the same framework as other curative interventions, implying a focus on value for money. Ignoring certain, obviously relevant, cost categories without any justification may mislead healthcare policy makers and result in non-optimal allocation of resources, both from a

healthcare and a societal perspective. As the examples mentioned in this chapter show, prevention still may offer (very) good value for money, even when accounting for unrelated medical costs in life-years gained, justifying the claim of the WHO that "*governments, in their stewardship role for better health, need to invest heavily in risk prevention, in order to contribute substantially to future avoidable mortality*".[46]

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Chapter 5

Healthcare Costs and Obesity Prevention

Drug Costs and Other Sector-Specific Consequences

Based on:

Rappange DR, Brouwer WBF, Hoogenveen RT, van Baal PHM. Healthcare costs and obesity prevention: Drug costs and other sector-specific consequences. ***PharmacoEconomics.*** *2009; 27: 1031-44*

5.1 INTRODUCTION

The increasing prevalence of obesity has become a public health issue in many countries.[1,2] With around 1.5 billion adults worldwide being either overweight or obese and increasing prevalence rates among children,[3,4] current and future attention to this problem is unsurprising. Especially since obesity has been found to cause coronary heart disease, hypertension, type 2 diabetes mellitus and certain types of cancer, therefore affecting the overall burden of disease and disability (and associated premature death).[5-9] While the development and implementation of effective strategies to reduce the disease burden associated with obesity is clearly desirable from the perspective of public health, it has also repeatedly been suggested that this would also improve the financial sustainability of national healthcare systems.[10]

Indeed, considerable economic costs are associated with obesity, and several studies have reported costs projections related to obesity concluding that obesity causes high medical expenditures. These findings suggest that preventing obesity, e.g. through lifestyle interventions, may not only lower the overall burden of disease, but at the same time decrease total healthcare expenditures.[11,12] In an era where the ageing of populations and increasing longevity already pose additional challenges to the sustainability of healthcare systems, this may sound like good news indeed. Recently, however, van Baal et al.[13] demonstrated that effective prevention of obesity may result in higher rather than lower lifetime medical costs. The savings due to preventing obesity-related diseases are offset in the long run by the additional costs of unrelated illness, especially in gained life-years.[1] Many of the studies that report the opposite did not apply a lifetime perspective, excluding the unrelated medical costs in life-years gained from their cost projections.[2] Therefore, as has previously been demonstrated for smoking,[17,18] obesity prevention may eventually increase total healthcare expenditures (although this may clearly still be worthwhile given the health benefits).[3]

As related and unrelated illnesses may be different in nature and in possible treatments, prevention strategies may not only affect the magnitude of future healthcare costs, but also the distribution of costs over different healthcare segments. Understanding this interaction is important, especially for the planning and financing of healthcare systems. Preventing obesity will most likely result in short-term savings in the curative sector due to a lower prevalence of obesity-related morbidity. Successful preventive strategies may reduce obesity-related morbidity but also increase longevity and the prevalence of unrelated diseases. This may influence the total amount of medical expenditures as well

1 This implies that obesity affects both morbidity and mortality. While there is some debate about whether this is also true for the latter, much evidence suggests that obesity may indeed affect life expectancy negatively, especially among younger adults.[6,8,14-16]

2 One study that does use a lifetime approach similar to the one followed by van Baal et al.[13] is the previously mentioned study by Allison et al.[11] These authors concluded that obesity prevention may lead to cost savings. Van Baal et al.[13] offer several possible explanations for their different findings.

3 It is important to note that prevention may sometimes increase total healthcare expenditure due to an increase of related medical costs that are induced in life-years gained alone.[19]

as the type of healthcare services needed. Indeed, "*elderly persons use healthcare services at a greater rate than younger persons*" and "*the effects of longevity on expenditures for acute care differ from its effect on expenditures for long-term care*".[20] Thus, changes in lifestyle may change future healthcare costs projections, not only at a total cost level, but also for the different segments of the healthcare sector.

As in other countries, obesity (prevention) may have important consequences for the Dutch healthcare financing system.[21] The Dutch healthcare system consists of three compartments covering different types of healthcare services. The entitlements in the first two compartments, which together "*offer all members of the public adequate cover against medical expenses*",[22] are laid down in two mandatory insurance schemes which are regulated differently. Long-term nursing care, home care and psychiatric care are covered in the first compartment which is regulated by the government at a regional level under the Exceptional Medical Expenses Act (AWBZ) "*under a regime of price and supply regulation*".[23] [4] GP care, pharmaceuticals and hospital care are all covered in the second compartment, which basically comprises all insurable, curative care regulated under the Health Insurance Act (ZVW). This latter scheme for curative care is based on regulated competition among private health insurers.[22,24] [5] Therefore, a substitution from one compartment to another compartment may have important distributional consequences among insurance schemes. Moreover, such a shift may prove to be even relatively more problematic if it is directed towards the first compartment, since possibilities of labour-saving technologies or increases in labour productivity are especially restricted in the area of long-term nursing and care, while a shortage of personnel is foreseen.[25]

In this chapter, using a cohort approach based on Dutch empirical data, we use a similar but extended version of the model used by van Baal et al.[13] to calculate annual and lifetime medical cost differences between obese and 'healthy-living' people (as well as smokers as an additional reference case). We focus on how prevention of obesity influences the breakdown of the medical costs into different segments and cost categories, especially highlighting the consequences of preventing obesity for lifetime spending on pharmaceuticals. Prior studies have mainly focused on the consequences of weight loss (interventions) on pharmaceutical expenses.[26-29] However, less is known about the (lifetime) sector-specific cost consequences of obesity *prevention*. Since obese people use more obesity-related pharmaceuticals than people with normal weight, one may expect initial savings on drugs. In contrast, people with normal weight probably live longer and may therefore induce additional drug costs for diseases such as Alzheimer's in additional life-years (with respect to obese people). Whether preventing obesity will result in cost savings in the drug segment may therefore importantly depend on how the savings on drugs for obesity-related diseases on the one hand relate to the additional drug costs in life-years gained on the other.

4 Note that the Long-Term Care Act (Wlz) replaced the Exceptional Medical Expenses Act (AWBZ) as of January 1, 2015.

5 Consumers may buy supplementary healthcare insurance from private health insurers for care that is not covered by either of the two Acts, i.e. care that is covered in the third compartment (e.g., cosmetic surgery and physiotherapy).

5.2 METHODS

In order to estimate the effects of obesity prevention on the annual and lifetime healthcare costs in different segments, in particular the pharmaceutical sector, the Chronic Disease Model (CDM) developed by the Dutch National Institute for Public Health and the Environment (RIVM) was used in combination with Dutch empirical data from a Cost of Illness (COI) study from 2003.[21] We briefly discuss the methods and input data used. For a more in-depth explanation of the RIVM CDM, we refer to Hoogenveen et al.[30] and van Baal et al.[31]

The National Institute for Public Health and the Environment Chronic Disease Model

The CDM is a Markov-type, multistate, transition model that describes the life course of different, hypothetical cohorts in terms of disease prevalence numbers, as well as mortality rates.[6] In this chapter we used two risk factors, obesity and smoking, to simulate incidence and prevalence rates of 22 risk factor-related chronic diseases, such as acute myocardial infarction, chronic heart failure, diabetes and different types of cancer. The risk factors and chronic diseases are linked by relative risks that are based on a wide range of international epidemiological studies. The prevalence of any chronic disease then determines the mortality risk (having a disease increases the risk of death) and thus the life expectancy.[7] Moreover, mortality may also be a direct consequence of risk factor-related diseases that are not explicitly included in the model.[13]

We used a cohort analysis to estimate the disease prevalence and mortality rates of obese people and compare these numbers with healthy people and smokers. Three different cohorts are distinguished: an 'obese' cohort, a 'smoking' cohort and a 'healthy-living' cohort. All cohorts consist of 500 men and 500 women who initially are all aged 20 years. The obese cohort consists of men and women who have a body mass index (BMI) ≥30 kg/m^2 and who have never smoked (and will never smoke).[8] BMI is an internationally commonly used indicator of body weight (i.e., weight-for-height index expressed in kg/m^2). The WHO broadly recognises four categories for adults according to predefined cut-off points: a BMI <18.5 kg/m^2 is used to classify 'underweight'; a person has 'normal weight' when his or her BMI ranges between 18.5 and 25 kg/m^2; a BMI ≥25 kg/m^2 indicates 'overweight' and a BMI ≥30 kg/m^2 is used to categorise 'obesity'.[34] The two reference cohorts that allow for disease prevalence and mortality rate comparisons are, first, a cohort consisting of people who are non-smokers and have a normal BMI (i.e., between 18.5 and 25 kg/m^2) [the 'healthy-living' cohort] and, second, a 'smoking' cohort of individuals with normal weight but who smoke throughout their entire lives. Furthermore,

6 Among other things, the CDM has previously been used for projections of risk factors and disease prevalence rates, and cost-effectiveness analyses.[32,33]

7 For example, smoking increases the chance of getting lung cancer, which subsequently increases the risk of dying. As a consequence, the life expectancy of smokers in the model is lower than the life expectancy of non-smokers.

8 The obese cohort is modelled as non-smokers to facilitate a clear interpretation of the substitution of diseases and its associated costs. Moreover, due to interactions between both risk factors with regard to mortality, it would pose additional data demands.

all cohorts are closed, meaning that there are no transitions among different cohorts (an obese person will never enter the 'healthy-living' cohort). Simulation of the cohorts proceeded for 100 simulations of one year until no survivors were left in any of the cohorts (i.e., nobody reached the age of 120 years). The CDM thus provides survival and prevalence numbers for diseases related to obesity and smoking. The prevalence of diseases unrelated to both risk factors (e.g., dementia) is considered equal for all cohorts. Therefore, prevalence numbers of such diseases will only depend on the number of survivors in each of the cohorts.

Cost of Illness Study

Linking the disease prevalence rates and cohort sizes to the healthcare costs per disease per patient divided per healthcare sector will result in estimations of annual and lifetime healthcare costs for different sectors of the three different cohorts. COI data from the Netherlands for 2003 were used to estimate these healthcare expenditures for the different cohorts.[21,35] This COI study is a product of a collaboration of the center for Public Health Forecasting of the RIVM and the Erasmus University Medical Centre and Statistics Netherlands (CBS) and builds on previous editions of COI studies in the Netherlands. Specific methodologies for and previous results from these COI studies have been discussed elsewhere.[35,36]

These data can provide an overview of the total healthcare costs and related welfare expenditures in a specific year. Costs can be broken down according to disease, age and sex. Using such a top-down approach avoids any double counting and, therefore, cost estimates are both comprehensive and mutually exclusive. Furthermore, costs can be ordered according to the main categories (i.e., diagnosis groups) of the ninth version of the WHO's International Classification of Diseases, Injuries and Causes of Death (ICD)[37] and further allocated to specific diseases. Beside this, costs can also be allocated to a wide range of more general categories, such as 'sector' (based on groups of healthcare providers), 'all other infectious diseases' and 'not disease-related expenditure'.

Which costs are to be included in the cost estimations depends on the definition of care used. In this study, we used the Organization for Economic Cooperation and Development (OECD) System of Health Accounts (SHA), which focuses exclusively on healthcare costs as a consequence of direct medical care (diagnosis, treatment and nursing) and enables international comparisons.[38] [9] It is important to note that the SHA does not include some specific types of care allocated to the long-term care function, such as costs of home care.[21] As such, the costs related to long-term care and, therefore, ageing, are underestimated. The segments used are those identifiable in the Dutch healthcare system. One feature especially relevant for the current study is that drugs used within the hospital are labelled

9 Other definitions of healthcare costs available in the Netherlands are the Dutch Health and Social Care Accounts used by Statistic Netherlands (CBS) and the Budgetary Scheme of Care used by the Dutch ministry of Health, Welfare and Sport. The first definition takes the broadest, societal perspective including some welfare costs and for example costs of housing and day nursery, while the latter includes costs that fall under the ministerial responsibility.

as 'hospital costs', as they largely fall under the hospital budget in the Netherlands. We address this issue further in the discussion of this chapter.

Analysis

In this chapter, we particularly focus on the costs of the four largest sectors: 'medicines and medical appliances', 'hospitals', 'long-term care' and 'primary healthcare'. The CDM thus describes the prevalence numbers for 22 chronic diseases (specified by age and sex) related to obesity and/or smoking. Costs for the different cohorts are estimated by multiplying these prevalence numbers by the costs per patient per sector (also specified by age and sex). Diseases that are unrelated to obesity or smoking, such as dementia, are all included in a rest category. To calculate the costs of this rest category, the total costs per person per sector are deducted by the sum of the related costs of the 22 chronic related diseases per person per sector. This cost of the unrelated diseases is multiplied by the number of survivors for each cohort. The total costs per sector for the cohorts are calculated by adding the separate costs for all diseases (related) and the rest category (unrelated diseases). This allows comparisons of the annual and lifetime healthcare costs – the latter is obtained by summing the annual costs up over time – of the three different cohorts and estimating the consequences, in terms of costs for the different healthcare sectors, of eradicating obesity from the population.[10]

Discounting

In order to assert whether preventing obesity results in cost savings in the pharmaceutical segment or any of the other major healthcare segments, we have to convert all the costs and benefits over time to the net present value. For this purpose, we discounted all costs and savings at a discount rate of 4%, which is in accordance with the Dutch national guidelines.[39] To allow for international comparisons[11] we also calculated cumulative differences in healthcare costs between the obese cohort and 'healthy-living' individuals employing different discount rates, including discount rates of 0%, 3% and 5%.

Sensitivity analyses

As the application of the RIVM CDM and the COI data require making various assumptions regarding key model input values and choosing between different definitions of healthcare costs (which may importantly influence the results), van Baal et al.[13] conducted several additional analyses. In this chapter, we also performed sensitivity analyses using similar starting points to van Baal et al.[13] which we deemed especially relevant for our study.

10 Note that we focus here on the consequences of prevention for healthcare costs, not on the costs of prevention itself. Therefore, we assume that the preventive intervention that would lead to this eradication (i.e., completely preventing obesity), is costless. Obviously, such interventions are hard to come by.

11 Discount rates for costs differ for different jurisdictions and national guidelines for pharmacoeconomic research. Discount rates usually range from 3% to 5%, although sensitivity analyses including discount rates from 0% to 6% are largely prescribed.[40-42]

First, we estimated the healthcare costs using the Dutch Health and Social Care Accounts healthcare costs definition (from Statistic Netherlands). This definition is broader than the SHA used in our base-case analyses and also comprises many types of social care, including care for the disabled, home care and day nursery. In the study by van Baal et al.[13] the adoption of this broader definition had the biggest impact on their results – it increased the healthcare costs for all cohorts and also the relative differences between the three cohorts substantially. In our study, therefore, we expect this analysis to be especially relevant for the effects on the long-term care sector.

Second, no consensus has been reached regarding the exact association between BMI levels and risk of death. Variation in mortality risks for higher levels of obesity has been observed among several studies.[43,44] As we do not distinguish between levels of obesity (above a BMI of 30 kg/m^2, relative mortality risks remain equal for all levels of obesity) and thus do not account for this variation in mortality rates, our lifetime medical costs estimates may be biased. Therefore, we examined the impact of varying the relative mortality risk associated to different levels of obesity. For this purpose and in line with van Baal et al.[13] we used the relative mortality risks from Flegal et al.[44] who used follow-up data from the series of National (US) Health and Nutrition Examination Surveys (NHANES). Flegal et al.[44] reported lower relative mortality risks for higher levels of BMI than cited in the international literature[45-47] (and used here). The input of these relative mortality risks into our model may influence the results for the obese cohort with regard to lifetime healthcare costs (as a consequence of lower mortality rates), which was also the case in van Baal et al.[13] In two separate scenarios, we applied the relative risk of mortality as reported in Flegal et al.[44], first, the relative risk of mortality for BMI levels between 30 and 35 kg/m^2 and second, for BMI levels ≥35 kg/m^2.

5.3 RESULTS

Life expectancy

Life expectancies differ for the three different cohorts. Starting with 1,000 people within each cohort, differences in mortality are negligible in the first 20 years. The main reason for this is that harmful effects of risk factors such as obesity and smoking predominantly effect mortality rates in the long run (in contrast to quality of life effects, which may also occur immediately). After 60 years (at the age of 80 years), 736 persons are still alive in the 'healthy-living' cohort as apposed to 483 persons in the smoking cohort. The smoking cohort is the first cohort to become extinct while the 'healthy-living' cohort is the last to lose all its members. Remaining life expectancies at the starting age of 20 years are thus longest for the 'healthy-living' cohort (64.4 years), followed by the obese cohort (59.9 years) and the smoking cohort (57.4 years).

Annual healthcare costs

Figure 5.1a shows the average additional annual costs of an obese person compared with a 'healthy-living' person, conditionally upon survival. An obese person incurs higher medical costs for each of the healthcare segments than a person in the 'healthy-living' cohort, at all ages. However, the size of the differences in annual medical costs incurred by an obese and a 'healthy-living' individual differs significantly between healthcare sectors, the most notable difference being the annual hospital costs. To account for the differences in spending between healthcare sectors, Figure 5.1b displays the annual cost ratio between the obese and 'healthy-living' cohorts. This lower panel shows that obesity has, relatively, the largest impact on medication spending. Between the ages of 30 and 40 years, an obese person spends, on average, 25% more on drugs than a 'healthy-living' individual.

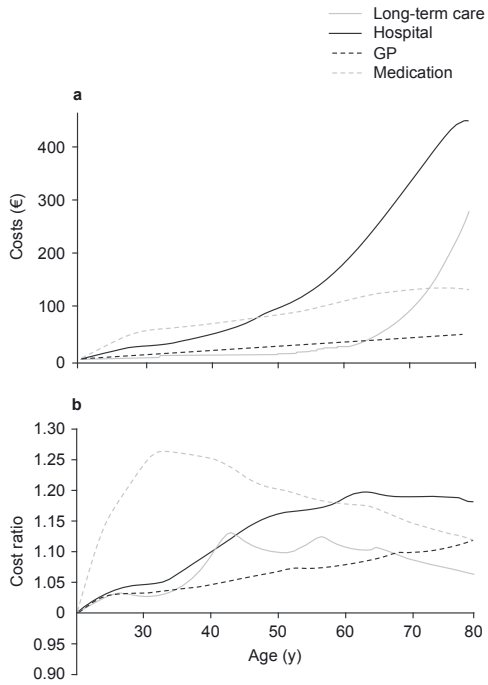

FIGURE 5.1 Average additional annual costs (**a**) and cost ratio (**b**), according to healthcare sector, for an obese person compared with a 'healthy-living' person (€, year 2003 values)

Expected lifetime medical costs

Table 5.1 describes the results of the average expected lifetime costs, specified for each of the four healthcare sectors, per obese person, 'healthy-living' person and smoker. Furthermore, costs are divided into two parts: those costs attributable to obesity and smoking-related diseases, and costs attributable to other, unrelated diseases that occur in life-years gained. Summing up the costs for all

risk factor-related diseases suggests that obese individuals are most expensive and 'healthy-living' people most inexpensive. The obese cohort incurs the highest related healthcare costs within all sectors, except for long-term care. Drug spending for obesity-related diseases for an obese individual is on average €9,200, compared with €7,200 and €5,200 for a smoker and a 'healthy-living' individual, respectively. For diseases other than those related to obesity and smoking, costs – which are much higher than costs attributable to obesity and smoking-related diseases – are highest for the 'healthy-living' cohort, especially due to large differences in costs for long-term care. Average pharmaceutical expenditures per capita differ among cohorts: €26,300 for the obese cohort, compared with €24,300 and €29,800 for the smoking and 'healthy-living' cohorts, respectively. As shown in Table 5.1, total expenditure on medication and medical appliances are thus highest for the obese cohort. Total lifetime medical costs (summing all the segments up) are, on average, highest for a person in the 'healthy-living' cohort (€281,000) followed by a person in the obese cohort (€250,000) and smoking cohort (€220,000). The main reason for this is the difference in life expectancies among the different cohorts. The costs incurred in these additional life-years, in particular the costs for long-term care caused by diseases unrelated to obesity and smoking, are the foremost contributors to the cost differences between the three cohorts.

TABLE 5.1 Expected lifetime medical costs per person (€ x 1,000, year 2003 values) at 20 years of age for the three cohorts, categorised by sector

Sector	Total healthcare costs (all diseases)								
	'Healthy-living' cohort			Obese cohort			Smoking cohort		
	Related diseases	Unrelated diseases	**Total**	Related diseases	Unrelated diseases	**Total**	Related diseases	Unrelated diseases	**Total**
Long-term care	16	85	**101**	14	58	**72**	12	42	**54**
Hospital	19	49	**68**	24	44	**68**	23	40	**64**
GP	3	20	**23**	4	19	**23**	3	18	**21**
Medication	5	30	**35**	9	26	**36**	7	24	**32**
Other[a]	3	51	**54**	4	48	**51**	3	46	**49**
Total	**46**	**235**	**281**	**55**	**195**	**250**	**48**	**172**	**220**

Note. Minor discrepancies with some of the totals may exist due to rounding off the cost estimates of the specific sectors.
[a] Includes the costs from all other sectors than the four explicitly listed in the table.

Obesity prevention and healthcare costs

To analyse how prevention of obesity might influence the breakdown of the medical costs into different segments and cost categories, we used the differences in lifetime healthcare costs between the obese and 'healthy-living' cohorts. We assumed that the preventive strategy that would lead to this conversion (the obese cohort becomes the 'healthy-living' cohort) is costless. Figure 5.2 shows the cost differences for each of the four cost categories for the entire period (100 years) between the 'healthy-living' and obese cohorts. Future costs were discounted at 4%.

Figure 5.2 shows that during approximately the first 50 years, converting obese people into 'healthy-living' people will save costs in all segments (i.e., the four main segments) of the healthcare sector. The reason for this is that healthy people have lower disease incidence rates related to obesity and thus lower related medical costs. The largest savings occur in the pharmaceutical and hospital segments. Savings in the medication segment are mainly a consequence of reduced medication and medical appliances expenditures for diabetes, osteoarthritis and low-back pain. After this period, a different picture emerges. Preventing obesity results in the incurrence of additional costs in life-years gained in all healthcare segments, in particular in the long-term care sector. It also becomes immediately clear that the costs of long-term care explain that preventing obesity may increase rather than decrease healthcare costs.

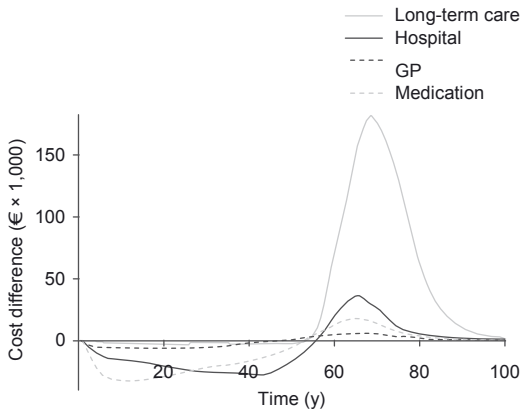

FIGURE 5.2 Difference in lifetime costs between the 'healthy-living' and obese cohorts, categorised by healthcare sector (year 2003 values)

From the age of 74 years, drug spending is higher for the 'healthy-living' cohort than the obese cohort because of increased costs related to diseases such as Alzheimer's and other diseases incurred in life-years gained. Despite this, lifetime expenditures on pharmaceuticals are lower when obesity is prevented – the cumulative difference in costs of pharmaceuticals between the obese cohort and the 'healthy-living' cohort is almost €1 million. Apparently, the savings on drugs for obesity-related diseases outweigh the additional costs for other diseases in life-years gained. Thus, successfully preventing obesity may result in cost savings in the short-term, which would apply for all healthcare segments, but in additional expenditures in the long-term, which sometimes outweigh the short-term savings. However, the medication segment (and the hospital segment, to a very small extent), will incur lower lifetime costs when obesity is successfully prevented, at the expense of higher costs elsewhere.

Discounting

The costs in Figure 5.2 are discounted at a rate of 4%. The discount rate may importantly determine whether or not the short-term savings, which are the result of converting the obese cohort into the 'healthy-living' cohort, are outweighed by the additional costs incurred in the long run, i.e. whether or not preventing obesity will save costs in any of the healthcare segments. Table 5.2 presents the estimates for cumulative differences in healthcare costs if obesity is successfully prevented, using different discount rates. Not discounting will especially affect the cumulative long-term care expenditures, resulting in a €29 million difference in costs in that segment between the obese and 'healthy-living' cohorts. Applying a discount rate of 6% would reduce these additional expenditures to zero! The reason for this is that although preventing obesity will primarily increase the costs within the long-term care segment compared with the costs in the other segments, these costs are most likely to be incurred predominantly during the life-years gained, i.e. in the far future (after 50 years). Thus, if intervention costs are fixed, applying a higher discount rate for additional future costs due to obesity prevention will result in a reduction of total costs. This would make obesity prevention a more attractive strategy in terms of net present value (i.e., net present costs), even for the long-term care segment. For the medication and medical appliances segment and the two other healthcare segments, the choice of the discount rate seems to be of rather limited importance. In case of pharmaceuticals, obesity prevention will – regardless of the discount rate – always result in a reduction of lifetime costs.

TABLE 5.2 Net present value differences of lifetime costs between the obese and 'healthy-living' cohorts, specified by discount rate for costs (€ x 1 million, year 2003 values)

Sector	0%	1%	2%	3%	4%	5%	6%
Long-term care	29	14	7	4	2	2	0
Hospital	0	-1	-1	-1	-1	-1	-1
GP	0	0	0	0	0	0	0
Medication	-1	-1	-1	-1	-1	-1	-1
Other	2	1	1	0	0	0	0

Sensitivity analyses

The results of the sensitivity analyses are shown in Table 5.3. In scenario 1 (using the broader definition of healthcare costs from Statistic Netherlands: the Dutch Health and Social Care Accounts healthcare costs definition), absolute estimates of expected lifetime long-term care costs per person increase (almost by a factor of 2) for all cohorts, while costs in the other segments remain unaltered. Absolute cost differences for long-term care also increase between cohorts. Applying this broader definition of healthcare costs would make obesity prevention even less favourable (in terms of lifetime medical costs).

TABLE 5.3 Expected lifetime healthcare costs per person: results of sensitivity analyses (€ x 1,000, year 2003 values)

Scenario	Sector	'Healthy-living' cohort	Obese cohort	Smoking cohort
Base-case scenario	Long-term care	101	72	54
	Hospital	68	68	64
	GP	23	23	21
	Medication	35	36	32
	Other	54	51	49
	Total	**281**	**250**	**220**
Scenario 1 (broader definition of healthcare costs)	Long-term care	198	141	105
	Hospital	68	68	64
	GP	23	23	21
	Medication	35	36	32
	Other	54	51	49
	Total	**378**	**318**	**271**
Scenario 2 (relative mortality risks for the obese cohort based on NHANES 30≤ BMI<35 kg/m^2)	Long-term care	98	82	51
	Hospital	67	72	62
	GP	23	24	21
	Medication	34	37	31
	Other	53	53	48
	Total	**275**	**267**	**212**
Scenario 3 (relative mortality risks for the obese cohort based on NHANES BMI ≥ 35 kg/m^2)	Long-term care	99	78	52
	Hospital	67	69	63
	GP	23	23	21
	Medication	35	36	31
	Other	53	52	49
	Total	**277**	**258**	**216**

Note. Minor discrepancies with some of the totals may exist due to rounding off the cost estimates of the specific sectors.
BMI = body mass index; **NHANES** = National Health and Nutrition Examination Survey.

For the second additional analysis, we used the relative mortality risks for BMI levels between 30 and 35 kg/m^2 as reported by Flegal et al.[44] who used data from NHANES – which are lower then used in our base-case scenario – as input values. Clearly, lower relative mortality rates for higher BMI levels will extend the life expectancy of the obese. This increases the difference regarding drug expenditures between obese and 'healthy-living' individuals. Moreover, it attenuates the differences in long-term care expenditures between the obese and 'healthy-living' cohorts (reducing the long-term care estimates for the latter, while increasing the long-term care costs for the former), but it slightly widens the gap for the hospital and GP segments (with higher expenditures for the obese cohort). In terms of total expenditures, applying lower relative mortality risks allows the obese people to incur more healthcare costs (as they live longer), which attenuates the differences in lifetime expenditures between the obese and 'healthy-living' cohorts. Preventing obesity will then be a relatively more attractive option – in terms of costs – with respect to the base-case scenario.

An almost similar pattern (but less pronounced) is shown in scenario 3 (relative mortality risks for the obese cohort based on NHANES BMI ≥35 kg/m^2). However, in this case, pharmaceutical expenditures are similar to our base-case analyses.

5.4 DISCUSSION

In this study, we used a Markov-type modelling approach to examine the consequences of obesity prevention for spending on pharmaceuticals and three other main Dutch healthcare segments, i.e. hospitals, long-term care and primary healthcare. We linked the RIVM CDM to cost figures from the 2003 edition of the Dutch COI study.[21] We have shown that average annual drug expenditures are – conditionally on survival – higher for an obese individual than for a 'healthy-living' individual. More importantly, although obese people have a lower life expectancy than 'healthy-living' people (and thus have fewer years to induce drug costs), lifetime spending on drugs is higher for the obese. This can be explained by the fact that obesity increases the incurrence of diseases such as coronary heart disease, hypertension and type 2 diabetes, which require (extensive) drug treatment. Preventing obesity may first induce savings (i.e., savings in the first 50 years from the starting age of 20 years) on drugs for such obesity-related diseases. However, prevention also increases life expectancy. Still, the additional drug costs for diseases unrelated to obesity in the life-years gained through preventing obesity are outweighed by these early savings. In the end, therefore, obesity prevention (at zero costs) will result in cost savings for the medication segment. This holds in all sensitivity analyses and regardless of the discount rate used in the analysis.

For the other healthcare segments, consequences are most pronounced (and different from those for the drug segment) for expenditures on long-term care. Obesity prevention will increase long-term care lifetime expenditures substantially in the long run. The magnitude of the cost increase depends to a large extent on the definition of healthcare costs used, the relative mortality risk associated with obesity and the discount rate. Nevertheless, the additional expenditures will easily offset short-term savings, which are negligible since treatment of obesity-related diseases in normal life-years usually does not involve long-term care. On the other hand, in life-years gained, many unrelated diseases may be incurred that do require long-term care (such as Alzheimer's disease). Thus, for the first compartment (which is the financing scheme that accounts for long-term care), obesity prevention will result in (much) higher costs. This implies that the future sustainability of the long-term care sector will increasingly be challenged if policy makers are able to prevent obesity. Moreover, several projection studies show that population ageing will further increase the demand for long-term care considerably, posing additional challenges regarding the financing as well as planning of (future) long-term care.[48,49]

For the two other healthcare segments, i.e. hospital care and primary healthcare, overall consequences of obesity prevention are almost negligible. Although short-term savings are achieved in the hospital segment, additional costs in the long-term almost completely offset these savings. Expenditures on GP care are hardly influenced by obesity prevention. Thus, although obesity prevention seems to have similar cost consequences for all healthcare segments – i.e. (relatively) short-term savings and additional expenditures in the long run – lifetime healthcare costs are affected in different ways for the different segments.

Previous studies show that changing lifestyles (into healthier ones) may be an efficient way to improve public health, even when medical costs in life-years gained are accounted for.[17,50-53] Although prevention may not lead to cost savings in every healthcare segment (and in terms of total healthcare expenditures), it may still be a rational thing to do if we can achieve better public health in a cost-effective way.[54,55] Therefore, it is important to realise that the substantial cost increase in the long-term care sector (and therefore rising total healthcare costs) as a consequence of obesity prevention does not imply that prevention of obesity is undesirable, but instead that much (policy) attention should be devoted to the future financing and planning of long-term care.

An important point in this context is where to draw the line regarding which costs to include in economic analyses (which may influence whether we perceive prevention as an attractive investment, in terms of costs, that is). From this chapter it is clear that applying a broader definition of healthcare costs increases the absolute difference of estimates for long-term care expenditures between cohorts substantially, making obesity prevention less attractive with respect to the base-case scenario in terms of costs. This can be explained by the fact that the additional costs that are incurred in the long-term care segment as a consequence of obesity prevention are not purely medical expenditures, but consist mainly of costs for more public welfare services. However, such costs may not be directly relevant from a healthcare perspective, but more so from a societal perspective. If we extend our perspective into a complete societal one, more societal costs and benefits need to be considered. Less obesity means less obesity-related morbidity and higher life expectancies. This may increase, for example, the productivity of the working population, since obesity has been found to induce productivity losses[56-59] as well as provide the possibility to delay pension age. Furthermore, as the proportion of elderly grows in developed countries, healthy ageing may lead to a reduced strain on informal care (both financially and emotionally) as well as a stronger network of childcare. On the other hand, more costs will also be incurred that deserve consideration. Such costs, often referred to as survivor consumption costs, may be related to housing, food and clothes.[60] It need not come as a surprise that such considerations may importantly affect the consequences of (preventive) interventions, in terms of costs and effects.

Limitations

There are several limitations to our study that deserve mention. Some of these were already discussed by van Baal et al.[13] and will therefore not be extensively repeated here. First, we used the standard classification used by the WHO for overweight and obesity, i.e. according to BMI. It has been argued that this measure may have its limitations and that a combination of BMI and an indicator of how fat is distributed over the body – usually this is the waist circumference or waist-to-hip ratio – or even the latter indicator alone, would be more appropriate to assess the real heath risk attributable to obesity.[8,61]

Second, in the simulation approach we used, we have not incorporated any subdivision in BMI levels for people who are obese. Previous research has shown that this may be important for the relative risks and mortality rates related to obesity. We therefore performed two additional analyses using lower mortality risks for the obese, which show that the negative cost effects of obesity prevention on long-term care expenditures are attenuated compared with our base-case scenario, but still large enough to offset (slightly increased) savings in the three other main healthcare segments.

Another possible limitation of our model is that it does not account for the influence of variation in obesity on the cost per patient for every disease related to obesity. This implies that the costs of, for instance, treating low-back pain are independent of BMI level, which may not always be realistic.

Furthermore, an important limitation is that expenditures that result from pharmaceutical utilisation within hospitals or intramural long-term care services were not included in the medication and medical appliances segment but were an inseparable part of the hospital costs and long-term care segment. This has to do with the current financing system of hospitals applied in the Netherlands, which implies that costs of intramural care, including medication, are largely part of the relevant institution's budget. This implies that our estimates of medication expenses will likely be an underestimation and may also affect estimates of costs and savings in the different segments. Future work could therefore be aimed at further disentangling these costs.

A final noteworthy limitation of using the Dutch COI study is that assigning healthcare costs to diagnosis groups, age and sex is sometimes difficult. Detailed information regarding how cases were dealt with in which specific diagnosis data were lacking, information on the age distribution was missing or data had been miscoded is provided elsewhere.[62]

Conclusions

The aim of this chapter was to show the consequences of preventing obesity for drug costs and other large segments of the healthcare sector. Obesity prevention will likely increase long-term care expenditures but induce savings in the pharmaceutical sector. This latter result is expected to be even more prominent as more and more obese people are being subjected to drug treatment. Despite possible cost increases as a consequence of obesity prevention, it may still be a worthwhile investment. This will to a great extent depend on how much health will be gained.[63] These are important considerations for healthcare policy makers who are concerned with the future financing and planning of the healthcare system.

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PART II

An Individual Perspective

Chapter 6

Back to the Consideration of Future Consequences Scale

Time to Reconsider?

Based on:
Rappange DR, Brouwer WBF, van Exel NJA. Back to the Consideration of Future Consequences Scale: Time to reconsider? ***The Journal of Social Psychology.*** *2009; 149: 562-84*

6.1 INTRODUCTION

The consideration of future consequences in current behaviour is increasingly acknowledged as being important, as the effects that current behaviours and attitudes may have on future wellbeing and health can be profound. The trade-off between satisfying immediate desires and future benefits is therefore a matter of concern in areas like healthcare (smoking, unsafe sex), environment (exhausting resources), and finance (savings and pension building). Whether individuals take these possible distant outcomes into consideration when deciding to engage in certain behaviours, or just focus on maximising their immediate benefits without regarding future consequences, is often considered to be a more or less stable and measurable personal characteristic.

Following initial studies on time perspective by Frank[1] and Lewin[2], several researchers[e.g., 3-8] have examined the concept of what has been labelled *future time perspective* in the second half of the last century. Although slightly different definitions of this concept have been used, it is generally defined as "*a rather generalised concern for future events and experiences*"[5]. Despite attempts to develop instruments that measure this general concern with the future adequately, researchers have not yet achieved satisfying results in terms of consistency, reliability, and validity (for a review, see Strathman et al.[9]).

Strathman et al.[9] developed the Consideration of Future Consequences (CFC) Scale, a measure for assessing individual differences in this construct of future thought. Given the complexity of the concept this instrument attempts to capture, this warrants a careful consideration of its construct validity. However, after the first study by Strathman et al.[9], only Petrocelli[10] has examined the factor structure of the CFC Scale. Contrary to Strathman et al.[9], Petrocelli[10] found evidence of two underlying factors, and hence suggested that an adjusted version of the CFC Scale would be a better measure of the CFC construct. So far, however, supporting evidence for this claim is lacking.

Meanwhile, as highlighted further below, the CFC Scale appears to be increasingly used in applied research in different contexts as a measure of consideration of future consequences. This makes it more important to address the questions regarding the underlying factor structure of the CFC Scale. Therefore, in this chapter, we present the results of a study that elaborated on the two previous studies regarding the properties of the CFC Scale, and that aimed at providing additional evidence in the factor validation process of the CFC Scale. Moreover, we examine the feasibility of the scale in young adolescents; the convergent validity of the scale – and possible underlying factors – with alternative measures assessing adolescents' appreciation and expectations of their future; and the relation of the scale with several personal characteristics.

Consideration of future consequences

Strathman et al.[9] tried to assess a unique aspect of the future time perspective and not merely a general preoccupation with the future. Strathman et al.[9] described the CFC as follows:

"*The CFC refers to the extent to which individuals consider the potential distant outcomes of their current behaviours and the extent to which they are influenced by these potential outcomes. It involves the intrapersonal struggle between present behaviour with one set of immediate outcomes and one set of future outcomes.*"

The CFC Scale consists of 12 items measured on a Likert-type scale ranging from 1 (*extremely uncharacteristic*) to 5 (*extremely characteristic*), of which seven items should be reverse-scored to obtain a total score ranging from 12 to 60 (or mean scores ranging from 1 to 5). A higher score indicates a higher level of consideration of future consequences (for original instrument and instructions see www.missouri.edu/~psyas/cfc.pdf). Individuals high in CFC are expected to focus more on the future implications of their behaviour and to use these as a guide for their current behaviours. In extreme cases, these individuals may completely disregard immediate outcomes in their decision-making process. On the other hand, individuals low in CFC are expected to focus more on immediate needs and concerns, and their actions are expected to be focused on meeting these immediate needs. At the extreme end, these individuals do not take future consequences into account at all.[9]

To provide evidence of the influence of CFC on behaviours and attitudes, Strathman et al.[9] showed in Experiment 1 the effect of the CFC construct on information processing by demonstrating that individuals high in CFC, because of their greater interest in the environment, were less in favour of increased offshore oil drilling. More important, high CFC individuals were more in favour of oil drilling when its advantages were framed in the future and its disadvantages in the present. Conversely, low CFC individuals were more in favour of oil drilling when the advantages were outlined as immediate and disadvantages as distant. These results suggest that the time frame in which the consequences are portrayed has a greater influence on the decision-making process of individuals as opposed to whether the outcomes are either positive or negative.

In Experiment 2, Strathman et al.[9] demonstrated that the CFC Scale accounts for unique variance in behaviour over and above other measures assessing individual differences, including the Stanford Time Perspective Inventory[11,12], for example in cigarette use and general health concern.

The CFC Scale has been used in several studies in various research areas. For example, researchers have demonstrated that individuals high in CFC, as compared to individuals low in CFC, are more likely to engage in pro-environmental *consumer* behaviour, [13,14] pro-environmental *political* behaviour,[15] safe sexual behaviour, and HIV testing[16]. Orbell et al.[17] reported that individuals high in CFC were

more in favour of participating in colorectal cancer screening, and Orbell and Hagger[18] found similar results with regard to Type 2 diabetes screening. In addition, researchers have demonstrated that high CFC individuals have higher academic achievement[19] and tend to have greater fiscal responsibility[20]. Joireman et al.[21], moreover, found evidence of a link between CFC and aggression, while Insko et al.[22] demonstrated that a higher CFC among members of different groups diminishes intergroup competitiveness. However, this latter finding is not supported by Insko et al.[23]

Factor validation of the CFC Scale

Strathman et al.[9] started with a set of 24 statements when developing the CFC Scale and conducted exploratory and confirmatory factor analysis to assess its factor structure. The results of both exploratory and confirmatory factor analysis provided evidence for a one-factor solution consisting of 12 items that measured the CFC construct best. Strathman et al.[9] demonstrated that these 12 items, together named the CFC Scale, were reliable in terms of internal consistency (Cronbach's *α*'s between .80 and .86) and stability over time (e.g., test-retest correlation of .72). In addition, relationships between the CFC Scale and other measures evidenced a good convergent validity, for example, between the CFC Scale and future orientation,[e.g., 9,24] delay of gratification, and conscientiousness.[9]

Its extensive use in a wide variety of studies, the inconsistent results regarding the association between CFC and intergroup competitiveness, and the modest amount of empirical validation, induced Petrocelli[10] to examine the factor structure of the CFC Scale in more detail. First, Petrocelli[10] explored the factor structure of the CFC Scale by means of principal component analysis resulting in two underlying factors. Subsequently, Petrocelli[10] used confirmatory factor analysis to examine four maximum likelihood solutions. Petrocelli[10] attained a Cronbach's alpha coefficient of only .48 for Factor 2 (as opposed to .82 for Factor 1), and a relatively low correlation between the two factors (r = .54) despite the fact that it concerns items from the same scale. Hence, Petrocelli[10] suggested that the two underlying factors might be assessing different constructs: Factor 1 focused almost exclusively on immediate behaviour and immediate consequences, and Factor 2 concerned distant consequences of immediate behaviour. Petrocelli[10] also evaluated a model composed of one factor containing all the reverse-scored items and Item 2. Petrocelli[10] found that this model, omitting items of Factor 2, produced the best fit and therefore proposed that an 8-item version of the CFC Scale, consisting of almost exclusively reverse-scored items, might be a more appropriate measure of the CFC construct. Petrocelli[10] concluded that the CFC Scale may not so much be a measure of the extent to which individuals consider future consequences of their behaviour, but more of the extent to which they are not influenced by immediate consequences of their actions – that is, if the reverse-scored items are in fact reverse-scored. Otherwise, these items could serve as a measure of the extent to which people are influenced by the immediate consequences of their actions.

Study hypotheses

Since the participants who completed the questionnaire for the study in this chapter are exclusively young adolescents, we assessed the feasibility of the CFC Scale in this study sample first. Although some authors have reported evidence of equal competency in decision-making between adolescents and adults,[e.g., 25] several authors have found that young adolescents are less able to foresee consequences of new alternatives and less able to conceptualise risks and benefits of their actions.[e.g., 26-28] Others have supported this notion of immaturity of judgment among young adolescents as opposed to older adolescents,[29,30] while van Exel et al.[31] theorised that adolescents would only consider their future to a very limited extent. Therefore, a lower mean CFC score is expected in the present study sample, as compared to results from other studies, and potentially a poor feasibility.

The general study hypothesis concerned the factor structure of the CFC Scale. Petrocelli[10] reported multiple underlying factors, therefore we hypothesised that the CFC Scale decomposes in two or more underlying factors. In order to clarify this further, we explored the convergent validity of the CFC Scale. We expected that the CFC Scale would correlate (positively) with other measures that assess young adolescents' appreciation and expectations of their future, as well as with health belief statements. However, the correlations between these measures and any underlying factors of the CFC Scale could be different. We also investigated this.

Finally, we investigated associations of the CFC Scale and any underlying factors with several personal characteristics. In past research, variables including *sex*, *educational level*, and *personality* have discriminated between individuals high and low in CFC. Contradictory results have been reported concerning sex. Petrocelli[10] found that men scored significantly lower on the 12-item CFC Scale than women. Similar sex differences were found in the first factor of the two-factor solution, but not in Factor 2. Other researchers found no significant differences in scores in CFC between men and women.[e.g., 18] No hypothesis is made here. Based on a study by Joireman[19] concerning academic achievement, a higher score in CFC is expected to correlate with a higher education. Other researchers have reported a correlation between CFC and Goldberg's *conscientiousness* dimension.[e.g., 9,18,22] Associations with all Big Five personality dimensions are investigated. Finally, we tested the discriminative power for *religious upbringing*, *Body Mass Index (BMI)*, *health status*, *happiness*, and *attitudes about health lifestyle*.

6.2 METHODS

Participants

We conducted secondary analysis on existing data of 2,006 young adolescents (1,064 girls and 942 boys) recruited in May 2005 from 10 secondary education schools throughout the Netherlands. Van Exel et al.[32] obtained the sample in a study investigating adolescents' health behaviour in relation to their attitudes about their health lifestyle and their consideration of the future consequences of their

behaviour. Participants between the ages of 11 to 15 (mean age = 13.2 years, *SD* = 0.70) attended either 1st or 2nd grade of pre-vocational or general secondary education. The vast majority of the study sample was autochthonous Dutch (90.1%).

Materials

Participants completed the "Health and Future" questionnaire during class, under supervision of their teacher. The questionnaire covered eight topic areas: *about you, about your health, about your future, about home, about school, about your leisure time, about what you eat, and about money*. The *about your future* section included the CFC Scale and some alternative measures assessing future appreciation and expectations. We translated the CFC Scale into Dutch and slightly simplified the wording to increase its comprehensiveness for young adolescents (see Appendix 6.1).

We assessed personality using a short version of Goldberg's Big Five Personality Inventory[33,34]. We asserted health status using a visual analogue scale ranging from 0 (*worst conceivable health state*) to 10 (*best conceivable health state*) and happiness using a visual analogue scale ranging from 0 (*completely unhappy*) to 10 (*perfectly happy*). We further assessed attitude about health lifestyle by means of self-categorisation to one of five attitudes identified within the same population before using Q-methodology: *carefree sporty, worrying dependent, contended independent, looks over content, and indifferent solitary.*[31] For a more detailed discussion of the sample method, questionnaire development and contents, and measures used, see van Exel et al.[32]

Procedure

First of all, we made a straightforward comparison of the descriptive statistics (scores on the CFC Scale) of the present study sample with the results from several other studies.

Feasibility

We asserted the feasibility of the CFC Scale in this sample by means of response analysis, i.e. in terms of the percentage of completed scales with no missing items, the percentage of completed scales with no more than 10% missing items, the percentage of missing values per item, and the standardised index of missing values. The standardised index is computed by dividing the mean number of missing values per respondent by total number of items, multiplied by 100.[35] We excluded completed CFC Scales with more than 10% missing items (that is, more than one missing item) from further analyses. In case of a single missing item, the average score of the respondent on the other 11 items replaced the missing item, after recoding the reverse-scored items.

Reliability

We analysed the reliability of the CFC Scale by assessing its internal consistency using two indicators: Cronbach's alpha coefficient and item-total correlation.

Factor analysis

We used factor analysis to assess the interrelationship among the scale items and to identify the number of underlying dimensions. First, we tested the factorability of the CFC data. We computed the determinant value of the correlation matrix to test for multicollinearity or singularity. This value should be greater than .00001.[36,37] Next, we performed Bartlett's Test of Sphericity[38] and Kaiser-Meyer-Olkin's (KMO) test of sampling adequacy[39,40]. To allow factor analysis, the first test should be significant ($p < .05$), while the size of the KMO value should exceed .60.[41] If all these tests are shown to be satisfactory, the data is suitable for factor analysis.

The actual factor analysis consisted of two phases. First, we subjected the CFC Scale to confirmatory factor analysis via the maximum likelihood method of estimation, using the factor solutions reported by Strathman et al.[9] and Petrocelli[10]. We evaluated two models: first, the solution of Strathman et al.[9], which consisted of one factor including all 12 items; second, the two-factor solution of Petrocelli[10], consisting of Factor 1 (Item 2, 3, 4, 5, 9, 10, 11, and 12) and Factor 2 (Item 1, 6, 7, and 8). To determine whether the number of extracted factors in both models was adequate, we computed two common goodness-of-fit tests: the chi-square (X^2) test and the ratio of the chi-square to its degrees of freedom (X^2/df). The advantage of the X^2/df ratio over the X^2 index is its insensitivity to large sample sizes, but there is some indistinctness in the literature about what cut-off point for the X^2/df ratio we should use to achieve an "adequate fit". We used the 5:1 ratio suggested by Wheaton et al.[42]

In the second phase, we conducted exploratory analysis on the present dataset, namely principal component analysis with Varimax rotation. To assert the number of factors to retain, we used three techniques, of which the Kaiser's criterion[e.g., 43] is the most commonly used, also known as the eigenvalue rule. Only factors with an eigenvalue greater than 1.0 are retained. This technique has been criticised in the past, as it tends to overestimate the number of factors to select.[e.g., 44] Next, we performed Catell's scree test[45], which implies inspection of the scree plot in which the extracted factors are plotted against their eigenvalues. The final approach, Horn's Parallel Analysis[46], involves the comparison of the eigenvalues with eigenvalues obtained from a randomly generated dataset of the same size. This technique is considered to be the most accurate[44] and we used Watkins[47] to conduct this test.

Convergent validity

We assessed the convergent validity through Spearman's rank-order correlation of the CFC Scale and any underlying factors with alternative measures assessing adolescents' appreciation and expectations of their future and some health belief statements. We asked respondents (A) how important it was to them what their life would be like 2, 5, and 25 years from now (Likert-type scale, four levels ranging from *very important* to *not at all important*); (B) to make a series of trade-offs between money values now and in the future (2, 5, and 25 years from now), which were used to calculate discount rates; (C)

to consider 3 x 2 investments in health (improve their dietary behaviour, exercise 30 minutes more per day, and take an injection that would make them sick for the next week) that would yield (i) a better health at age 70 or (ii) extend life with 3 years; (D) for their subjective life expectancy; (E) for their expectations regarding their health status at the age of 40 and 70; and (F) to evaluate seven health belief statements. To ensure that higher scores indicated higher appreciation of the future, we reversed the scores for Measure A, B, C, and F. We interpreted the strength of the relationship according to the guidelines suggested by Cohen[48]: *r*s = .10 to .29 indicates a small, *r*s = .30 to .49 a medium, and *r*s = .50 to 1.0 a large correlation effect size.

Relation with personal characteristics and health variables

Finally, we used *t* tests, one-way between-groups ANOVA with Tukey's post hoc test, and Spearman's rank-order correlation to explore associations of the CFC and any underlying factors with personal characteristics and several health variables. We assessed the strength of the relationships found using the *t* tests using Cohen's *d* (i.e., *d* = 0.20 indicates a small, *d* = 0.50 a medium, and *d* = 0.80 a large effect).

6.3 RESULTS

We received completed questionnaires from 2,006 young adolescents residing in the Netherlands. Averaged individual mean scores on the 12-item CFC Scale ranged from 1.33 to 4.75. The average score in the present study sample was 3.27 (*SD* = 0.50), and the median was 3.33. This is similar to the mean score of 3.28 in a recent Dutch academic sample collected by Rappange[49] and to mean scores reported among samples of 50- to 69-year-olds[17,32]. In contrast, Strathman et al.[9] and Petrocelli[10] reported mean scores around 3.50 in academic settings. Our findings are inconsistent with our expectation that young adolescents would score lower on the CFC Scale.

We further anticipated that the feasibility of the CFC Scale in this study sample might be poor. However, we found excellent results on all measures of feasibility. In total, we received 1,946 (97%) scales without missing values. Only 9 out of 2,006 completed questionnaires had more than 10% missing values on the CFC Scale, which we therefore excluded from further analyses. Missing values per item ranged from 0.1% to 0.6%, and the standardised index of missing values was 0.4.

We assessed the internal consistency to investigate the reliability of the CFC Scale. Cronbach's alpha coefficient for the scale was .76, and item-total correlations ranged from .26 to .58. Both values are similar to results from previous studies.

Factor analysis

Preceding the evaluation of the different factor solutions found by Strathman et al.[9] and Petrocelli[10], we assessed the suitability of the dataset for factor analysis. The determinant value was .130, the Barlett's Test of Sphericity reached significance, $X^2 = 4068.430$, $p < .01$, $df = 66$, $N = 1{,}997$, and the KMO value was .830, which meets Kaiser's "meritorious" criteria[40]. All tests support the factorability of the data.

Confirmatory factor analysis

Evaluation of the one-factor structure reported by Strathman et al.[9] and the two-factor structure by Petrocelli[10], using confirmatory factor analysis, resulted in unsatisfactory results. Factor loadings on the one-factor solution ranged from .224 to .710. The model did not produce an adequate fit, X^2 (54, $N = 1{,}997$) = 804.95, $p < .01$ and $X^2/df = 14.91$. This exceeds the 5:1 ratio proposed by Wheaton et al.[42] The two-factor model also produced a poor fit, X^2 (43, $N = 1{,}997$) = 435.37, $p < .01$ and $X^2/df = 10.12$. The factor pattern matrix and the factor structure matrix of this model, together with the item descriptives, are shown in Table 6.1. In absence of satisfactory results, we conducted additional exploratory factor analysis to explore more appropriate factor structure solutions.

TABLE 6.1 Item descriptives and factor pattern/structure matrix of the CFC Scale: maximum likelihood with Direct Oblimin rotation ($\delta = -0.50$)

Item	Item descriptives		Factor pattern matrix		Factor structure matrix	
	M	*SD*	Factor 1	Factor 2	Factor 1	Factor 2
1	3.36	0.97	.169	**.603**	.365	**.658**
2	2.56	0.99	–.023	**.562**	.159	**.555**
3[a]	2.91	1.08	**.587**	.138	**.632**	.328
4[a]	2.76	0.96	**.522**	–.005	**.520**	.164
5[a]	3.55	0.95	**.329**	–.016	**.324**	.090
6	3.64	0.89	**.306**	.172	**.362**	.271
7	3.80	0.93	**.317**	.169	**.372**	.272
8	3.43	0.92	.241	.248	.321	.326
9[a]	2.27	0.99	**.626**	–.084	**.599**	.119
10[a]	2.53	0.97	**.543**	.013	**.547**	.189
11[a]	2.36	0.96	**.762**	–.064	**.742**	.183
12[a]	3.12	0.90	**.388**	–.086	**.360**	.039

Note. Item means and standard deviations are before reverse-scoring. Loadings in bold are values greater than .30 and are retained for that factor. Underlined values indicate a multiple loading on two factors. Eigenvalues for Factor 1 and Factor 2 are 2.743 and 0.650, respectively (before rotation). The two-factor solution explains a total amount of 28.3% of the variance, with Factor 1 contributing 22.9% and Factor 2 contributing 5.4% (before rotation). Factor 1 and Factor 2 are correlated ($r = .32$).
[a]Reverse-scored items.

Exploratory factor analysis

Principal components analysis with Varimax rotation resulted in three factors with eigenvalues greater than 1.0, explaining a total of 49.0% of the variance with the three factors accounting for 20.8%, 16.4%, and 11.9%, respectively. The factor loadings of all items on the three factors are shown in Table 6.2. Inspection of the scree plot revealed a break after the third factor, and this was further supported by the results Parallel Analysis provided, which showed three eigenvalues exceeding the corresponding eigenvalues from the generated data (12 variables x 1,997 subjects). Next, principal components analysis with Direct Quartimin rotation ($\delta = 0$) showed that the correlation between the three factors ranged from .09 to .27. The absence of strong relations among any combination of two factors justifies the use of Varimax rotation.[36,37] In addition, we performed reliability analysis for all factors. Factor A1 (Item 3-5 and 9-12) scored well in terms of internal consistency (Cronbach's $\alpha = .74$).

TABLE 6.2 The factor loading matrix of the CFC Scale: principal components analysis with Varimax rotation

Item	Factor			Communality
	A1	A2	A3	
4[a]	**.713**	–.019	.174	.539
3[a]	**.662**	.189	.299	.563
11[a]	**.647**	.418	–.005	.594
5[a]	**.575**	–.175	.153	.385
9[a]	**.523**	.461	–.136	.505
10[a]	**.488**	.402	–.004	.400
12[a]	**.478**	.124	–.100	.254
8	–.027	**.692**	.186	.515
7	.118	**.636**	.059	.422
6	.102	**.601**	.149	.393
2	.023	.059	**.839**	.707
1	.163	.295	**.701**	.605
Eigenvalue	2.490	1.966	1.427	5.877
% of variance	20.8	16.4	11.9	49.0

Note. Loadings in bold are values greater than .40 and are retained for that factor. Underlined values indicate a multiple loading on two factors. Eigenvalues and percentage of variance are after rotation.

[a]Reverse-scored items.

We found lower Cronbach's alpha coefficients (.52 and .54) for Factor A2 (Item 6-8) and Factor A3 (Item 1-2), respectively. The respondents scored higher on Factor A2 ($M = 3.62$, $SD = 0.66$), as compared to Factor A1 ($M = 3.21$, $SD = 0.61$) and Factor A3 ($M = 2.96$, $SD = 0.81$). Factor A1 turned out to consist of the seven reverse-scored items, and Factors A2 and A3 of the positively worded items. Although the three-factor solution indicates a clear - statistical - distinction between Factors A2 and A3, a closer

examination of the content of these items and an attempt to interpret both factors did not result in a comparable clear-cut distinction between the two factors. Moreover, both factors independently did not prove to be very stable. Therefore, we also included a two-factor solution consisting of Factor B1 (identical to A1) and Factor B2 (A2 and A3 combined; Cronbach's $\alpha = .59$; $M = 3.36$, $SD = 0.58$) in further analyses.

Convergent validity

Table 6.3 presents the correlations between the CFC Scale, underlying factors, and six other measures assessing appreciation of the future. We found small positive correlations for the CFC Scale and underlying factors with importance of future life (Measure A) and health expectancy at age 40 and 70 (Measure E). Correlations with adolescents' discount rates (Measure B) were also small and decreased substantially when the trade-offs between money now and later involved longer delays. This may indicate that adolescents´ time horizon when thinking about future outcomes is fairly limited, or that the CFC predominantly captures mid-term (2-5 years) outcomes in adolescents. Regarding the health investments (Measure C), we found higher correlations for improving dietary behaviour than for the other two investments, and – not shown in the table – for investments that would yield a better health at age 70 rather than extending life by three years. This applied to the CFC Scale as well as to the underlying factors. We found no correlation with life expectancy (Measure D), while correlations with the health belief statements (Measure F) varied considerably.

Relation with personal characteristics and health variables

Table 6.4 presents relations of the CFC Scale and underlying factors with several personal characteristics and health variables. Some are discussed in more detail here. We found no significant association between the CFC score and sex $t(1,991) = 1.84$, $p = .07$, when we measured CFC using the 12-item CFC Scale. However, girls scored significantly higher on Factor A1 (and B1), $t(1,991) = 4.22$, $p < .01$, $d = 0.19$, while boys scored significantly higher on Factor A3, $t(1,991) = -6.50$, $p < .01$, $d = 0.29$ and Factor B2, $t(1,991) = -2.34$, $p = .02$, $d = 0.10$. Pupils attending general secondary education scored significantly higher on the 12-item CFC Scale, $t(1,971) = 5.02$, $p < .01$, $d = 0.23$. We found similar results for Factors A1, A2, and B2: $t(1,971) = 4.95$, $p < .01$, $d = 0.22$; $t(1,971) = 4.60$, $p < .01$, $d = 0.21$, and $t(1,971) = 3.19$, $p < .01$, $d = 0.14$, respectively.

Adolescents with a religious upbringing scored higher on the 12-item CFC Scale, $t(1,981) = 5.36$, $p < .01$, $d = 0.24$; Factor A1, $t(1,981) = 5.68$, $p < .01$, $d = 0.26$; Factor A2, $t(1,981) = 2.64$, $p < .01$, $d = 0.12$, and Factor B2, $t(1,981) = 2.82$, $p < .01$, $d = 0.13$. The strength of these relationships is, however, predominantly limited.

Respondents with a worrying dependent attitude about their health lifestyle scored significantly higher on the 12-item CFC Scale and on all underlying factors except for Factor A3.

TABLE 6.3 Convergent validity: correlation of the CFC Scale with other measures of appreciation and expectations of the future and health belief statements

Variable	Category	CFC Scale	Three-factor structure			Two-factor structure	
			A1	A2	A3	B1	B2
(A) Meaning of future life	In 2 years	.20††	.15††	.18††	.12††	.15††	.19††
	In 5 years	.23††	.17††	.20††	.16††	.17††	.23††
	In 25 years	.21††	.16††	.19††	.17††	.16††	.21††
(B) Discount rate	2 years	.20††	.18††	.12††	.09††	.18††	.13††
	5 years	.14††	.12††	.08††	.06††	.12††	.09††
	25 years	.06††	.07††	.04†	.01	.07††	.02
(C) Health investments							
Improve dietary behaviour		.27††	.22††	.24††	.17††	.22††	.26††
Exercise 30 minutes per day more		.21††	.15††	.17††	.17††	.15††	.21††
Take an injection that makes you sick for a week		.16††	.11††	.14††	.16††	.11††	.19††
(D) Life expectancy		.00	.01	.00	.00	.01	.00
(E) Health expectancy at age	40	.18††	.15††	.15††	.12††	.15††	.16††
	70	.12††	.10††	.10††	.10††	.10††	.12††
(F) Health belief statements							
"I eat healthy"		.14**	.11**	.13**	.10**	.11**	.13**
"I exercise enough to stay fit"		.10**	.06**	.11**	.09**	.06**	.12**
"Living healthy makes me feel better"		.24††	.17††	.26††	.14††	.17††	.25††
"If I live unhealthy I may incur all sorts of diseases in the future"		.21††	.14††	.22††	.15††	.14††	.24††
"If I live unhealthy I may die sooner"		.19††	.11††	.22††	.15††	.11††	.23††
"If I want, I can easily live healthier than I do now"		.00	.03	.04*	.04*	.03	.06*
"If I were regularly ill, I would start living healthier"		.12††	.12††	.14††	.08††	.09††	.13††

Note. *N* ranges from 1,761 to 1,990. The strength of the relationship can be interpreted according to the following guidelines suggested by Cohen[48]: *r*s = .10 to .29 indicates a small, *r*s = .30 to .49 a medium, and *r*s = .50 to 1.0 a large correlation. *$p < .05$, two–tailed. **$p < .01$, two–tailed. †$p < .05$, one–tailed. ††$p < .01$, one-tailed.

Investigation of the relation between CFC and all Big Five personality dimensions revealed that a positive loading on any of the five personality dimensions was associated with a significantly higher score on the 12-item CFC Scale: *neuroticism*, $t(1,735) = 2.04$, $p = .04$, $d = 0.10$; *extraversion*, $t(1,735) = 2.43$, $p = .02$, $d = 0.12$; *openness to experience*, $t(1,735) = 4.56$, $p < .01$, $d = 0.22$; *conscientiousness*, $t(1,735) = 5.90$, $p < .01$, $d = 0.28$; *agreeableness*, $t(1,735) = 3.78$, $p < .01$, $d = 0.18$. We found different results for the underlying factors. We found significant associations between positive personality-factor loaders and all underlying factors for only two dimensions, openness to experience and conscientiousness.

TABLE 6.4 Relation of the CFC Scale with personal characteristics and health variables

Variable	Category	CFC Scale	Three-factor structure			Two-factor structure	
			A1	A2	A3	B1	B2
Sex	Girls	3.29	3.27**	3.65	2.85**	3.27**	3.33*
	Boys	3.25	3.15	3.59	3.08	3.15	3.39
Education	Pre-vocational	3.21**	3.13**	3.54**	2.95	3.13**	3.30**
	General secondary	3.32	3.27	3.68	2.96	3.27	3.39
Body Mass Index	Mean or lower	3.27	3.21	3.64	2.93	3.21	3.35
	Above mean	3.28	3.23	3.61	3.00	3.23	3.36
Attitude about health lifestyle	Carefree sporty	3.26	3.18	3.64**	2.96	3.18	3.37
	Worrying dependent	3.39**	3.34**	3.73**	3.03	3.34**	3.45**
	Contended independent	3.20	3.15	3.52	2.86	3.15	3.26
	Looks over matter	3.27	3.21	3.60	2.99	3.21	3.36
	Indifferent solitary	3.03	2.96	3.30**	2.88	2.96	3.13
Happiness	Mean or lower	3.22**	3.18	3.53**	2.93	3.18	3.29*
	Above mean	3.30	3.23	3.66	2.98	3.23	3.39
Personality[a]	Neuroticism +	3.31*	3.23	3.66	3.03**	3.23	3.41**
	Neuroticism -	3.26	3.21	3.60	2.89	3.21	3.31
	Extraversion +	3.31*	3.25	3.65	3.02*	3.25	3.40*
	Extraversion -	3.25	3.20	3.61	2.90	3.20	3.33
	Openness to experience +	3.33**	3.26**	3.70**	3.05**	3.26**	3.44**
	Openness to experience -	3.22	3.18	3.56	2.86	3.18	3.28
	Conscientiousness +	3.35**	3.30**	3.69**	3.01**	3.30**	3.42**
	Conscientiousness -	3.21	3.14	3.57	2.90	3.14	3.30
	Agreeableness +	3.32**	3.24	3.73**	3.00*	3.24	3.44**
	Agreeableness -	3.23	3.20	3.51	2.91	3.20	3.27
Health status	Mean or lower	3.20**	3.14**	3.54**	2.91*	3.14**	3.29**
	Above mean	3.32	3.26	3.67	2.99	3.26	3.40
Religious upbringing	Yes	3.31**	3.26*	3.64**	2.98	3.26*	3.38**
	No	3.17	3.08	3.55	2.90	3.08	3.29

Note. *N* ranges from 1,821 to 1,994.

[a]Positive versus negative personality-factor loaders. *$p < .05$. **$p < .01$.

6.4 DISCUSSION

The main goal of this chapter was to provide additional evidence in the factor validation process of the CFC Scale, which measures "*the intrapersonal struggle between present behaviour with one set of immediate outcomes and one set of future outcomes*" [9]. Even though this scale has not been extensively validated so far, it has already been used in a large variety of studies. To provide further insight into the validity of the CFC Scale, we examined the factor structure of the CFC Scale. Like Petrocelli[10],

the results from this chapter suggest a multiple factor solution. In addition, the results presented above give an indication of the convergent validity of the CFC Scale and the extent to which several personal characteristics, including sex, have discriminative power. The examination of the relationships between CFC and several health variables produced mixed results.

Factor analysis

Confirmatory factor analysis demonstrated that both the Strathman et al.[9] and Petrocelli[10] solutions do not provide an adequate fit of the data. Subsequent exploratory factor analysis provided evidence for a three-factor solution: a Factor A1 consisting of all seven reverse-scored items; and a clustering of positively worded items into two factors, Factor A2 (Item 6, 7, and 8) and Factor A3 (Item 1 and 2).

The first factor from the present study is almost identical to Factor 1 reported by Petrocelli[10]. However, Petrocelli[10] added Item 2, a non-reverse-scored item, to this first factor. Although Petrocelli[10] attained good internal consistency for his Factor 1, a closer look at the content of these items does not provide much support for the choice to retain this single non-reverse-scored Item 2 together with seven reverse-scored items in Factor 1, especially considering that the difference between the two factor loadings of Item 2 in the Petrocelli[10] study was negligible. The results presented here also contradict the choice of Petrocelli[10] of including Item 2 in Factor 1. The correlations shown in this chapter between Factor A1 and other measures of appreciation and expectations of the future, though modest in size, seem to confirm that Factor A1 is related to a more general future time concept.

The exploratory factor analysis also distinguished two mainly future-oriented factors, Factor A2 and Factor A3. The absence of multiple loadings on these factors and the presence of high factor loadings suggest that the positively worded items may represent two different aspects of future time perspective. Despite this clear statistical difference between the two factors, examination of the content of the items, however, suggests that it seems rather precarious to pursue this distinction. What is more, the stability in terms of internal consistency of both factors was modest, which seems to indicate that the factors do not represent two independently relevant aspects of the CFC construct. The convergent validity tests and the relation with personal characteristics and health variables showed that the combined Factor B2 accounts for most of the relations found for Factors A2 and/or A3. Future research must clarify whether a two-factor structure, distinguishing the reverse-scored items from the non-reverse-scored items, is indeed a more appropriate solution. The correlation among the three factors was low despite the fact that they all consist of items included in the 12-item CFC Scale. This suggests that the Factors A1, A2, and A3 may be measuring more than one construct.

Relation between sex and CFC

Several researchers have demonstrated that time perspective and sex are associated.[24,50] Men tend to score higher on measures of present time perspective, while women tend to report higher future time perspective scores. In accordance with these findings, Petrocelli[10] reported that women scored significantly higher on the 12-item CFC Scale and Factor 1, while there were no sex differences in Factor 2. In the present study, no sex differences were observed in the 12-item CFC Scale, which is similar to previous studies using the CFC Scale. However, girls scored higher on Factor A1/B1, and boys higher on Factor B2 and Factor A3. In other words, girls show a higher CFC when the construct is framed in present-oriented statements, and boys when it is framed in future-oriented statements. This provides further indication that the factors underlying the CFC Scale may be measuring different CFC constructs. More positively, given the fairly similar convergent validity of the CFC Scale and the underlying factors, one might conclude that the CFC Scale measures different aspects of one broader construct. However, regardless of where the line between constructs and aspects of constructs is drawn – a question that might be answered in future research – the important conclusion from these findings is that the underlying factors explain different aspects of (health) behaviour and, therefore, their distinction is important.

Construct validity of the CFC Scale

Petrocelli[10] argued that a short version of the 12-item CFC Scale, consisting of the eight items loading on Factor 1, might be a more appropriate measure of the CFC construct. The evidence presented in this chapter suggests that if this short version of the CFC Scale were indeed a better measure of the CFC construct, it would be most appropriate to use the reverse-scored items exclusively. Statistically, the 12-item CFC Scale and Factor A1/B1 from this study perform similarly as a measure of the CFC construct. In addition, in terms of internal consistency, the reliability of the 12-item CFC Scale and Factor A1/B1 are highly comparable. Inclusion of the five non-reverse-scored items does not substantially improve the reliability of the CFC Scale, while omission of these items makes it more efficient. The results provide additional supporting evidence with regard to the convergent validity of both the 12-item CFC Scale and Factor A1/B1.

Although intuitively appealing, others have already suggested that it is incorrect to assume that scoring low on a present-oriented scale automatically indicates being future-oriented.[10,24] Indeed, Petrocelli[10] claimed that if an individual states that they are not influenced by the immediate outcomes, it does not mean that they are influenced by the distant consequences of current behaviour. If this is true, summing up the reverse-scored items and the positively worded items would be nonsensical. Then, the short version of the CFC Scale would assess a more present-oriented aspect of the CFC construct, which differs from what was originally proposed by Strathman et al.[9] In this context, Petrocelli[10] argued that "*it might be more appropriate to consider the CFC Scale as indicating the extent to which an individual is not influenced primarily by the immediate consequences of behaviour.*" The repeated result

that the more present-oriented statements are the most dominant and consistent part of the 12-item CFC Scale in any case appears to implicate the construct validity of the 12-item CFC Scale.

Furthermore, the findings from this chapter suggest that it could be inappropriate to completely exclude Factors A2 and A3 (or B2), despite their modest internal consistency. Convergent validity was more or less equally provided for all factors, and the relations of Factors A2 and A3 (or B2) with personal characteristics and health variables suggest they pick up part of the CFC construct. In part, the Factors A2 and A3 (or B2) seem complementary to Factor A1/B1, as they account for something the 12-item CFC Scale picks up, but Factor A1/B1 does not (or, as in the case of sex, pick up opposite effects that cancel out in the 12-item CFC Scale). This is, for instance, the case with happiness and the personality dimensions *neuroticism*, *extraversion*, and *agreeableness*. But most of the time, Factors A2 and A3 (or B2) show similar relations as Factor A1/B1. It would be instructive to examine the content of Factors A2 and A3 (or B2) in more detail in future research.

Temporal discounting

In this chapter we used, among other approaches, temporal discounting as a measure of time preference. It is important to note that there are several mathematical methods to measure discount rates.[e.g., 51-54] We used a hyperbolic-like model that uses an empirically derived parameter value of time preference often denoted as *k*. Using a continuous form of *k,* rather than the ordinal form of *k* we used, yields very similar correlations with the CFC Scale and underlying factors. Recently, a potentially valuable alternative labelled "area-under-the-curve" (AUC)[52] has come to the forth. This theoretically neutral approach measures time preference as the area under the empirical discounting curve and so avoids making any assumptions about the mathematical form of the discounting curve.[55] AUC has been used, for example, in studies concerned with discounting in relation to individual competitive ability[56] and discounting by pathological gamblers[57]. We investigated whether using the AUC approach altered our findings, regarding correlations between temporal discounting and the CFC Scale and/or underlying factors. The mean AUC value was .48 and Spearman's rank-order correlations between AUC and the CFC Scale, Factor A1/B1, Factor A2, Factor A3, and Factor B2, were .16, .15, .09, .06, and .10, respectively. All correlations were significant at $p < .01$, except for AUC and Factor A3 (significant at $p < .05$). These correlations were very similar to the correlations found between the CFC Scale and underlying factors and the computed discount rate when trade-offs were pictured at 5 years from now. Moreover, the structure of the magnitude of the associations across the CFC Scale and underlying factors was almost identical for all discount rate measures. This supports the validity of our findings.

Limitations

A shortcoming of previous research concerned with the factor validation of the CFC Scale was the academic setting in which the CFC Scale was administered. The present study provides evidence of the factor structure in a non-academic setting. The respondents in this and the study of Strathman et al.[9] differ in many aspects. The Strathman et al.[9] study sample consisted of American college students in the early 1990s, while we report on a recent sample of Dutch secondary school pupils between the ages of 11 and 15. When we compare the mean CFC scores found in these studies – as well as those reported in recent studies by Petrocelli[10], who used a sample of American undergraduate students, and Rappange[49], who used a sample of Dutch college students – it seems that the differences between respondents in terms of age, educational level, and time period of study have little effect on CFC scores. The same seems to apply to the possible effect of cultural differences between the samples. As supporting evidence, previous research has shown that differences in long-term orientation between the Americans and the Dutch are marginal.[58, see www.geert-hofstede.com] It is, however, not possible to say how these differences in age, educational level, time period of study, and culture may affect the factor structure of the CFC Scale.

However, it would be inappropriate to pass by to the widely spread notion of immaturity of judgment of young adolescents and their ignorance in foreseeing future consequences. Given our sample, the participants may be presumed a priori to be more present-oriented, which might have blurred the scores on the more future-oriented statements. The results with regard to the feasibility of the CFC Scale in the present study and the mean CFC score provide encouraging evidence that the alleged immaturity of the participants did not influence the findings too much. In future research, the CFC Scale should preferably be administered in a general population.

Another limitation of this study is that participants were asked to complete a translated and somewhat simplified version of the CFC Scale in order to make it more suitable for young adolescents. Although this was done with utmost care, the influence on the measurement of CFC is unknown.

Finally, in the "Health and Future" questionnaire, the 12 items of the CFC Scale were administered in the same order for the whole population. As far as we know, this is common in research using the CFC Scale. However, the split we found in the factor structure of the CFC regarding the future-oriented statements – i.e. Items 1 and 2 in Factor A3 versus Items 6, 7, and 8 in Factor A2 – raises the question of whether the order and clustering of items may influence participants' response and therewith the factor structure. Future studies might consider presenting the statements in a different order.

CFC in healthcare research

Though the CFC Scale consists of general statements about the CFC, this has not restrained researchers from using the scale in healthcare research. The current analysis was conducted on a dataset from a previous study concerned with adolescents' behaviour in relation to attitudes about their health lifestyle and their consideration of future consequences in their health behaviour. Although not every result is completely independent of how we used the CFC Scale, we found that CFC was significantly related to adolescents' attitudes about health lifestyle, happiness, and health status, but not to Body Mass Index. Moreover, the significant relationships between CFC and the health investments and some of the health belief statements used to provide convergent validity, suggest that CFC is also useful when the consequences of behaviour are related to health issues. Nevertheless, in most cases, the strength of the relationships was small. The lack of consistent results and the modest strength of the significant relationships should be reckoned when using the CFC Scale in healthcare research.

In summary, the findings from this chapter confirm the evidence for a multiple factor structure underlying the 12-item CFC Scale. The current study helped make the content and shape of the first factor more evident and showed once more that this present-oriented factor is producing results similar to the 12-item CFC Scale. However, it remains unclear how many factors the remaining future-oriented items represent and what these items actually reflect. These are important considerations for future research.

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APPENDIX

APPENDIX 6.1 Consideration of Future Consequences Scale: Dutch Version for Young Adolescents [in English]

Do the following statements fit you?

1	2	3	4	5
not at all	not	a little	well	extremely well

1. I think about what my life might be like in the future, and try to improve my future with the things I do now.
2. I often do things that might only give me pleasure in the long run.
3. I only do things that I enjoy, and do not worry about what may happen later on.
4. I only do things that give me pleasure right away.
5. I prefer choosing the line of least resistance.
6. I am willing to do something I find not much fun, if it pays off later on.
7. I think it is important to know whether things could have negative consequences, even though you may not find out these consequences for a long time.
8. I think it is better to do something that is very important for the future, than something that has a little bit importance for now.
9. Some things could have negative consequences in the long run, but I do not worry too much about that. I will resolve things before they get too bad.
10. I think sacrificing now because of possible future consequences is unnecessary. I can deal with future consequences later on.
11. I only do things that I enjoy at this moment. I will resolve any future problems when they occur.
12. Because the outcomes of my behaviour now are clear, they are more important to me than possible distant outcomes.

Chapter 7

Rational Expectations?

An Explorative Study of Subjective Survival Probabilities and Lifestyle across Europe

Based on:

Rappange DR, Brouwer WBF, van Exel J. Rational expectations? An explorative study of subjective survival probabilities and lifestyle across Europe. ***Health Expectations.*** *2015; 19: 121-37*

7.1 INTRODUCTION

Individuals' own perception of remaining lifetime is increasingly considered relevant in relation to lifestyle behaviours such as smoking. Individuals generally face uncertainty regarding their own mortality risk or may have inaccurate expectations regarding longevity and the impact of health behaviours thereon. If people underestimate or even ignore the health consequences (i.e., longevity reductions) of unhealthy behaviour, they may more easily adopt and maintain an unhealthy lifestyle. Therefore, more insight into how individuals assess their own mortality risks in relation to unhealthy behaviours may help understand health behavioural decision-making. This is even more important as modifiable unhealthy behaviours are an increasing threat to global mortality and morbidity and even small lifestyle improvements may importantly improve health and lower mortality risk.[1] In this chapter, we therefore investigate the relations between individuals' subjective survival probabilities (SSPs) and socio-demographic characteristics, health and especially health behaviour. This chapter adds to the literature by investigating these issues in a population of elderly (i.e., 60 years and older) from 15 European countries, using data from the Survey of Health, Ageing and Retirement in Europe (SHARE).

The importance of lifespan uncertainty in the decision-making process of individuals was already emphasised by Yaari[2].When maximising lifetime utility, people trade-off subjectively expected gains and costs. To predict and explain individual behaviour, economists traditionally used assumptions about individual subjective expectations rather than actual data.[3] More recently, data on subjective expectations and probabilities of survival have been collected in large household surveys.

Several studies have investigated the congruity between SSPs and actuarial survival probabilities to assess whether individuals' beliefs about their remaining lifetime are accurate.[4–11] Less congruity may imply inaccurate subjective expectations, but may also signal individuals' private information beyond what is accounted for in life tables.[9] Such information may be used by individuals when making economic decisions.[12,13] Studies have also highlighted the relation between SSPs and economic decisions regarding retirement, social security claiming,[8,14,15] saving, consumption and bequests[12,13,16,17]. These studies suggest that SSPs are indeed important in economic decision-making processes of individuals. Another stream of research has focused on whether SSPs predict individuals' actual mortality[7,18–21] and the relation between SSPs and socio-demographic characteristics and socio-economic status,[5,22,23] but also, for example, parental longevity[19]. Note that research on subjective life expectancy has been conducted using point estimates or verbal answers rather than probabilities. In this chapter our focus is on studies that used SSPs as elicitation method.

In line with these research applications in the field of economic decision-making, SSPs have been found relevant for lifestyle decisions as well. Regarding tobacco use, there is large consensus that smoking decreases longevity, possibly up to 10 years.[24] Hurd and McGarry[5] found that SSPs indeed

vary systematically with smoking. Lower SSPs for smokers compared to non-smokers are reported, although among smokers little variation in SSPs was found according to intensity of smoking[25] Schoenbaum[26] found that heavy smokers (≥25 cigarettes per day) fail to adjust their survival expectations downwards in line with life tables, while expectations of never, former and light smokers (<25 cigarettes per day) resembled actuarial predictions. Khwaja et al.[27] also concluded that smokers expect to live longer than objective longevity figures predict. Balia[28] used the first wave of the SHARE data to study the formation of SSPs in relation to smoking and individual perception of health risks, with a particular focus on the short- and long-term effects of smoking and the reversibility of these effects.

Besides smoking, obesity is an important public health issue. While the consequences of obesity on morbidity are commonly acknowledged, the relation between obesity and life expectancy is less straightforward. It seems that obesity is more harmful in terms of reduced longevity among younger adults than among older people.[29,30] Walter et al.[31] did not find evidence that increased body weight decreases life expectancy among older people. In terms of impact of obesity on SSPs, Falba and Busch[32] reported lower SSPs among respondents who were overweight or obese compared to normal weight respondents. These authors concluded, however, that obese individuals do not fully update (i.e., lower) their subjective survival chances in line with the excess mortality risk associated with obesity as estimated in life tables used in their study. Hurd and McGarry[5] even found no association between SSPs and (over)weight.

Other lifestyle-related risk factors in part related to obesity, such as alcohol consumption and physical activity, also seem to be systematically related to SSPs. In line with epidemiological data, moderate alcohol consumers report higher SSPs than heavy drinkers (five or more glasses per day) and people who abstain from drinking.[5,10] In addition, people who are physically active report, on average, higher longevity expectations.[5]

In general, previous research findings regarding the association between SSPs and lifestyle-related health risk factors suggest that SSPs in general vary with risk factors in a fairly systematic way, commonly in expected directions. The relation between obesity and SSPs is more diverse. The study presented in this chapter adds to this empirical and theoretical literature in a number of ways. First, we provide descriptive statistics of SSPs using cross-national European data and perform a country comparison among thirteen countries. Second, we investigate whether the SSPs vary with socio-demographic characteristics and socio-economic status, objective health status and, in particular, lifestyle, which is the main objective of our study. Finally, we address the validity of the probabilistic elicitation format for collecting data on individuals' longevity expectation, as it is unclear whether respondents are capable of expressing their survival expectations using probabilities. The remainder of this chapter is structured as follows: first, in the next section, we describe our data, measures and analyses. After that, we present our results. We end with a discussion of our main findings.

7.2 METHODS

Data source and description

For our study, we used data from the second wave (2006/2007) of the Survey of Health, Ageing, and Retirement in Europe (SHARE). SHARE is a cross-national and multidisciplinary panel database with micro-level information on health, socio-economic status, and social and family networks. Its format is analogous to the US Health Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). The SHARE database contains data from more than 22,000 households in 15 countries across Europe. Based on probability samples and using a computer-assisted personal interviewing technique (for details, see Börsch-Supan et al.[33], Börsch-Supan and Jürges[34]), information is collected of non-institutionalised individuals aged 50 and older and their spouses (who may also be younger than 50 years). More documentation and information on SHARE can be found at http://www.share-project.org. We excluded respondents aged under 60 and over 90 years, as explained in the next section, and respondents from Ireland or Israel because complete data were not available at the time of our study. We also left out respondents that had item non-response on any covariate under study, except for household income. We used logistic regression to test whether responding to the survival probability question was attributable to particular characteristics.

Measurement

Exploratory variable

SHARE provides an indicator of individuals' SSP. In the 'Expectations' module of the SHARE questionnaire, after a warm-up question and several other questions about expectations, respondents were asked to state their SSP on a scale from 0 to 100 as follows:

What are the chances that you will live to be age [T] or more?

The target age T (75, 80, 85, etc.) presented to the respondent depends on the age of the respondent. Respondents aged between 50 and 65 at the time of the interview were presented a target age of 75 years implying time horizons, that is the target age minus current age, ranging from 9 to 25 years. Respondents aged 66 through 90 years were presented with target ages using time horizons varying systematically between 9 and 15 years. For example, respondents aged 65 through 70 received a target age of 80, while those aged 80 through 85 received a target age of 95. Respondents older than 90 years got increasingly shorter time horizons with a minimum of 6 years. For congruity reasons, we decided to limit the variety of time horizons and therefore to retain only those respondents aged between 60 and 90 years old, who were all presented with a target age T which was in the range of 9–15 years from their current age. As time horizons differ between respondents, conditioning of the distribution of SSPs on age and target age is necessary.

Covariates

The covariates used in our analyses (and their reference categories) are displayed in Appendix 7.1. Below we highlight some variables that need further explanation.

Education was operationalised using a re-categorisation into four levels of the 1997 International Standard Classification of Education (ISCED-97). Respondents who indicated that they were still in school or have had an 'other type of education' were assigned to one of the four levels according to the number of years of education. *Household income* concerned the overall income received in Euros, net of tax, by all household members together in an average month in the last year. Missing values for income were imputed based on age, gender, country, household size, years of education and work status. Income value was adjusted (i) for household size, by dividing household income by the square root of the number of persons in the household, and (ii) for the purchasing power of different currencies using the PPP exchange rate of the year in which the interview was administered (i.e., 2006 or 2007). Because the distribution of income was skewed, income was dichotomised using the overall sample median (net) average income per month (€ 991).

We used the following health behaviour variables: *smoking*, *alcohol consumption* and *physical (in) activity*. We differentiated between non-smokers, past smokers (i.e., smoked at least for a year in the past) and current smokers. Data on alcohol consumption were used to construct a binary variable identifying respondents that consumed more alcohol than the recommended levels in the Netherlands (two glasses per day for men, one glass per day for women) in the last three months prior to the interview. Respondents were considered to be physically inactive when they hardly ever or never engaged in moderate (e.g., gardening, walking) or vigorous physical activity (e.g., sports).

Analyses

We provide descriptive statistics of the SSP variable with particular attention to the variation in SSP according to age and country. Intuitively, one may expect that the age of a respondent will have a considerable influence on his SSP to some future age. We used analysis of variance to this end. Furthermore, as we used data from 13 countries across Europe, we look for any particular response patterns of SSP across countries.

Multivariate analysis

We used multivariate ordinary least squares regression to examine the association between SSP and the covariates. We defined four models, each consecutive model nested in the previous one. The first model investigated the association of SSP with socio-demographic characteristics and socio-economic status, including a squared term of age to adjust for a nonlinear effect. In the second model, we added health indicators, and in the third model, we added lifestyle factors. Finally, in the fourth model, we tested for several interactions between socio-demographic variables and lifestyle variables

and subsequently added two statistically significant interaction terms: excessive alcohol consumption x gender, and physical inactivity x age. In addition, to explore possible country-specific associations, we estimated the fourth model for each country separately.

Reliability

It is important to understand whether respondents are willing and/or able to answer probabilistic questions.[3] We investigated the reliability of SSP responses using two criteria from the SHARE database. First, we took the sum of two related questions about the chance that the standard of living will be better or worse 5 years from now. To be internally consistent, answers to these questions should not add up to more than 100%. Considering some margin of error, a tolerance level of 10% was applied.[28] Second, we used a numeracy test. Respondents were asked: 'If the chance of getting a disease is 10 per cent, how many people out of the 1,000 would be expected to get the disease?' The possible answers were categorised as follows: 100, 10, 90, 900 and 'other'. To check the sensitivity of our findings to the reliability of SSP responses, we repeated our multivariate regression analysis using a subsample consisting of the respondents that provided valid answers to both criteria. Analyses were conducted using STATA 11 IC (StataCorp, College Station, TX, USA).

7.3 RESULTS

Sample characteristics

From the SHARE Wave 2 database (n=33,281), 20,421 respondents were selected based on their age and country of residence. Furthermore, 345 respondents (1.7%) with target ages outside the range of 9–15 years were excluded. SSP response rate in this subsample was about 89%; hence, 2,225 more respondents were dropped. Logistic regression analysis showed that, besides significant country differences, a higher age, a lower educational level and being physically inactive decreased SSP response rate significantly, $X^2(36)=808.44$, $p < .001$. Finally, from the 17,851 respondents left, we excluded observations with item non-response on any of the included covariates except household income (n=1,556), leaving 16,295 (81% of the relevant sample) respondents as our final sample for further analyses.

Overall subsample sizes varied by country, from approximately 1,600 in Italy and Belgium to around 800 in Austria and Switzerland. The overall composition of the sample by country was as follows: Austria 5.1%, Belgium 9.8%, Czech Republic 7.2%, Denmark 7.9%, France 7.4%, Germany 8.6%, Greece 8.8%, Italy 10.5%, the Netherlands 8.0%, Spain 5.7%, Sweden 9.0% and Switzerland 4.9%. Males were slightly underrepresented (47%). Table 7.1 provides the characteristics of our final sample.

TABLE 7.1 Sample characteristics (*n*=16,295)

Variable	Category	%
Age (mean [*SD*])		70.3 (7.2)
Male (%)		47.2
Living alone (%)		27.6
Parent(s) alive (%)		9.6
Child(ren) (%)		90.8
Educational level (%)	ISCED 0 or 1	37.0
	ISCED 2	17.6
	ISCED 3 or 4	29.6
	ISCED 5 or 6	15.8
Working (%)		8.2
Income high (%)		50.0
Living in rural area or small town (%)		51.8
Chronic disease (%)		81.3
Depressed (%)		24.3
Obese (%)		19.1
Doctor visits high (%)		45.7
Drug use (%)		78.9
Hospital stay (night) (%)		16.4
ADL limitations (%)		11.4
iADL limitations (%)		18.8
Smoking status (%)	Never	55.0
	No, stopped	30.2
	Yes	14.8
Excessive alcohol consumption (%)		34.1
Physically inactive (%)		12.4

Subjective survival probabilities

The mean time horizon in eliciting SSP was 12.4 years (SD=1.5), and the mean SSP was 56.5% (SD=30.4). Figure 7.1 presents the distribution of SSP, which took 58 different values in the range of 0 to 100. 7% of the respondents thought that they had no chance of surviving until their target age, and 12.7% thought this chance was 100%. Almost one quarter of the sample stated a SSP of 50%. A large majority of the respondents rounded their SSP: 93.6% of the answers were rounded to tens (50, 60, 70, etc.) and 98.7% to fives or tens (50, 55, 60, etc.).

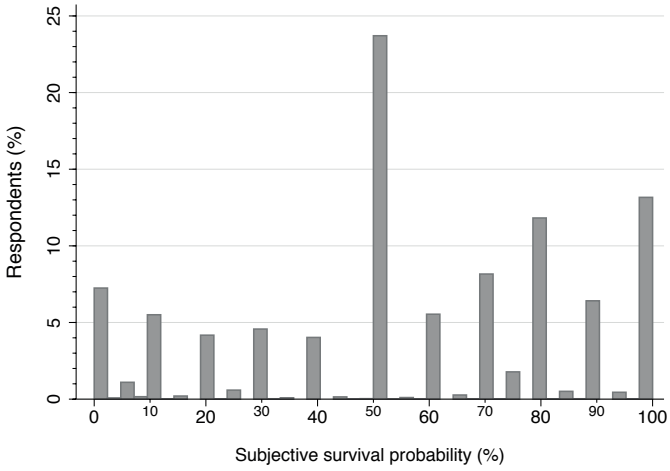

FIGURE 7.1 Distribution of subjective survival probability (*n*=16,295)

Age groups

We constructed six age categories with 5-year age bands. Table 7.2 presents these categories, the number of respondents, the time horizon and the mean SSP for each age group. Mean SSP varied significantly across all age groups, $F(5, 16{,}294)=595.68$, $p < .001$. As expected, the youngest age group reported the highest SSP (68.7%) and the oldest group reported the lowest (28.3%). Time horizons differed across age groups, for example the mean time horizon of the age group 65-70 years was significantly lower compared to all other age groups.

TABLE 7.2 Time horizon and subjective survival probability by age group (*n*=16,295)

Age categories	*n*	Time horizon Mean (SD)	Survival probability Mean (SD)
Age 60-65 yrs	4,807	12.6 (1.5)	68.7 (25.2)
Age 65-70 yrs	3,939	11.6 (1.5)	62.9 (27.6)
Age 70-75 yrs	3,183	12.6 (1.4)	54.0 (29.1)
Age 75-80 yrs	2,403	12.7 (1.5)	44.1 (30.6)
Age 80-85 yrs	1,427	12.8 (1.4)	35.4 (29.5)
Age 85-90 yrs	536	13.0 (1.3)	28.3 (30.4)
Total	**16,295**	**12.4 (1.5)**	**56.5 (30.4)**

Mean SSP varied significantly across countries, $F(12, 16{,}282)=61.72$, $p < .001$. The means in the Czech Republic and Poland were clearly the lowest, that is 42.1% and 44.3%, respectively. The average SSP in Belgium (lowest), Germany, Austria, France, Sweden, Spain and Greece (highest) ranged from 53.6% to 59.5%.

In four countries (Netherlands, Italy, Denmark and Switzerland), mean survival probabilities were higher than 60%, with highest mean SSP reported in Denmark (64.1%). Mean time horizons were all within the range of 12.25 years (Germany) to 12.47 years (Greece), while mean ages across countries varied from 69.6 years to 71.9 years for the Netherlands and Spain, respectively.

Figure 7.2 presents the mean SSP by age group and country. All countries showed a similar pattern to that in Table 7.2, with some deviation in the patterns of Poland and the Czech Republic. Note that the mean SSP in these two countries were significantly lower than in all other countries. In Sweden, the range of mean survival probabilities, from the lowest age group (i.e., 60–65 years) to the highest age group (i.e., 85–90 years), was greatest, while this range was smallest in Poland.

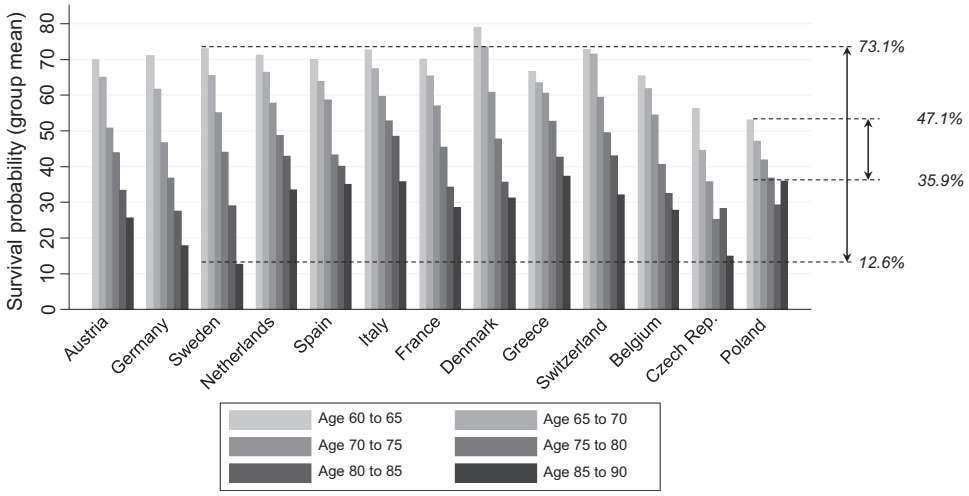

FIGURE 7.2 Subjective survival probability by age category and country

Multivariate analysis

Table 7.3 presents the results of the multivariate analysis of SSP including all the covariates shown in Table 7.1. Results indicated that the final model explains 26% of the variance in SSP. The R^2 significantly increased with each consecutive model, although the actual increments in R^2 were relatively small. In general, the (signs of the) coefficients of the covariates were fairly stable across the four models, except for the first, most restrictive model.

A longer time horizon was negatively associated with respondents' SSP. Men had lower SSPs than women (not confirmed in Model 1), while age showed an accelerating declining effect on SSP (given the significant squared term). Country coefficients varied to a great extent in line with the results from Figure 7.2.

TABLE 7.3 Regression analysis of subjective survival probability

Variable	Model 1	Model 2	Model 3	Model 4
Time horizon	-1.62***	-1.65***	-1.66***	-1.65***
	(0.144)	(0.140)	(0.140)	(0.140)
Male	-0.51	-2.31***	-2.65***	-1.55***
	(0.416)	(0.410)	(0.451)	(0.552)
Age	-1.24***	-1.14***	-1.14***	-1.15***
	(0.075)	(0.073)	(0.073)	(0.073)
(Age)^2	-0.02***	-0.01**	-0.01*	-0.01***
	(0.004)	(0.004)	(0.004)	(0.004)
Germany	-4.55***	-4.72***	-4.92***	-4.87***
	(1.315)	(1.253)	(1.252)	(1.252)
Sweden	0.46	-1.51	-2.00	-2.05
	(1.374)	(1.330)	(1.334)	(1.332)
Netherlands	2.93**	1.33	1.00	1.05
	(1.290)	(1.235)	(1.242)	(1.241)
Spain	2.63*	2.84**	2.90**	2.97**
	(1.530)	(1.448)	(1.449)	(1.447)
Italy	6.66***	7.59***	7.77***	7.90***
	(1.301)	(1.239)	(1.240)	(1.239)
France	1.67	2.01	1.64	1.68
	(1.320)	(1.262)	(1.263)	(1.264)
Denmark	6.77***	5.11***	4.70***	4.63***
	(1.366)	(1.309)	(1.317)	(1.317)
Greece	3.41***	2.48**	2.33*	2.39**
	(1.257)	(1.207)	(1.207)	(1.207)
Switzerland	5.13***	2.91**	2.54*	2.65*
	(1.441)	(1.394)	(1.397)	(1.396)
Belgium	-2.20*	-1.79	-2.19*	-2.18*
	(1.237)	(1.183)	(1.184)	(1.184)
Czech Republic	-14.33***	-14.41***	-14.32***	-14.32***
	(1.397)	(1.330)	(1.328)	(1.328)
Poland	-10.81***	-6.96***	-6.64***	-6.51***
	(1.434)	(1.380)	(1.382)	(1.382)
Living alone	-2.82***	-1.98***	-1.78***	-1.75***
	(0.559)	(0.541)	(0.541)	(0.541)

TABLE 7.3 Continued

Variable	Model 1	Model 2	Model 3	Model 4
Parent(s) alive	3.13***	3.04***	2.99***	2.93***
	(0.680)	(0.662)	(0.660)	(0.659)
Child(ren	1.50*	1.75**	1.59**	1.56**
	(0.799)	(0.775)	(0.775)	(0.774)
ISCED 2	0.82	-0.30	-0.35	-0.32
	(0.677)	(0.657)	(0.656)	(0.656)
ISCED 3 or 4	2.69***	1.00	0.80	0.78
	(0.623)	(0.606)	(0.607)	(0.607)
ISCED 5 or 6	4.01***	1.92***	1.61**	1.56**
	(0.722)	(0.706)	(0.704)	(0.704)
Working	4.44***	3.09***	3.12***	2.97***
	(0.764)	(0.758)	(0.757)	(0.755)
Income high	1.18*	0.75	0.63	0.54
	(0.606)	(0.589)	(0.588)	(0.588)
Rural area	-1.15**	-1.24***	-1.31***	-1.34***
	(0.482)	(0.467)	(0.467)	(0.467)
Chronic disease		-2.18***	-2.20***	-2.19***
		(0.623)	(0.623)	(0.623)
Depressed		-9.66***	-9.32***	-9.31***
		(0.567)	(0.569)	(0.569)
Obese		-0.66	-0.74	-0.66
		(0.552)	(0.552)	(0.552)
Doctor visits high		-3.63***	-3.64***	-3.62***
		(0.473)	(0.472)	(0.471)
Drug use		-2.89***	-2.90***	-2.83***
		(0.622)	(0.621)	(0.621)
Hospital stay (night)		-1.06*	-0.84	-0.84
		(0.618)	(0.619)	(0.618)
ADL limitations		-2.64***	-1.92**	-2.10**
		(0.808)	(0.821)	(0.822)
iADL limitations		-5.73***	-5.09***	-5.16***
		(0.676)	(0.686)	(0.684)
Stopped smoking			0.43	0.36
			(0.513)	(0.513)

TABLE 7.3 Continued

Variable	Model 1	Model 2	Model 3	Model 4
Currently smoking			-2.85***	-2.87***
			(0.639)	(0.639)
Excessive alcohol consumption			1.82***	0.46
			(0.472)	(0.611)
Physically inactive			-3.62***	-6.54***
			(0.816)	(1.185)
Excessive alcohol consumption x female				3.07***
				(0.867)
Physically inactive x age				0.33***
				(0.096)
Constant	82.24***	93.27***	93.69***	93.53***
	(2.309)	(2.279)	(2.284)	(2.285)
***F* stat**	164.67	167.14	151.75	145.48
R^2	0.21	0.26	0.26	0.26
Adjusted R^2	0.21	0.25	0.26	0.26

Note. *N*= 16,295. Robust standard errors in parentheses. Austria is country reference group. For education, ISCED 0 or 1 is reference group. For smoking status, non-smokers are reference group.
*** $p<.01$, ** $p<.05$, * $p<.10$

Other important predictors of SSPs are mental health and the variables related to the social environment of the respondent. In particular, individuals who indicated that one or both parents were still alive reported significantly higher probabilities (Model 4: coefficient 2.93), having children had a similar, albeit smaller effect. The effect of living alone was also similar, but negative. Living in a rural area or small town was associated with lower SSPs.

In Model 4, all health indicators, except for obesity and hospital stay overnight, were negatively associated with SSP. Regarding the lifestyle covariates, respondents who smoked or were physically inactive reported lower SSPs, while having quit smoking was not related to SSP. Interestingly, excessive alcohol consumption was associated with higher SSP in the third model, but when adding the interaction term with gender, the main effect was no longer significant. The interaction term, however, was significant indicating that the 'positive' effect from the third model related only to women. In other words, only women who drink excessively (i.e., more than one glass per day) had significantly higher SSP. Age significantly attenuated the negative effect of being physically inactive on SSP.

The estimation of the fourth regression model for each country separately revealed a similar pattern for many variables in terms of sign and magnitude of the coefficient, for example, for 'time horizon', 'age',

'depression' and 'doctor visits'. Table 7.4 shows estimation results for six countries (the other countries are shown in Appendix 7.2). Coefficients of some other variables, however, differed substantially. Among others, the effects of gender and having children from the previous analysis were not present in any of the six countries, while smoking only had a significant negative association with SSP in the Netherlands. Former smokers from Spain and the Czech Republic reported significantly higher SSP than non-smokers, while quitters from the Netherlands reported lower probabilities. The results for alcohol consumption also differed from the original analysis, while the outcomes for the variable 'physically inactive' were similar to those in Table 7.3. Note that the standard errors are much larger due to smaller sample sizes.

TABLE 7.4 Subjective survival probability regression analysis (Model 4) by country

Variable	Sweden	Netherlands	Spain	Italy	Greece	Czech Rep
Time horizon	-1.35***	-1.86***	-1.98***	-1.29***	-0.65	-1.86***
	(0.509)	(0.442)	(0.601)	(0.451)	(0.411)	(0.512)
Male	1.05	1.31	-2.73	-1.77	2.49	1.18
	(1.839)	(1.824)	(2.095)	(1.649)	(1.588)	(2.074)
Age	-1.02***	-1.44***	-1.16***	-0.84***	-0.27	-2.15***
	(0.285)	(0.236)	(0.345)	(0.228)	(0.209)	(0.251)
(Age)^2	-0.06***	0.01	0.00	-0.01	-0.04***	0.06***
	(0.015)	(0.014)	(0.019)	(0.015)	(0.013)	(0.016)
Living alone	-2.07	1.06	-2.45	-3.22*	-4.13***	2.71
	(1.927)	(1.860)	(2.934)	(1.927)	(1.409)	(1.746)
Parent(s) alive	1.35	-1.10	8.32***	4.55**	1.77	1.16
	(2.030)	(2.210)	(3.045)	(2.188)	(1.736)	(2.707)
Child(ren)	4.65	2.68	4.06	-2.27	-0.82	4.60
	(2.942)	(2.775)	(4.097)	(2.456)	(1.821)	(2.970)
ISCED 2	3.70*	-2.22	-2.68	-1.31	-1.25	-1.04
	(2.088)	(2.083)	(2.576)	(1.916)	(1.920)	(2.144)
ISCED 3 or 4	6.71***	0.73	2.51	-3.88*	2.83*	-2.78
	(1.988)	(2.393)	(3.405)	(2.132)	(1.713)	(2.257)
ISCED 5 or 6	0.20	-1.83	0.34	-6.31**	1.68	-1.77
	(2.059)	(2.484)	(3.549)	(2.678)	(2.170)	(3.077)
Working	5.02**	1.83	4.88	2.56	-1.06	1.06
	(2.126)	(2.527)	(3.711)	(3.272)	(1.968)	(3.319)
Income high	-2.18	2.63	-6.36***	2.30	1.58	-25.67***
	(3.955)	(2.138)	(2.183)	(1.593)	(1.340)	(3.592)
Rural area	-2.87*	0.83	-1.14	-2.14	1.80	-3.53**
	(1.577)	(1.501)	(2.082)	(1.648)	(1.506)	(1.631)

TABLE 7.4 Continued

Variable	Sweden	Netherlands	Spain	Italy	Greece	Czech Rep
Chronic disease	-1.54	-3.37*	-3.68	-2.40	-1.12	-4.86*
	(1.963)	(1.900)	(2.769)	(2.334)	(1.857)	(2.553)
Depressed	-3.75	-7.35***	-12.86***	-13.23***	-7.88***	-9.24***
	(2.306)	(2.042)	(2.337)	(1.666)	(1.749)	(1.910)
Obese	1.23	2.95	-5.21**	-0.44	0.21	-1.29
	(2.068)	(1.968)	(2.151)	(1.748)	(1.427)	(1.714)
Doctor visits high	-1.50	-5.42***	-7.44***	-0.10	-3.96***	-6.43***
	(1.607)	(1.644)	(2.045)	(1.456)	(1.248)	(1.777)
Drug use	-5.53***	-3.79**	2.52	-1.34	-1.20	-2.82
	(1.979)	(1.747)	(2.907)	(2.239)	(1.861)	(2.782)
Hospital stay (night)	3.48	-1.62	-6.11**	1.88	-4.13*	-0.28
	(2.383)	(2.319)	(2.676)	(2.010)	(2.275)	(2.061)
ADL limitations	-0.23	-0.50	2.71	-7.19***	-8.33***	-2.31
	(3.069)	(3.315)	(3.656)	(2.722)	(3.033)	(2.637)
iADL limitations	-2.35	-6.34***	-12.51***	-5.08**	2.71	-4.00*
	(2.768)	(2.232)	(3.072)	(2.109)	(1.667)	(2.311)
Stopped smoking	-1.23	-3.04*	4.05*	0.96	2.77	3.44*
	(1.598)	(1.571)	(2.436)	(1.684)	(1.706)	(2.011)
Currently smoking	-3.71	-7.66***	-1.84	0.24	-1.41	-0.96
	(2.380)	(2.232)	(3.186)	(2.105)	(1.557)	(2.439)
Excessive alcohol consumption	-2.61	-3.75*	-1.43	0.33	3.91**	-4.70**
	(2.100)	(2.026)	(2.817)	(1.929)	(1.659)	(2.299)
Physically inactive	-18.83***	-3.33	-8.85*	-6.89**	-14.79***	-9.46***
	(6.009)	(4.569)	(4.680)	(2.786)	(4.727)	(3.013)
Excessive alcohol consumption x female	6.48**	6.94**	10.11*	3.46	2.43	4.33
	(2.992)	(2.776)	(5.654)	(3.484)	(2.553)	(3.373)
Physically inactive x age	1.33***	0.35	0.41	0.48*	1.07***	0.16
	(0.469)	(0.408)	(0.395)	(0.260)	(0.361)	(0.274)
Constant	85.76***	98.03***	102.38***	97.65***	75.21***	83.63***
	(7.326)	(6.674)	(8.754)	(6.717)	(5.861)	(7.414)
Observations	1,471	1,302	923	1,715	1,428	1,179
R^2	0.32	0.23	0.28	0.18	0.21	0.27
Adjusted R^2	0.30	0.22	0.26	0.17	0.20	0.25

Note. Robust standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.10$

Reliability

The final analyses concerned the reliability of the answers to the SSP question. 435 respondents (2.7%) did not answer either one or both of the two questions about the standard of living in 5 years. Of the remaining 15,860 respondents, 96.9% provided a reliable answer. In addition, 77% (*n*=12,550) of the respondents answered the numeracy question correctly. In total, a subsample of 11,918 respondents (75.2%) answered both questions validly.

Re-estimation of the fourth regression model (from Table 7.3) with this subsample showed that this model performed similarly to the initial model (using our original sample) in terms adjusted R^2 (0.24 vs. 0.26) (results not shown here). Although the coefficients varied somewhat in size between both analyses, almost all variables retained their sign and statistical significance.

7.4 DISCUSSION

In this chapter, we have presented the SSP from respondents aged 60 through 90 years from several European countries, using data from the second wave of SHARE and related them to general characteristics, (mental) health and, our main focus, lifestyle factors. The average SSP of surviving the next 9–15 years was around 57%. In general, the findings from this chapter show associations between SSP and socio-demographic, socio-economic, social context and (objective) health indicators in line with previous research.

Regarding socio-economic status, one would expect a positive significant relation between measures like education and income and SSP, considering the fact that richer and higher educated people may have better living conditions as well as better access to (better) healthcare services. Indeed, our results suggest that higher educated respondents report higher SSP, but this effect diminishes once we introduce health and lifestyle variables into our model. The same pattern holds for income, where we only find a significant association between a higher income and SSP in our first model, although the sign remains consistent in all models.

Obesity is not significantly associated with SSP. Although several previous studies did report such an association, it is coherent with the recent literature that indicates that being obese at older ages does not necessarily shorten remaining life expectancy but instead increases morbidity and disability. It would therefore be interesting to investigate whether obese individuals adjust their expectations regarding future quality of life accordingly.

As expected, smokers reported significantly lower survival chances compared to non-smokers. Interestingly, however, no SSP difference was found between non-smokers and former smokers. This is interesting, since risk of disease and early death from most smoking-related causes only declines to the level of never-smokers after many years. A number of possible explanations for this somewhat

surprising finding may be given. First, quitters may have already stopped smoking for many years and therefore take all the benefits of quitting into consideration. Alternatively, more recent quitters may be overoptimistic regarding the benefits of stopping and incorporate this into their survival chances. Finally, our findings may also indicate that non-smokers underestimate their SSP.

The association between SSP and alcohol consumption is rather striking. Our third regression model showed that individuals who drink excessively report significantly higher SSP than moderate drinkers and abstainers. However, after introducing the interaction term 'excessive alcohol consumption x gender', this result only held for female excessive drinkers. A possible explanation for this has to do with the (believed) protective effect of (light–)moderate alcohol consumption. Female excessive drinkers might not consider themselves to be heavy drinkers and therefore belief to have benefits from their alcohol use. This relates to the fact that excessive drinking among women, according to the Dutch alcohol norm, starts from one glass of alcohol per day. Another possible explanation comes from the increasing risk of harmful health effects as the amount of drinking increases. From our data, it turned out that men, next to being more likely than women to drink excessively, consume more alcohol also excessively.

Finally, physical inactivity was negatively associated with SSP. It is important to emphasise that such an association need not signal causality. Indeed, being physically inactive may result from poor health rather than being a lifestyle decision. The fourth regression model indicated that a higher age attenuates the negative relation between physical inactivity and SSP. This may be partly explained by the acceptance of less mobility or a poorer health state at more advanced stages of life. If a declining physical functionality is considered a normal part of ageing, then its relation with SSP may become weaker. Instead, physical inactivity at younger ages can be an outcome of a serious health issue that individuals may believe to influence their longevity.

Cross-country differences

Our results showed important cross-country differences in terms of average SSP, the range between the lowest and highest age group, and some associations between SSP and the covariates, such as alcohol consumption and having stopped smoking. Regarding the latter, current smokers in the Netherlands reported by far the lowest SSP relatively to non-smokers and quitters. This may signal that Dutch smokers are informed about and aware of the negative effects of smoking on life expectancy. Therefore, despite the success of tobacco control policies in declining smoking rates and raising awareness about the harmful effects of smoking, the Dutch government may reconsider its prioritisation in tobacco control, aiming, for example, at higher prices of cigarettes and better treatment (coverage) to help smokers stop, instead of increasing consumer information. These results show the value of examining the differences in the public uptake of preventive strategies between countries.

Furthermore, a striking finding in this chapter was the fact that, overall, respondents living in a rural area or small town reported significantly lower expected survival chances than respondents living in an urban environment. In our country analyses, we found this negative significant relationship only for Sweden and the Czech Republic, although for most countries the signs were consistent with our main model. This clear impact of living in a rural area deserves more attention in future studies. While it may reflect differences in lifestyles, access to healthcare facilities or working conditions, the current study cannot answer these questions.

Overall, results from Poland and the Czech Republic seemed to be somewhat deviant compared to other countries. A possible explanation is that both Eastern European countries were not included in the first wave of SHARE. This means that both the Czech and Polish respondents were probably unfamiliar with the probabilistic format as well as with subjective longevity questions, which may have had some influence on their responses. Alternatively, respondents from other countries were observed for the second time and may have gained knowledge about their longevity expectations prior to the second wave (so-called learning effect). It would therefore be interesting to see whether the result patterns between Eastern and Western European samples are more similar in the fourth wave of SHARE. These considerations also raise the question whether it is more informative to analyse all country samples separately instead of aggregating these subsamples to one sample. In that context, a recent cross-sectional study by Péntek et al.[36] showed that subjective life expectancy patterns (using a point estimate) in Hungary and the Netherlands were similar, despite differences in actuarial life expectancy and cultural diversity. This supports the idea that results across European samples may be comparable.

Probabilistic format

The use of the probabilistic format when investigating subjective longevity expectations is increasingly embraced in the literature for reasons of interpretation, interpersonal comparability and comparisons with known event frequencies, and the possibility to investigate the consistency of responses.[37] However, it is still important to understand the willingness and capability of individuals to answer probabilistic questions. A promising result from our study in this chapter that supports the use of SSPs is the relatively high SSP response rate (89%), especially considering the average age of our sample (around 70 years). It is unclear how much of the non-response can be ascribed to misunderstanding, cognition or observation error. Our analysis showed that, among other things, non-response was higher in certain countries and among older and lower educated people. This indicates that the use of probabilities as an elicitation method may be less valid under some circumstances. Recently, initiatives using visual aids have been employed that could be useful in respondents who are less capable or willing to answer probability questions verbally. See Delavande et al.[38] for instance, for a review on methods for eliciting SSPs in developing countries.

We have addressed this issue also by identifying 'reliable' respondents according to two validity criteria. Outcomes using only reliable responses (around 75% of our sample) were very similar to our original analysis. This is indicative of good validity of the SSP question, but still it is worth investigating further whether respondents should be systematically excluded based on such criteria. In a similar context, however, Hurd and McGarry[5] argue that even lower quality responses contain information that is worthwhile. Furthermore, they argue that a certain amount of inconsistency (i.e., as found in our study) is acceptable and most likely similar to inconsistencies and errors found in many of the predictor variables.

Related issues are that of rounding numerical responses and 'focal-point responses', which are common in SSP data.[8,12] From the distribution shown in Figure 7.1, it becomes evident that this is also the case in our study. For example, the (often highest) spike at 50% is problematic in terms of interpretation. Bruine de Bruin et al.[39] suggest that this response may reflect more fundamental uncertainty (similar to 'don't know') or the cognitive inability to answer probabilistic questions rather than real probabilistic thinking. However, while focal values probably represent measurement error, it is still believed that focal-point responses do contain valuable information. Therefore, the general practice is to take numerical answers at face value instead of correcting for biases, including those at 0%, 50% and 100%.[8,40] This line was also taken here.

Limitations

Several issues deserve attention when interpreting the results from this chapter. First, a drawback of our study is a consequence of the fact that SHARE only includes one SSP question with one individual target age instead of a sequence of questions using different target ages. Therefore, SHARE does not provide the opportunity to estimate a whole distribution of probabilities of the expected 'time of death'.

Another limitation concerns the measures used for assessing objective health. The input for our health indicators, like the amount of doctor visits, were given by the respondents and not objectively measured. This arguably introduces measurement errors. More objective health measures, such as the measurement of how fast a respondent can expel air from his/her longs and walking speed, were present in the dataset of SHARE but available only for certain age groups. Moreover, response rates were relatively low, possibly because respondents did not feel safe performing the tests. We deliberately opted for the most objective measure of health status available instead of a subjective measure, such as self-assessed health. Previous research has shown that self-assessed health is indeed a good predictor of SSP and predicts mortality rather well,[28] but more objective health indicators reduce problems of endogeneity.

Third, as SSP was measured on a continuous scale that took on a value within a defined range from 0 to 100, ordinary least squares regression may prove inadequate as it does not necessarily constrain inference about the outcome values to the predefined range.[41] To test the influence on our results, we also performed a generalised ordered logit model for ordinal dependent variables. SSP was restructured into three ordinal categories: 0–33% (*n*=3,860), 34–66% (*n*=5,530) and 67–100% (*n*=6,905). The results (not shown here) showed largely the same outcomes as the ordinary least squares regression (in terms of both signs of the coefficients and significance levels). The most salient results were the lack of significance for the variables 'age squared' and 'having children'. Other differences from the original analysis were merely related to the degree of significance. Some covariates, like 'age', 'depression', 'physical inactivity' and two country dummies, violated the parallel lines assumption, which means that their effect is not the same across the three SSP categories (but these differences are related more to the strength of the observed relationships than more fundamental differences). Overall, this lends support to our choice for interpreting the independent variable as continuous and for presenting the results from the ordinary least squares regression.

A final, important issue is related to the use of cross-sectional data. It is clear that using panel data allows us to better understand the formation of SSPs. The use of panel data would provide the opportunity to see whether people update their SSP according to new information and events (e.g., quit smoking). However, the objective in our study was mainly of descriptive nature and, moreover, at the time of this study, only two 'prospective' waves were available. Only few people that would fit our criteria of sample inclusion and that participated in the first wave had experienced relevant new events or passed away before the start of the second wave. Moreover, it needs to be stressed that even when using panel data, statements about causality regarding the relation between SSP and behaviour remain tentative and contentious since this relation is to a large extent circular. In other words, it is unclear whether SSPs are affected by lifestyle decisions and/or vice versa. Other, advanced econometric methods may be used to tackle this issue of endogeneity.

Conclusions

The findings from our study suggest that SSPs are useful, informative and important in relation to lifestyle decisions and can be validly obtained in elder people. Although negative health effects of certain lifestyle decisions are widely publicised, individuals may not adequately personalise the possible consequences of such decisions. Unawareness or underestimation of health risks related to unhealthy behaviour (e.g., excessive alcohol consumption) or the possible benefits from lifestyle improvements impede the effectiveness of health policy aimed at improving lifestyle and with that reducing avoidable premature mortality. Our results show that the relation between SSP and lifestyle differs among subgroups. This was most markedly for excessive alcohol consumption among men and women and, to a lesser extent, for physical inactivity at higher ages. Obese respondents did not report lower SSP than respondents with normal weight, despite the fact that research shows that

obese adults recognise the adverse health effects of obesity.[42] Moreover, significant cross-country differences regarding SSP and its relation to lifestyle were observed. These findings provide interesting implications for health policy and, for instance, targeting health communication strategies. Moreover, they warrant the further exploration of not only SSPs, but also of expectations of future quality of life in relation to lifestyle decisions.

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APPENDICES

APPENDIX 7.1 Glossary of variables

Variable	Variable definition / categories
SSP	Subjective survival probability (range 0-100)
Time horizon	Target age - current age (range 9-15 years)
Male	1 if male, 0 if female
Age	Age in years
(Age)^2	Age in years squared
Country (dummy variables)[a]	Austria (reference group), Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Czech Republic, Poland
Living alone	1 if living alone, 0 if living with spouse or partner
Parent(s) alive	1 if one or both parents alive, 0 if no parents alive
Child(ren)	1 if respondent has child(ren), 0 if respondent has no child(ren)
ISCED 2[b]	1 if lower secondary education or second stage of basic education, 0 otherwise
ISCED 3 or 4[b]	1 if (upper) secondary education or post-secondary non tertiary education, 0 otherwise
ISCED 5 or 6[b]	1 if first or second stage of tertiary education, 0 otherwise
Working	1 if worker (both employed and self-employed), 0 otherwise
Income high[c]	1 if above median income, 0 if below median income
Rural area	1 if living in a small town, rural area, or village, 0 if living in a city, suburb, or large town.
Chronic disease[d]	1 if chronically ill, 0 if not chronically ill
Depressed[e]	1 if depressed, 0 if not depressed
Obese	1 if obese (BMI ≥ 30 kg/m^2), 0 otherwise
Doctor visits high[f]	1 if above country median number of contacts with medical doctor in the last 12 months, 0 otherwise
Drug user	1 if used physician prescribed drugs in the last week, 0 otherwise
Hospital stay (night)	1 if a respondent stayed in a hospital overnight during the last 12 months, 0 otherwise
ADL limitation	1 if at least one limitation with daily activities of daily living (e.g., dressing), 0 otherwise
iADL limitation	1 if at least one limitation with instrumental activities of daily living (e.g., preparing hot meal), 0 otherwise
Stopped smoking[g]	1 if quit smoking, 0 otherwise
Currently smoking[g]	1 if currently smoking, 0 otherwise
Excessive alcohol consumption	1 if drinking more than recommended levels or excessively, 0 otherwise
Physically inactive	1 if physically inactive, 0 otherwise
Excessive alcohol consumption x female	1 if female and drinking more than recommended levels or excessively, 0 otherwise
Physically inactive x age	Physically inactive multiplied by age

[a] Reference category (indicated by 0) is Austria, because the mean SSP was closest to the overall sample mean SSP.
[b] Reference group is ISCED 0 or 1, i.e. no education, pre-primary education, primary education and first stage of basic education.
[c] Overall sample median (net) average income per month is € 991, adjusted for household size and PPP.
[d] A respondent was considered to be chronically ill in case s/he reported to be diagnosed with a chronic disease by a doctor.
[e] Depression was assessed using the 12-item EURO-D scale with scores above three indicating a clinically significant level of depression.
[f] Dentist visits were disregarded.
[g] Reference group is non-smokers.

APPENDIX 7.2 Subjective survival probability regression analysis (Model 4) by country

Variable	Austria	Germany	France	Denmark	Switzerland	Belgium	Poland
Time horizon	-2.86***	-2.94***	-1.20**	-1.27**	-1.88***	-1.79***	-1.22**
	(0.600)	(0.473)	(0.531)	(0.497)	(0.649)	(0.437)	(0.532)
Male	-2.56	-3.40*	-5.98**	-3.60	-3.33	-1.32	-3.14
	(2.230)	(1.972)	(2.319)	(2.481)	(2.568)	(1.887)	(2.193)
Age	-1.50***	-1.94***	-1.20***	-1.53***	-0.94***	-1.13***	-0.98***
	(0.325)	(0.295)	(0.268)	(0.254)	(0.338)	(0.212)	(0.283)
(Age)^2	0.00	0.02	-0.00	-0.00	-0.03	-0.02	0.03
	(0.019)	(0.017)	(0.018)	(0.015)	(0.020)	(0.014)	(0.019)
Living alone	3.32	-0.49	-2.62	-4.87**	-0.12	0.23	-3.53*
	(2.243)	(2.140)	(1.925)	(1.942)	(2.373)	(1.659)	(2.092)
Parent(s) alive	1.35	8.31***	2.49	0.88	3.48	3.41*	1.98
	(3.246)	(2.213)	(2.203)	(2.333)	(2.828)	(2.027)	(3.250)
Child(ren)	6.33**	-0.19	-1.42	-0.42	-1.04	0.20	11.33***
	(2.809)	(3.025)	(2.648)	(3.177)	(2.888)	(2.234)	(3.652)
ISCED 2	5.66*	-2.14	4.77*	0.23	-5.53	0.89	13.59**
	(3.166)	(10.088)	(2.770)	(3.917)	(3.435)	(1.764)	(6.669)
ISCED 3 or 4	4.99**	-0.21	1.43	3.26	-1.62	-1.24	2.16
	(2.494)	(9.939)	(1.943)	(2.221)	(3.021)	(1.861)	(2.105)
ISCED 5 or 6	8.30**	3.11	3.48	2.54	0.77	2.56	2.07
	(3.285)	(10.091)	(2.284)	(2.269)	(3.944)	(1.935)	(3.694)
Working	6.22	3.22	4.99	1.99	-0.45	-2.24	1.11
	(3.905)	(2.672)	(3.158)	(2.188)	(2.722)	(3.031)	(6.311)
Income high	3.48	4.42*	0.85	-3.91	0.32	2.18	-1.91
	(2.305)	(2.281)	(2.067)	(2.984)	(2.227)	(1.605)	(2.916)
Rural area	-0.40	-2.55	0.27	-2.09	-0.85	-1.59	-2.31
	(2.122)	(1.566)	(1.695)	(1.533)	(2.183)	(1.395)	(1.997)
Chronic disease	-4.79*	1.09	-4.16*	-2.71	-2.33	1.24	-6.55**
	(2.477)	(2.054)	(2.213)	(1.935)	(2.412)	(1.982)	(3.333)
Depressed	-11.40***	-10.76***	-11.15***	-7.77***	-3.98	-7.90***	-9.59***
	(2.692)	(2.195)	(1.735)	(2.559)	(3.244)	(1.660)	(1.879)
Obese	-3.03	-2.41	2.87	-1.40	-2.54	-0.54	1.34
	(2.201)	(2.161)	(2.146)	(2.178)	(3.165)	(1.675)	(2.051)
Doctor visits high	-1.55	-3.90**	-4.58***	-4.99***	-5.34**	-3.96***	-2.53
	(1.981)	(1.635)	(1.766)	(1.681)	(2.182)	(1.514)	(1.896)

APPENDIX 7.2 Continued

Variable	Austria	Germany	France	Denmark	Switzerland	Belgium	Poland
Drug use	-1.32	-4.82**	-0.72	-3.52*	1.01	-3.00	-1.15
	(2.500)	(2.021)	(2.379)	(1.887)	(2.568)	(1.993)	(2.956)
Hospital stay (night)	-1.05	0.46	-2.12	0.81	1.42	-0.78	-5.51**
	(2.223)	(1.978)	(2.287)	(2.224)	(2.909)	(1.845)	(2.150)
ADL limitations	-7.36**	-1.12	-0.32	2.05	-2.26	-3.24	-0.69
	(3.245)	(2.836)	(2.832)	(3.757)	(5.408)	(2.282)	(2.205)
iADL limitations	-9.21***	-7.61***	-1.51	-8.51***	-9.01***	-3.49	-8.38***
	(2.917)	(2.852)	(2.418)	(3.066)	(4.348)	(2.171)	(2.288)
Stopped smoking	-0.44	1.10	2.87	0.96	-2.06	-2.89*	-0.97
	(2.355)	(1.801)	(1.968)	(1.651)	(2.354)	(1.547)	(2.219)
Currently smoking	-3.81	-3.46	0.34	-2.26	-1.37	-7.03***	-4.65*
	(2.814)	(2.269)	(2.771)	(2.029)	(2.843)	(2.251)	(2.548)
Excessive alcohol cosumption	1.45	-0.14	3.16	-0.68	-1.04	3.57*	4.80*
	(2.766)	(2.077)	(2.456)	(2.288)	(2.796)	(1.909)	(2.518)
Physically inactive	-4.28	-4.42	-2.27	-8.12	-7.51	-3.65	4.75
	(4.255)	(5.810)	(4.135)	(6.566)	(10.093)	(3.862)	(3.064)
Excessive alcohol consumption x female	-1.37	3.84	-4.42	3.93	-0.33	1.53	-1.21
	(3.702)	(2.988)	(3.187)	(3.047)	(3.717)	(2.647)	(3.867)
Physically inactive x age	0.45	-0.12	-0.40	-0.24	0.09	0.11	-0.15
	(0.327)	(0.420)	(0.323)	(0.423)	(0.703)	(0.296)	(0.296)
Constant	99.09***	106.05***	90.73***	100.14***	104.31***	90.40***	71.15***
	(9.191)	(11.928)	(7.886)	(7.312)	(9.575)	(6.450)	(8.155)
Observations	829	1,403	1,206	1,280	794	1,597	1,168
R^2	0.33	0.31	0.27	0.32	0.22	0.24	0.17
Adjusted R^2	0.31	0.30	0.25	0.31	0.20	0.23	0.15

Note. Robust standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.10$

Chapter 8

Measuring Subjective Life Expectancy

Survival Probabilities versus Point Estimates

Based on:
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8.1 INTRODUCTION

The study of subjective life expectancy (SLE) is important in the context of economic choice behaviour,[1] predicting mortality[2] and investment in future health[3]. Such individual subjective expectations may contain information not captured by their objective, actuarial counterparts.[4] Therefore, subjective longevity beliefs are increasingly elicited in order to better understand peoples' decisions in various life domains, including health.

However, the measurement of SLE is not straightforward. In general, two elicitation approaches can be distinguished: the non-probabilistic and the probabilistic approach.[1] The first approach concerns the direct measurement of individuals' subjective estimates of expected lifetime, typically asking for a point estimate. While this method is simple and straightforward to administer, it does not provide information regarding the uncertainty of reaching the specified age.[5] The second elicitation approach asks people for their subjective survival probability (SSP), i.e. their assessment of the probability of surviving to a certain target age. SSPs are used in various large-scale household surveys such as, for example, the Health Retirement Study (HRS) and the Survey of Health, Ageing and Retirement in Europe (SHARE). Research using such data has focused on their accuracy compared to actuarial data, their predictive power for actual mortality, and their relevance in the context of economic decisions.[6-8] SSPs capture uncertainty and allow for computing survival probability distributions, but do not inform directly about SLE, and their elicitation is cognitively demanding,[9] leading to inconsistencies.[10] Rounding and focal point answers are common phenomena in both approaches, but remain underexplored.[11,12]

The comparison of results from studies using these different approaches requires the comparison of both elicitation techniques. This helps to understand possible differences between elicitation methods. Moreover, considering the unresolved issues with both approaches, studying different elicitation techniques remains important. Only a few studies have directly related both approaches. Hamermesh[13] first employed both approaches in a single survey, using two unrepresentative samples, and found slightly higher estimates (i.e., 0.5-1 year) when probability estimates were used. Recently, Wu et al.[14] evaluated the consistency of both approaches among Australian respondents aged between 50 and 74 years and indicated that '*even for those individuals who consistently evaluated their survival probabilities, very few choose life expectancies matching their personal beliefs of survival probabilities*'.

In this chapter, we report on one of the few studies providing a head-to-head comparison of both elicitation formats administered in one study sample. We show the distribution of responses from both approaches and focus on focal point answers, rounding and the consistency of answers. We

1 Verbal expectations questions (e.g., "How likely do you think it is that you will live up to 80 years old?" – very likely, fairly likely, not too likely, or not at all likely) are not within the scope of the study presented in this chapter.

compare both formats and relate them to relevant background characteristics of respondents such as health, lifestyle, and age of death of next of kin. Furthermore, we highlight possible consequences of sequential questioning (when eliciting SSPs).

8.2 METHODS

Survey and question formats

A web-based questionnaire was administered to 1,223 people, representative for the Dutch population aged between 18 and 65 years in terms of age, gender and education level. The data presented here were collected in the context of a larger study investigating expectations about longevity and quality of life at older age,[15] acceptability of less than perfect health states,[16] and health state valuations[17].

To get a point estimate of SLE, respondents were asked: *"What age do you expect to reach yourself?"* Answers could comprise any integer between 0 and 120. This question format has been used before.[18,19] Then, after introducing the concept of probabilities using two warm-up questions,[2] respondents were asked: *"What are the chances that you will live to be age [T] or more?"* This question was presented to each respondent for the five target ages (T) of 60, 70, 80, 90, and 100 years. Answers could comprise any integer between 0 and 100. The wording is in line with aforementioned household surveys, but we used a range of target ages so that individual subjective survival curves could be estimated.[14]

Other relevant components of our survey included questions on demographics (i.e., age, gender, marital status, age of death of next of kin), socioeconomic status (i.e., education, income), health (i.e., having a chronic disease or a severe disorder), and lifestyle (i.e., smoking).

To compare the SLE point estimate to the SSPs directly, we derived a best point estimate from the SSPs by computing the age at which the probability distribution of a respondent intersected 50%.[3] We assume that a 50/50 chance of reaching a certain age is a reasonable proxy for what a respondent would report as their SLE and, as such, the most logical comparison with a point estimate.

2 First warm-up question: "Later on we will ask you what you think your chances are of reaching a certain age. Let us start with an example question about the weather. What are the chances that it will be a sunny day tomorrow? If you answer 90, this means that the chance that tomorrow will be a sunny day is 90%. You can answer the following questions using a number between 0 and 100" (mean = 43.4; SD = 26.0; range = 0-100). Second warm-up question: "Now an example about health. What are the chances that you will have a severe illness in the next 10 years?" (mean = 34.2; SD = 22.9; range = 0-100).

3 If a respondent reported a probability of 50% at one of the target ages, then that target age equalled the computed life expectancy based on SSPs (hereafter SSP point estimate). If a respondent answered 50% at subsequent target ages, then the mean of those target ages was the SSP point estimate. If the probability of 50% fell between the SSPs at two subsequent target ages, we employed linear interpolation to obtain the SSP point estimate.

To further investigate the coherence between the answers to SLE and SSPs questions, we computed a 'certainty score' for each individual SLE point estimate in order to ascertain the chance that a respondent would reach his SLE point estimate. For this purpose, we used the probabilities at the surrounding target ages and linear interpolation if the SLE point estimate fell between two target ages (or the probability at a specific target age if the SLE point estimate equalled that target age).[4]

We analysed the correlation between the SLE and SSP point estimates. We used ordinary least square (OLS) regression to investigate variables associated with both point estimates, to explain the computed difference between those estimates, and to assess for which subgroups of respondents the certainty score for the SLE point estimate was closest to 50%.

8.3 RESULTS

From our initial sample of 1,223 respondents we excluded 156 (12.8%) who completed the online questionnaire in less than 15 minutes. This minimal completion time for the questionnaire was determined on the basis of a pilot-test of the questionnaire. Next, we selected the respondents who answered all SSP questions for age 60 and above, i.e. those aged between 20 and 59 years (n=878).[5] For reasons of consistency and to enable the envisaged comparisons between approaches, we consecutively excluded respondents who had: a SLE point estimate lower than the current age (n=3); a SLE lower than 60 or higher than 100 (because we did not have SSPs for those ages) (n=37); provided the same answers to all five SSP questions (n=25), including 19 respondents reporting a 50% chance to all five target ages; an increasing SSP for higher ages (n=24); or a distribution of SSP answers that did not intersect 50% within the 60-100 years age range (n=52). Finally, 737 respondents (60.3%) remained for further analyses. Compared to the initial sample of 1,223, this led to slightly more centred distributions for age and education and an underrepresentation of men. The sample characteristics are shown in Table 8.1.

4 If a respondent gave 90 years as point estimate of SLE, then the SSP the respondent gave for target age 90 (e.g., 70%) was used as certainty score for the point estimate. If a respondent gave 85 years as point estimate for SLE, we employed linear interpolation of the SSPs for target ages 80 and 90 to obtain the certainty score for this point estimate.

5 A small group of respondents aged 18 and 19 years (n=43) were excluded to form four equal age groups (20-29 years, 30-39 years, etc).

TABLE 8.1 Sample characteristics (*n*= 737)

Variable	Category	Value
Age (Mean (SD))		41.3 (11.3)
Age (%)	20-35 years	31.8
	36-59 years	68.2
Male (%)		47.6
Marital status (%)	Living alone/divorced	32.2
	Married/living together	67.8
Educational level (%)	Low	24.6
	Middle	44.9
	High	30.5
Income (%)	Low	28.1
	Middle	50.5
	High	21.4
(Self-)Employed (%)		61.9
Having severe disorder (currently/ever) (%)		26.5
Having chronic disease (%)		35.8
Smoking (%)	Never	58.9
	Yes, occasionally	10.3
	Yes, daily	30.8
Kin's age of death (%)	< 75	21.0
	75 to 85	54.4
	≥ 85	24.6

Note. Respondents were categorised into two age groups for further analyses because inspection of descriptive statistics of SSPs in different age groups showed a clear difference in SSPs between respondents aged below and above 35 years.
Education: 'Low'= primary or secondary education; 'Middle'= upper secondary education or post-secondary non-tertiary education; 'High'= bachelor, master, doctoral or equivalent. Income (net household monthly income): 'Low'< €1,500; 'Middle'= €1,500-2,999; 'High'= > €3,000.

Using point estimates, mean SLE was 80.2 years (SD=8.3). Figure 8.1 shows the frequency distribution of SLE point estimates. In line with earlier studies, approximately 40% of answers were rounded to tens, and 70% to fives. Peaks were observed at ages 75, 80 and 85.

Mean SSP declined from 87.6% (SD=13.6) at target age 60 to 13.4% (SD=15.5) at target age 100 (Figure 8.2). More than 75% of responses to the five probability questions were multiples of ten, while almost 95% were multiples of five. A "50%" answer was most often observed for the SSP questions at target ages 80 and 90 (around 18% of responses for both ages).

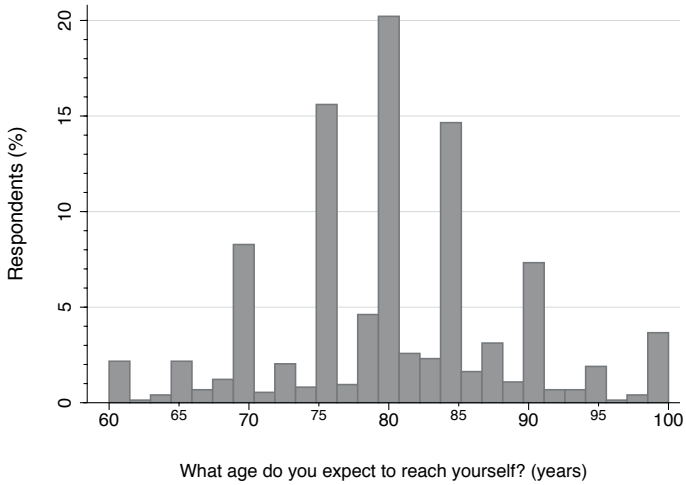

FIGURE 8.1 Distribution of the SLE point estimate (*n*=737)

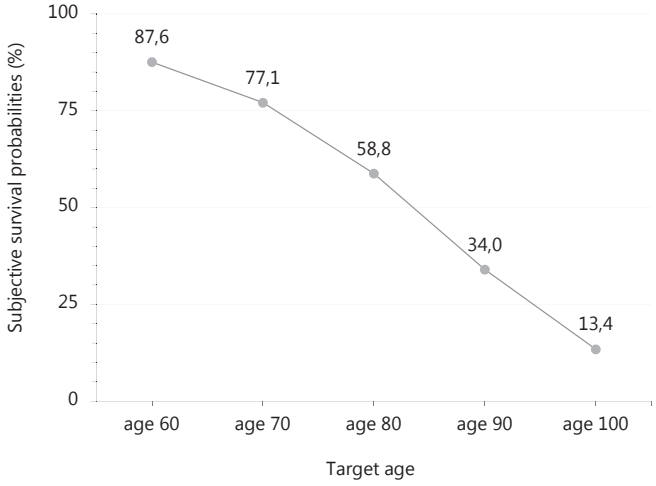

FIGURE 8.2 Subjective survival probabilities at target ages (*n*=737)

The mean point estimate obtained from the SSPs was 83.6 (SD=9.3), which is on average 3.4 years (SD= 8.7) higher than the SLE point estimate. The SLE point estimate and the point estimate obtained from SSPs were correlated (r= .52, p<.001).

Individual differences between SLE and SSP point estimates ranged from -32 to +40 (Figure 8.3), and the distribution showed a slight positive skew. Finally, the certainty score for the SLE point estimate derived from SSPs was 58.8%.

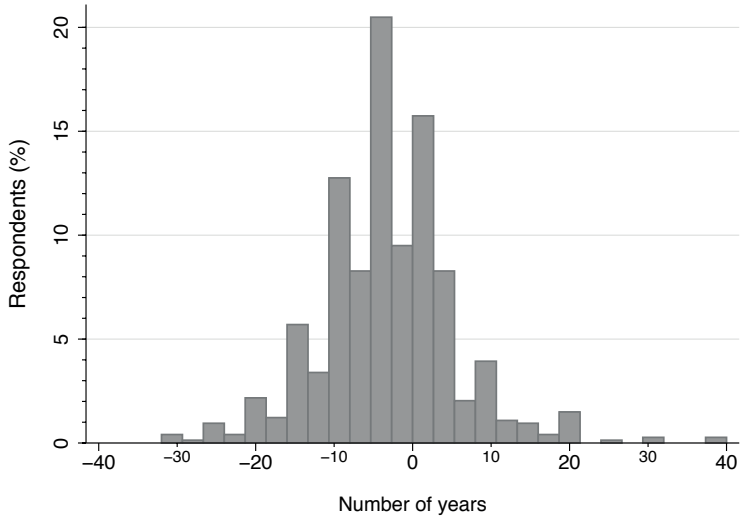

FIGURE 8.3 Distribution of differences between SLE and SSP point estimate (*n*=737)

Variables associated with SLE and SSP

Table 8.2 shows the results of OLS regression models investigating variables associated with SLE and SSP point estimates, the difference between the two estimates, and the uncertainty surrounding the SLE point estimate.

The regression models for SLE (model 1) and SSP (model 2) showed similar outcomes. We found statistically significant associations with expected signs for severe disorder, smoking and age of death of next of kin. Having a chronic disease was only significant in the SLE model, (high) education only in the SSP model. Overall, the SLE model performed slightly better in terms of adjusted *R*-squared.

The difference between the SLE and SSP point estimates was associated with age and income (model 3). The SSP point estimate was closer to the SLE point estimate for younger respondents and those with higher incomes. The fourth model showed that the certainty score for the SLE point estimate was closer to the 50% mark for respondents with higher education, higher income, and younger respondents.

TABLE 8.2 OLS regression analysis (*n*= 737)

Variables	SLE point estimate	SSP point estimate	Difference between SLE and SSP point estimates	Certainty score for SLE point estimate from SSPs
	(model 1)	(model 2)	(model 3)	(model 4)
Male	-0.54	0.25	-0.80	1.95
	(0.587)	(0.673)	(0.663)	(1.372)
Age group >35 years	-0.73	0.60	-1.33*	3.97***
	(0.659)	(0.743)	(0.747)	(1.492)
Low education	-0.42	-0.45	0.03	2.55
	(0.741)	(0.896)	(0.896)	(1.820)
High education	-0.42	-1.24*	0.83	-2.59*
	(0.647)	(0.741)	(0.686)	(1.531)
Low income	-0.32	-0.78	0.45	-0.40
	(0.683)	(0.781)	(0.785)	(1.628)
High income	0.75	-1.30	2.06***	-3.55**
	(0.689)	(0.841)	(0.779)	(1.664)
Kin's age of death low	-4.64***	-4.79***	0.15	1.73
	(0.729)	(0.909)	(0.811)	(1.703)
Kin's age of death high	4.18***	3.43***	0.76	-0.32
	(0.715)	(0.765)	(0.805)	(1.703)
Chronic disease	-1.88***	-1.05	-0.83	1.80
	(0.694)	(0.785)	(0.802)	(1.661)
Severe disorder	-1.53*	-1.63*	0.09	-0.56
	(0.794)	(0.845)	(0.883)	(1.844)
Smoking	-1.88***	-1.44**	-0.44	-0.16
	(0.628)	(0.717)	(0.700)	(1.431)
Constant	82.74***	85.49***	-2.75***	55.44***
	(0.753)	(0.904)	(0.913)	(1.762)
R^2	0.19	0.11	0.03	0.04
Adjusted R^2	0.17	0.10	0.01	0.03

Note. Robust standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.10$

8.4 DISCUSSION

In this chapter, we presented estimations of subjective life expectancy based on two elicitation techniques, using a representative sample of the Dutch population aged 18 to 65 years in terms of age, gender and education level. On average, respondents were more optimistic (about 3.5 years) about their longevity when expressed in survival probabilities, using the 50% chance point to calculate a SSP point estimate. Despite this difference, variables associated with SLE and SSP point estimates were very similar and their coefficient signs were plausible. Gender, age and socioeconomic variables like education and income were not strongly associated with the SLE and SSP point estimates. We found that age turned insignificant after introducing health indicators in the SLE model (results not shown here), which is not uncommon.[7] SLE and SSP point estimates were more similar for younger respondents and respondents with a higher socioeconomic status. This may reflect a higher capability of handling probability scores.

Some limitations of this study and the methods used are noted before highlighting the implications of our findings. First, this study was web-based and performed in one single country. This limits its generalisability. Second, excluding respondents with inconsistent answers from further analyses may have induced a selection bias in our results. Excluded respondents more often had a lower income and were male.

Nonetheless, we emphasise some important findings. First, inconsistencies in survival probabilities across target ages (i.e., same answers to all five SSP questions, increasing SSP for higher ages) were quite common (n=49). Inconsistencies in SLE estimates (i.e., lower SLE than their current age) were less common (n=3). Obviously, besides the difficulty of SSP estimates, this may reflect the fact that respondents answered five SSP questions but only one SLE question, providing greater opportunity for inconsistencies.

Second, rounding and focal point answers were common, as observed before.[11,12] One in five respondents reported a SLE point estimate of exactly 80 years, for instance. While this may reflect a genuine expectation, it may also emanate from uncertainty, imprecision, or a tendency to provide focal answers. SSP responses also showed clear rounding issues. Here, special attention is required for a "50%" answer. Bruine de Bruin et al.[20] for example, suggested that such "50/50" answers may indicate high uncertainty (similar to "don´t know") rather than a genuine probabilistic belief. Respondents reporting a 50% chance for all five target ages (n=19) were excluded from the analyses in this chapter. Therefore, we expect that the remaining 50% answers are more likely to represent a genuine probabilistic belief than high uncertainty, and thus to contain valuable information. Nevertheless, given that the SSP point estimate was determined using the probability of 50%, this deserves more attention in future studies. Adjusting for probability weighting may also be important.[21]

Third, sequential questioning may lead to anchoring.[22] Here, the probability of reaching the first target age given by respondents may have influenced probabilities at subsequent target ages. We tested this by comparing SSPs of respondents aged 50-59 (included in the current sample) with those of respondents aged 60-69 (excluded from the current sample). The younger group of respondents started with 60 as first target age, the older group with 70 as first target age. Interestingly, the answers of both groups resulted in very similar probability distribution curves, starting at almost the same probability, but the latter starting 10 years later (Figure 8.4). While this may relate to a rational shift of expectations, it may also signal anchoring.

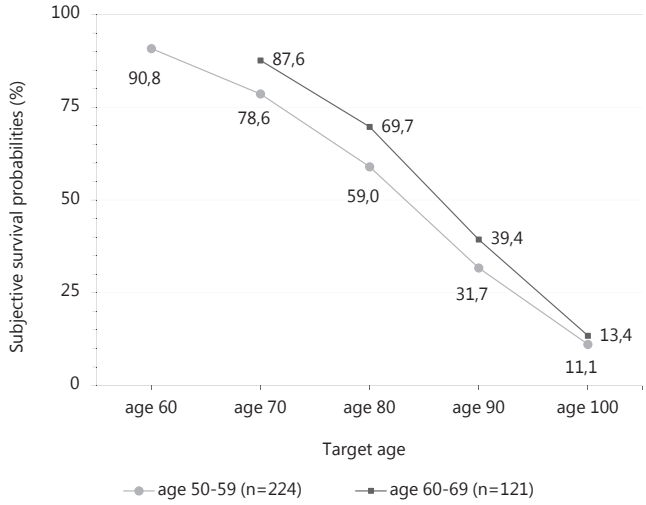

FIGURE 8.4 Comparison of SSPs between respondents aged 50-59 and 60-69

Our results relate well to existing literature. For instance, the explanatory variables significantly associated with subjective life expectancy were largely in line with those reported by Hamermesh[13]. Moreover, the difference found between the two methods (probability estimates being higher than point estimates) was in the same direction as reported by Hamermesh[13], albeit somewhat larger. This may relate to methodological differences between the studies (e.g., Hamermesh[13] used unrepresentative samples from the US, in which academic economists and male respondents were overrepresented, two instead of five target ages, and a different method to derive subjective survival curves). Inconsistencies between these elicitation formats were also observed by Wu et al.[14] [6]

6 Note that the methodological approach applied by Wu et al.[14] differs from the current study as well. For example, Wu et al.[14] used a sample from a different country including respondents aged higher than in our study sample. Furthermore, they used a different approach to elicit SSPs. Respondents chose probabilities from a discrete list with ten categories representing a range of probabilities.

In conclusion, an increasing amount of research aims to understand (the formation of) subjective longevity expectations and their relation to health behaviours and outcomes. Different elicitation methods are used across studies. The results from this chapter suggest that findings may not be directly comparable across studies, especially in certain subgroups of the population. Future work may compare both approaches in relation to objective survival expectations and predicting economic choice behaviour. More research on how to measure subjective expectations is therefore warranted.

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Chapter 9

A Long Life in Good Health

Subjective Expectations regarding Length and Future Health-Related Quality of Life

Based on:
Rappange DR, Brouwer WBF, van Exel J. A long life in good health: Subjective expectations regarding length and future health-related quality of life. ***The European Journal of Health Economics.*** *2015; doi 10.1007/S10198-015-0701-1*

9.1 INTRODUCTION

The wish for a long and healthy life is often heard. Still, not everyone will live such a life. Differences in life expectancy and healthy life expectancy between groups remain large.[1] Many individuals will have subjective expectations regarding their own length of life and their future health-related quality of life, which may differ (substantially) from objective projections. Such subjective expectations remain understudied, especially regarding future health-related quality of life, but they may be relevant for a number of reasons.

First, subjective expectations regarding length and future health-related quality of life may be important if they influence decisions. If people have specific ideas about how old they will become and how they will become old, this may influence current decisions in several life domains. For instance, expectations may influence the decisions to invest in their future health and length of life or choices regarding pensions and savings. Therefore, understanding (the formation of) subjective expectations enables us to learn more about, and possibly influence, decision-making. For the health domain, this is important given the preventable mortality and morbidity attributable to modifiable, unhealthy health behaviours.[2] People who expect old age to be associated with low quality of life regardless of current investments may be less likely to engage in preventive actions. Moreover, individuals who expect ageing to be associated with unavoidable deterioration of health may also be less prone to use healthcare. For example, Sarkisian et al.[3] found that older adults with low expectations regarding ageing believed seeking healthcare to be less important for age-associated, modifiable ill-health conditions. As such, subjective expectations for length and future quality of life can influence current decisions. Especially when subjective expectations are inaccurate (for instance too pessimistic) this may result in non-optimal decisions.

Second, the demand for healthcare services and need for long-term care may increase as societies age and the proportion of elderly rises, which is the case in most developed countries (e.g., Yang et al.[4]). This poses important challenges for the future sustainability of healthcare systems and society in general, both in terms of financing and planning. Subjective expectations obtained from individuals, instead of actuarial data, may provide more insight into future healthcare needs and demands if they contain (private) information other than what is accounted for in actuarial data.[5]

Third, subjective expectations regarding length and future health-related quality of life may also play a role in research. For instance, in explaining discount rates observed in experiments or when valuing health states using the time trade-off (TTO) method (see van Nooten and Brouwer[6] and van Nooten et al.[7]), these expectations may be important.

Several large household surveys include questions regarding longevity expectations, mostly elicited as subjective survival probabilities. Studies using these data have focused on the accuracy of such longevity expectations compared to actuarial figures[e.g., 8-12] or investigated their ability to predict

mortality[e.g., 10,13-16]. Other research has studied these subjective survival probabilities in relation to (economic) decisions regarding retirement, saving and lifestyle[e.g. 9,17-22]. In general, subjective survival probabilities contain information not found in objective measures, are found informative in predicting mortality, and are relevant for explaining economic and lifestyle decisions of individuals. Thus far, the study of subjective expectations regarding future health-related quality of life has received less attention. Recently, Péntek et al.[23] explored subjective expectations regarding future health and treatment effects among patients with rheumatoid arthritis (and their rheumatologists), and concluded that such expectations may be important in the context of treatment decisions and compliance. The authors advocated more work in this area.

Our study therefore set out to investigate these subjective expectations regarding length and also future health-related quality of life in more detail. It elaborates on previous work of Brouwer and van Exel[24] and Péntek et al.[25] who studied (the accuracy of) expectations regarding both length and future health-related quality of life. Expectations regarding length of life were not based on survival probabilities in these studies, but directly elicited by asking respondents their expected age of death. Brouwer and van Exel[24] found in a sample from the Dutch general public that individuals generally overestimate their life expectancy (males more than females), as had been found before,[8] but (considerably) underestimate future quality of life from age 70 onwards. Furthermore, age, current health status and perception of own lifestyle compared to others each explained a significant part of the variance in the expectations regarding length and future quality of life. What is more, the average age of death of next of kin was related to subjective life expectancy. Péntek et al.[25] conducted a similar study in members of the general public in Hungary and found results which were largely in line with those from Brouwer and van Exel[24].

In this chapter, we present new data on subjective expectations regarding both length and future health-related quality of life. Our study adds to the previous two studies Brouwer and van Exel[24] and Péntek et al.[25] in a number of ways. First, Brouwer and van Exel[24] combined two unrepresentative Dutch convenience samples from two independent studies, while Péntek et al.[25] used an unrepresentative Hungarian sample gathered through a Hungarian web journal. In our study, we used a representative sample of the Dutch general public instead. Second, in contrast to these two previous studies, we used a more elaborate set of background, health and lifestyle variables, which are potentially important in the context of subjective expectations. A final, specific feature of our study that adds to those reported by Brouwer and van Exel[24] and Péntek et al.[25] is that we combine subjective expectations regarding length and future health-related quality of life into one single composite measure. In other words, we extend the concept of subjective life expectancy by adding (and correcting for) self-estimated quality of life during these years. Using this method, we assess the subjective expectations regarding the remaining number of life-years after age 65 adjusted for the quality of life in these years lived. Moreover, we examine the relationship between these expectations and background characteristics, objective health indicators and, in particular, lifestyle, since subjective

life expectancy is increasingly considered important in relation to lifestyle choices. We investigate whether this latter hypothesis holds for a measure that combines subjective life expectancy with expectations regarding future health-related quality of life. We also discuss the implications of using different methods to construct our composite expectations measure.

The remainder of this chapter is structured as follows. First, we discuss our data, methods and analyses. In particular, we describe how we constructed our combined subjective measure of expectations. After that, we present our results. We end this chapter with a discussion of our main results and the implications resulting from our findings.

9.2 METHODS

Data collection and outcome measures

For our study, we developed a web-based questionnaire that was administered to a sample of 18- to 65-year-olds from the Netherlands, representative in terms of age, gender and level of education. The overall objective of this survey was to investigate how Dutch people think about (future) health and choices in healthcare.

We included a measure of subjective life expectancy as well as a measure of expected health-related quality of life in our survey to operationalise our main outcome variable 'subjective future quality adjusted life-years (QALYs) expectation from age 65 onwards'. The concept of (objective) QALYs is frequently applied in the evaluation and comparison of healthcare interventions,[26] but not in the context of individuals' subjective expectations.[1] After introducing the concept of subjective expectations we elicited a point estimate of the subjective life expectancy for each respondent (see Box 9.1). Respondents were allowed to fill in any integer between 0 and 120. This method was successfully used before by Brouwer and van Exel[24] and Péntek et al.[25]

> What age do you expect to reach yourself?
>
> … years

BOX 9.1 Question used for eliciting a point estimate of subjective life expectancy

Next, to elicit respondents' current and expected future health states we employed the EQ-5D instrument[27] (see also http://www.euroqol.org), as was done previously[24,25]. The EQ-5D is a generic health-related quality of life instrument comprising five health dimensions: 'mobility', 'self-care', 'usual activities', 'pain/discomfort' and 'anxiety/depression'. For each dimension the respondent could indicate to (expect to) experience 'no problems', 'some problems' and 'extreme problems'. Thus, 243 distinct health states can be distinguished for which preference scores exist which were obtained in

1 In this chapter, when we refer to QALYs or expected QALYs, we mean *subjective* QALY expectations.

the general public.[28] The EQ-5D instrument was designed to measure current health. Box 9.2 specifies how we asked questions regarding *future* health using the EQ-5D dimensions. This method was also used in the previous two studies.[24,25]

What do you think your health state will be at the age of 60? I expect that at the age of 60 I will have…

No	Some	Severe	
☐	☐	☐	problems in walking about
☐	☐	☐	problems with washing or dressing myself
☐	☐	☐	problems with performing my ususal activities
☐	☐	☐	pain or discomfort
☐	☐	☐	anxiety or depression

This question was repeated for the ages of 70, 80 and 90.

Respondents aged 60 or older automatically proceeded to target age 70 (instead of 60). Note that in all other situations respondents were 'forced' to complete all future quality of life questions, even if the target age was higher than their self-estimated life expectancy.

BOX 9.2 Questions for eliciting expectations regarding future health, using the dimensions of the EuroQol-5D

Combining the expectations regarding length and future health-related quality of life presented above provides us our main, single outcome variable, i.e. a measure of subjective expectations regarding the remaining amount of QALYs from 65 onwards. In Box 9.3 we present two examples to explain our computation method.

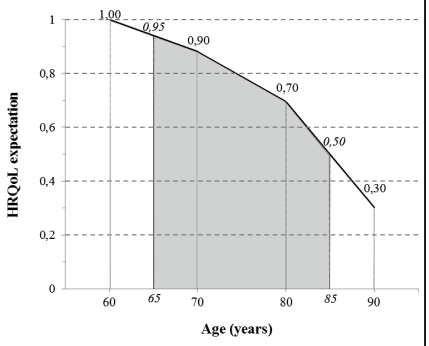
Since we had no information on respondents' expected quality of life at time of death, except for those respondents that reported a subjective life expectancy equal to one of our target ages used for the quality of life questions, we imputed these scores. As can be seen in Box 9.3, we differentiated our imputation method according to the subjective life expectancy of respondents. For respondents who reported a subjective life expectancy of 90 or lower, we computed the quality of life at time of death based on the QALY scores of two subsequent target ages. Respondents with a subjective life expectancy higher than 90 were ascribed a quality of life score of 0 at time of death, since no information on quality of life expectations was available for ages higher than 90.

In order to retain all respondents while ensuring that the future QALY expectations for all respondents started at age 65, we imputed quality of life scores at age 65. For the respondents aged between 18 and 60 (60-year-olds not included), we used quality of life scores at age 60 and 70 to come up with a mean quality of life score at age 65 (see 'example a' in Box 9.3). For respondents aged between 60 and 65, we used their current self-reported health state and the expected quality of life score at age 70, as is the case in 'example b' from Box 9.3.

Example a)

Consider a 50-year old respondent with the following self-estimated values:

- Subjective life expectancy = 85
- Self-estimated future health-related quality of life (EQ-5D):
  - at age 60: 1.0
  - at age 70: 0.9
  - at age 80: 0.7
  - at age 90: 0.3



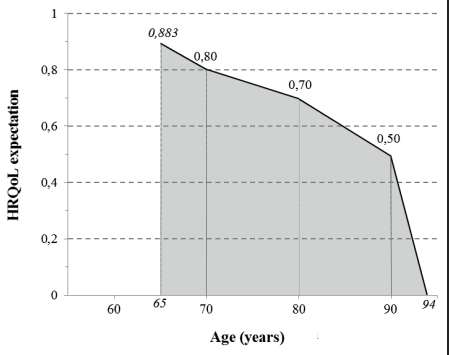
The expected amount of QALYs for this respondent from age 65 onwards can be calculated as follows:

- For the age range 65-70, the quality of life score at age 65 is estimated using linear interpolation of the expected HRQoL values at ages 60 and 70: (1.0+0.9)/2 = 0.95. The expected QALYs can then be calculated as: ((0.95+0.9)/2)*(70-65) = 4.6.
- For the age range 70-80, the expected QALYs can then be calculated as: ((0.9+0.7)/2)*(80-70) = 8.0.
- For the age range 80-85, the quality of life score at age 85 is estimated using linear interpolation of the expected HRQoL values at ages 80 and 90: 0.7-((0.7-0.3)*((85-80)/(90-80))) = 0.5. The expected QALYs can then be calculated as: ((0.7+0.5)/2)*(85-80) = 3.0.
- The total expected amount of QALYs from 65 until the expected age at death of 85 years then is calculated as: 4.6+8.0+3.0 = 15.6.

Example b)

Consider a 64-year old respondent with the following self-estimated values:

- Subjective life expectancy = 94
- Current quality of life (EQ-5D) = 0.9
- Self-estimated future health-related quality of life (EQ-5D):
  - at age 70: 0.8
  - at age 80: 0.7
  - at age 90: 0.5



The expected amount of QALYs for this respondent from age 65 onwards can be calculated as follows:

- For the age range 65-70, the quality of life score at age 65 is estimated using linear interpolation of the HRQoL value at current age 64 and the expected HRQoL value at age 70: 0.9-((0.9-0.8)*((65-64)/(70-64))) = 0.883. The expected QALYs can then be calculated as: ((0.883+0.8)/2)*(70-65) = 4.2.
- For the age range 70-80, the expected QALYs can then be calculated as: ((0.8+0.7)/2)*(80-70) = 7.5.
- For the age range 80-90, the expected QALYs can then be calculated as: ((0.7+0.5)/2)*(90-80) = 6.0.
- For the age range 90-94, HRQoL at expected age of death age 94 is set at 0. The expected QALYs can then be calculated as: ((0.5+0)/2)*(94-90) = 1.0.
- The total expected amount of QALYs from 65 until the expected age at death of 94 years then is calculated as: 4.2+7.5+6.0+1.0 = 18.7.

BOX 9.3 Computation method for combining expectations regarding length and future health-related quality of life into a single outcome variable measuring expectations regarding remaining QALYs from age 65 onwards

Other variables / instruments

The survey included questions on socio-demographic characteristics, such as gender, age, marital status and net income. Moreover, respondents indicated their height and weight and were asked about the following lifestyle indicators: *physical (in)activity*, *eating habits, smoking* and *alcohol consumption*. Respondents were asked to indicate how many days a week they performed at least 30 minutes of (vigorous) exercise, such as walking, cycling or sports. The Dutch guidelines for healthy exercise require at least 30 minutes of exercise at least five times a week.[29,30] Then, respondents reported how many days a week, on average, they ate healthily (i.e., balanced meals including a wide variety of food in the right proportions and amount). A minimum of six days per week was set to classify respondents as having a healthy diet. We distinguished non-smokers from occasional smokers and current smokers. Male and female respondents were considered heavy drinkers when their weekly amount of alcohol consumption exceeded 21 drinks and 14 drinks, respectively, or when consuming six drinks or more on one occasion at least once a week.[31]

After general questions regarding the (past) presence of a severe disorder and any current chronic diseases (both physical and psychological), a vertical, visual analogue scale ranging from 0 ('worst imaginable health') to 100 ('best imaginable health') was used to obtain respondents' own valuation of current health. A similar format was used to elicit a general happiness score. Respondents were also asked to state their preference between a shorter life in perfect health and a longer life in a less than perfect health state and to give an indication of the average age most of their next of kin had reached.

Finally, we used an instrument that measures expectations regarding ageing (ERA-12). This validated 12-item survey measures expectations regarding ageing on three domains of four items each, i.e. expectations regarding physical health, expectations regarding mental health and expectations regarding cognitive function. These three subscales combine to one general scale measuring expectations regarding ageing.[3,32]

Descriptive statistics

First, sample characteristics are presented. Due to the way we constructed the survey, we avoided missing values on any of the variables. However, two respondents reported a bodyweight of 0 kilogram (kg). We imputed these values based on height, gender and education in our sample.

We constructed a 'lifestyle index' based on the four aforementioned indicators of risky behaviour (based on Dutch health norms), i.e. smoking (on a daily basis), excessive alcohol consumption, physical inactivity and unhealthy diet. The index ranged from 0 to 4 with higher values indicating an unhealthier lifestyle. For example, a lifestyle index of 3 may indicate a person who smokes daily, drinks excessively and is physically inactive. For our analyses we combined groups 3 and 4 because of low numbers (2%) in group 4.

Descriptive statistics of subjective expectations of life expectancy and future health-related quality of life expectations are presented. Subsequently, this is done for our main outcome variable, i.e. the subjective expectations of future QALYs from 65 onwards. Since the answers to the questions regarding subjective life expectancy and future health-related quality of life differed importantly (and therefore automatically also regarding our main outcome variable) between respondents from the age groups 18-59 and 60-65, we focused in particular on these differences throughout our analyses.

Finally, for validation purposes, we analysed the extent to which our measure of expectations regarding future QALYs remaining from age 65 onwards correlated with the 12-item ERA survey and its three 4-item subscales.

Multivariate analyses

We used linear regression analysis to identify explanatory variables for the number of subjective expected QALYs from 65 onwards. Explanatory variables were included based on the previous findings of Brouwer and van Exel[24] and Péntek et al.[25] We defined four models, each model nested in the previous one, which successively introduced (i) socio-demographic characteristics and socioeconomic status, (ii) health indicators, (iii) age of death of next of kin and finally, and (iv) the lifestyle index. Due to notably different results on our expectation variables for the groups 18-59 and 60-65, we included age both as a dummy variable, differentiating between both age groups, and as a continuous variable. Furthermore, we paid particular attention to the explanatory power of the lifestyle index/indicators and also conducted our regression analysis for men and women separately.

Sensitivity analyses

We performed several sensitivity analyses in order to test several choices we made. Most importantly, an alternative computation method for the expected total amount of future QALYs from 65 onwards involves using a quality of life score of 0 at time of death for all respondents, instead of using the quality of life score at the subsequent target age. Alternatively, we altered our initial approach only for those respondents reporting a subjective life expectancy over 90 years old. Instead of assuming a quality of life score of 0 at time of death we used the reported quality of life score at target age 90 (i.e., assuming no decline from that point onwards). Other aspects that deserved attention regard (the elimination or adjustment of) possible outliers and the examination of the impact when age and lifestyle indicators are included differently into our regression analysis. We ran our multivariate analysis incorporating these adjustments. All analyses were conducted using STATA 11 IC (StataCorp, College Station, TX).

9.3 RESULTS

Sample characteristics

A sample of 1,223 respondents representative of the general population from the Netherlands in terms of age, gender and level of education completed the web-based survey. We excluded observations based on the time it took to complete the survey. In our sample, all respondents completed the survey between 5 and 62 minutes with mean length of almost 26 minutes (SD=9.0 minutes). A small pilot exercise indicated that the minimal time necessary to complete the survey quickly but carefully was 15 minutes. Therefore, we excluded 157 respondents who completed the survey within 15 minutes (12.8% of total sample). We also excluded respondents who reported a lower life expectancy than their age at the time of the interview (n=3). Our final sample therefore consisted of 1,064 respondents. The main sample characteristics are shown in Table 9.1.

Respondents excluded from the final sample were younger and more often male (p<.01), so that our final sample for analysis was no longer completely representative for the Dutch population aged 18-65 years old. Mean subjective life expectancy and subjective QALY expectation were not significantly different (p<.01) between included and excluded respondents.

Subjective life expectancy

The mean expected age of death in our sample was 81.1 years (SD=10.9 years). Respondents reported life expectancies in a range between 19 and 120 years old. The distribution of these subjective life expectations is presented in Figure 9.1. A considerable part of the respondents used round numbers in expressing their longevity expectation: 41.0% of the predictions were rounded to tens (60, 70, 80, etc.) and 71.3% to fives or tens (70, 75, 80, etc.). Clear peaks were present at 75, 80 and 85 (12.2%, 19.5%, 13.4%, respectively). The time gap between the respondent's age at the time of the survey and their subjective life expectancy ranged between 0 and 102 years and was on average 37.9 years (SD=17.0). As expected, this time gap diminished as respondents' age at the time of the interview increased. Analysis by age group showed that the mean subjective life expectancy was significantly higher in the group 60-65 compared to the group 18-59, 84.8 and 80.5 years, respectively [t(1,062)= -4.4964, p<.001]. No variation in subjective life expectancy was found between respondents aged below 60.

TABLE 9.1 Sample characteristics (*n*=1,064)

Variable	Category	Mean (SD) / %
Male		50.1
Age (Mean [SD])	Range (18–65)	43.2 (13.6)
Educational level[a] (%)	Low	27.3
	Middle	42.0
	High	30.7
Marital status[b]	Living alone/divorced	32.2
	Married/living together	67.8
Having child(ren) (%)		60.2
(Self-)Employed (%)		53.0
Income[c]	Low	30.1
	Middle	47.3
	High	22.7
Health (EQ-5D) [Mean (SD)]	Range (-0.13–1)	0.84 (0.23)
Disorder (currently/ever) (%)		28.2
Chronic disease (%)		36.6
Health (VAS) [Mean (SD)]	Range (0–100)	75.1 (16.5)
Happiness (VAS) [Mean (SD)]	Range (0–100)	74.5 (18.0)
Obese[d] (%)		19.2
Physically inactive		50.9
Healthy diet		47.5
Smoking (%)	Never	60.5
	Yes, sometimes	11.0
	Yes, daily	28.5
Alcohol consumption	No	35.9
	Moderate	52.6
	Excessive	11.5
Lifestyle index	0	20.5
	1	33.4
	2	32.4
	3 or 4	13.7
Next of kin's age of death	< 75	19.5
	75 to 85	53.7
	≥ 85	26.9

[a] 'Low' = Primary or lower secondary education; 'Middle' = Upper secondary education or post-secondary non-tertiary education; 'High' = bachelor, master, doctoral or equivalent.

[b] The category "Married/living together' also included 37 respondents (3.5%) who indicated 'Do not want to say/other'.

[c] 'Low' = <1,500; 'Middle' = 1,500-2,999; 'High'= >=3,000 in euros.

[d] 'Obese' indicates BMI>=30 kg/m2. Mean (SD) BMI= 26.4 (5.1).

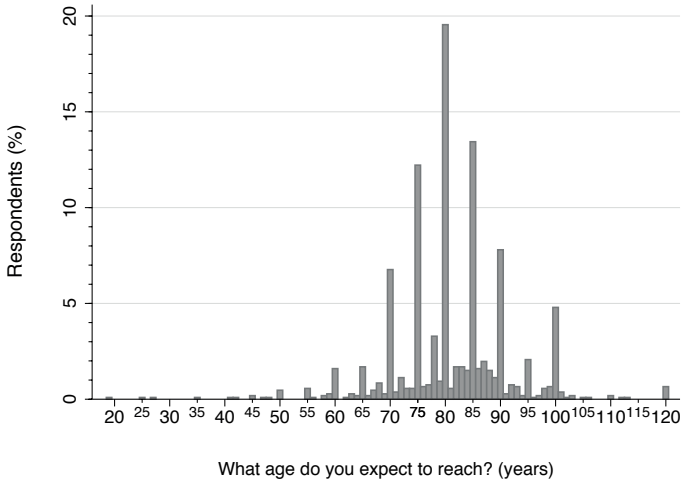


FIGURE 9.1 Distribution of subjective life expectancy (*n*=1,064)

Subjective expectations regarding future health-related quality of life

Respondents were asked to report their expectations regarding future health-related quality of life at the target ages of 60 up to 90. Average scores declined steadily with age, from 0.77 to 0.69, 0.51 and 0.32 at the ages of 60, 70, 80 and 90, respectively [recall that respondents aged 60 or more (*n*=143, 13.4%) did not need to predict health at age 60]. The scores ranged from -0.329 to 1 at all ages, equalling the possible minimum and maximum scores according to the EuroQol system.

Figure 9.2 presents the future health-related quality of life expectations for two age groups, 18-59 and 60-65. Similar as for life expectancy, values were significantly higher for the older group. Interestingly, the initial (i.e., first) reported score was fairly similar for both age groups. The gap between the scores of both groups increased at advanced target ages, from 0.105 to 0.173 at the ages 70 and 90, respectively.

Interestingly, 1.6% of the respondents indicated the same expected health profiles for all target ages, while an additional 0.6% of the respondents indicated the same profiles for the ages of 70, 80 and 90. These respondents apparently did not expect their health to deteriorate over time. In addition, 8.4% of the respondents gave at least one score at a certain target age that was higher than the score at a lower target age.

Respondents were presented with all future health-related quality of life questions despite their subjective life expectancy. Similarly to Brouwer and van Exel[24] and Péntek et al.[25], further analysis revealed significantly lower scores at the target ages 60-90 for respondents that did not expect to live up to these given ages compared to those who did expect to be alive at these ages. The average scores for the first group and the latter group at ages 60, 70, 80 and 90 were respectively: 0.34 vs 0.79

(Mann-Whitney, p<.001, non-survivor group n=27), 0.25 vs 0.73 (Mann-Whitney, p<.001, non-survivor group n=87), 0.30 vs 0.63 (Mann-Whitney, p<.001, non-survivor group n=377) and 0.26 vs 0.58 (Mann-Whitney, p<.001, non-survivor group n=852).

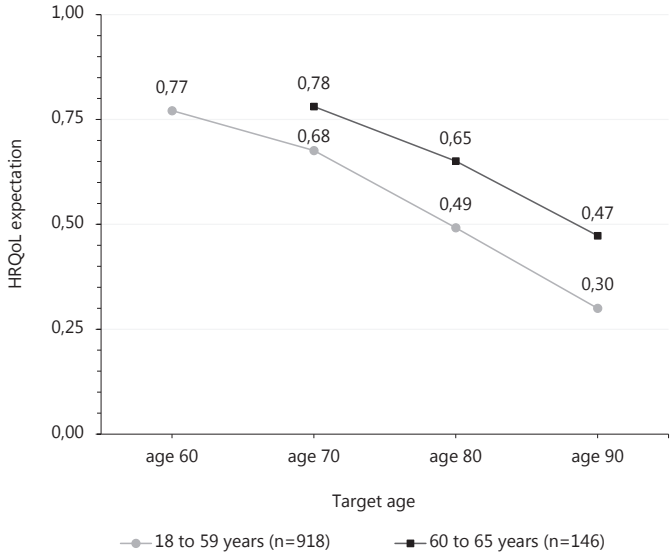


FIGURE 9.2 Health-related quality of life (HRQoL) expectations at age 60, 70, 80 and 90 years old (n=1,064)

Subjective expectations of remaining number of QALYs from 65 onwards

We estimated the number of subjective expected remaining QALYs after age 65 using the information above regarding subjective life expectations and those on future health-related quality of life. Total amount of expected QALYs from 65 onwards to expected death ranged from -9.0 to 40.0 QALYs and mean QALY expectation was 11.0 (SD=7.4). The distribution of QALY expectations is presented in Figure 9.3.

Excluding the lowest and highest 1% of QALY expectations resulted in QALYs varying between -0.9 and 30.0. Out of the respondents, 3.1% reported negative QALY expectations of which two respondents reported expectations lower than -6.0. Such extreme negative QALY expectations can be explained by the fact that these two respondents had already relatively low present self-perceived health status (-0.1 and 0.2), but nonetheless expected to live up to respectively 100 and 92. A longer period of time with such low QALYs scores cumulates to a large negative total of remaining QALYs. Out of the respondents, 3.0% expected to have more than 25 QALYs after the age of 65. All these respondents expected to reach at least 90 years (mean life expectancy of this group is 103 years) in generally good health. One respondent reported a QALY expectation of 40. This respondent reported a life expectancy of 120.

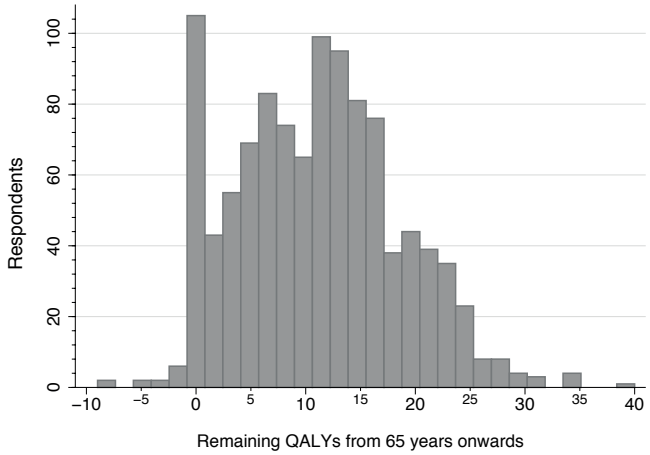


FIGURE 9.3 Distribution of self-estimated amount of QALYs from age 65 onwards until death (*n*=1,064)

The highest peak was around 0 remaining QALYs. 6.4% of the respondents self-estimated exactly 0 remaining QALYs after 65. The explanation for this is that these respondents reported life expectancies of 65 or lower. Considering the fact that we did not assign QALYs for the year of expected death, by definition, their total amount of expected future QALYs after 65 amounted to 0.

As expected based on the results above, the mean subjective QALY expectation for the age group 18-59 was 10.5 and significantly lower than the mean expectation of 14.2 of the group 60-65 [$t(1,062)= -5.6353$, $p<.001$]. Again, no significant variation was found within the age group 18-59.

A small majority of the respondents (56.1%) preferred a shorter life in perfect health over a longer life in a less then perfect health state. These respondents had a significantly lower mean QALY expectations compared to others, respectively: 10.3 vs 11.9 [$t(1,062)= -3.6577$, $p<.001$].

Expectations regarding ageing (ERA)

Analysis of the correlation between our future remaining QALY measure and the 12-item ERA resulted in $r=.25$, which was significant at the $p<.001$ level. The three 4-item subscales correlated in the same direction as the 12-item version of the ERA Scale: $r=.20$, $r=.20$ and $r=.19$ ($p<.001$ for all correlations) for the expectations regarding physical health scale, mental health scale and cognitive function scale, respectively.

Multivariate analyses

Table 9.2 presents the results of the multiple regression analysis with expected remaining QALYs from 65 onwards as dependent variable. We started with a block of background characteristics. Successively,

we then added the objective health indicators, two dummy variables representing next of kin's age of death and finally our lifestyle index.

TABLE 9.2 Multivariate analysis of remaining QALYs from age 65 to expected death (*n*=1,064)

Variables	Model 1	Model 2	Model 3	Model 4
Male	0.64	0.44	0.63	0.76*
	(0.468)	(0.445)	(0.424)	(0.420)
Age dummy	4.82***	4.04***	3.63***	3.45***
	(0.839)	(0.774)	(0.761)	(0.742)
Age	-0.03	0.03	0.02	0.01
	(0.022)	(0.021)	(0.020)	(0.020)
Low education	-1.08*	-1.41**	-1.26**	-1.08**
	(0.588)	(0.551)	(0.521)	(0.512)
High education	0.30	0.40	0.39	0.30
	(0.541)	(0.512)	(0.483)	(0.477)
Low income	-0.23	0.19	0.13	0.12
	(0.581)	(0.542)	(0.523)	(0.517)
High income	0.89	0.66	0.36	0.30
	(0.559)	(0.532)	(0.493)	(0.487)
Married	0.58	0.48	0.62	0.39
	(0.555)	(0.521)	(0.505)	(0.502)
Having child(ren)	0.79	0.43	0.55	0.77
	(0.547)	(0.516)	(0.498)	(0.492)
(Self-)employed	1.55***	0.49	0.49	0.45
	(0.484)	(0.465)	(0.443)	(0.438)
Chronic disease		-2.34***	-2.25***	-2.23***
		(0.547)	(0.510)	(0.499)
Disorder		-4.02***	-3.73***	-3.66***
		(0.559)	(0.540)	(0.526)
Obese		-0.20	-0.02	0.08
		(0.586)	(0.562)	(0.555)
Kin's age of death low			-2.93***	-2.71***
			(0.500)	(0.493)
Kin's age of death high			3.44***	3.30***
			(0.511)	(0.508)
Lifestyle index				-1.12***
				(0.210)
Constant	9.85***	10.01***	9.76***	11.99***
	(0.966)	(0.927)	(0.936)	(1.021)
R^2	0.07	0.17	0.25	0.27
Adjusted R^2	0.06	0.16	0.24	0.26

Note. Unstandardised coefficients. Robust standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.10$

The fourth, final model explained 27% of the variance in our outcome variable. In this final model, the age dummy, reflecting the difference between the two age groups 18-59 and 60-65, having a chronic disease and/or disorder, the age of death of next of kin and the lifestyle index were most importantly associated with expectations regarding future QALYs. Less healthy respondents expected to have fewer QALYs from 65 onwards. The same accounts for respondents with an unhealthy lifestyle, a low education and respondents whose next of kin generally died younger. When family members became older, respondents reported higher QALY expectations. For the lifestyle index, each additional type of risky behaviour (i.e., smoking, drinking excessively, etc.) decreased the total amount of future QALYs with 1.12 QALYs. It becomes clear from the beta weights (not shown here) that having a disorder had the strongest effect on the outcome variable. Interestingly, being obese was not a significant explanatory variable for the amount of expected QALYs while being employed was only significant in the first, most restricted model.

We repeated the fourth model of the regression analysis, but replacing the lifestyle index with the individual behavioural risks. Furthermore, we performed the regression analysis for men and women separately. The results are presented in Table 9.3.

TABLE 9.3 Multivariate analysis of remaining QALYs from age 65 to expected death: risk factors instead of lifestyle index and distinction male/female

Variables	Model 1	Female	Male
Male	0.76*		
	(0.429)		
Age dummy	3.40***	1.76	4.65***
	(0.745)	(1.112)	(1.068)
Age	0.01	0.04	-0.03
	(0.020)	(0.027)	(0.032)
Low education	-1.07**	-0.77	-1.34
	(0.518)	(0.634)	(0.860)
High education	0.22	0.51	-0.01
	(0.481)	(0.707)	(0.681)
Low income	0.16	-0.23	0.73
	(0.521)	(0.653)	(0.889)
High income	0.27	-0.12	0.39
	(0.490)	(0.759)	(0.659)
Married	0.41	0.51	0.18
	(0.505)	(0.724)	(0.780)
Having child(ren)	0.80	0.34	1.34*
	(0.491)	(0.634)	(0.807)
(Self-)employed	0.48	1.05*	0.00
	(0.441)	(0.577)	(0.698)

TABLE 9.3 Continued

Variables	Model 1	Female	Male
Chronic disease	-2.25***	-2.49***	-2.15***
	(0.502)	(0.710)	(0.720)
Disorder	-3.64***	-3.46***	-3.85***
	(0.529)	(0.727)	(0.774)
Obese	0.01	-0.94	1.17
	(0.561)	(0.699)	(0.912)
Kin's age of death low	-2.69***	-3.28***	-1.98***
	(0.495)	(0.656)	(0.744)
Kin's age of death high	3.31***	3.17***	3.69***
	(0.511)	(0.714)	(0.736)
Smoking	-1.30***	-0.89	-1.56**
	(0.450)	(0.605)	(0.661)
No alcohol	-0.09	-0.25	0.13
	(0.453)	(0.575)	(0.747)
Excessive alcohol	-0.49	-2.87***	0.59
	(0.624)	(0.931)	(0.826)
Physically inactive	-0.78*	0.10	-1.75***
	(0.411)	(0.556)	(0.623)
Unhealthy diet	-1.52***	-1.80***	-1.39**
	(0.421)	(0.558)	(0.631)
Constant	12.15***	11.08***	14.01***
	(1.014)	(1.412)	(1.502)
Observations	1,064	531	533
R^2	0.28	0.29	0.28
Adjusted R^2	0.26	0.27	0.26

Note. Unstandardised coefficients. Robust standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.10$

The regression model in which the lifestyle index was replaced performed similarly in terms of adjusted R^2 to the final model from the regression analysis that included the index. An unhealthy eating habit and smoking were the strongest health behavioural explanatory variables in this model. On average, these variables may be relatively strongly associated in people's perception with morbidity and mortality, therefore. Both dummies regarding alcohol consumption did not have a significant effect. As can been seen in Table 9.3, there were some striking differences between men and women regarding the explanatory variables. First, the age dummy had a much stronger effect on expected future QALYs for men than for women. Second, as in the first model shown in Table 9.3, the alcohol variables were not significant for men. However, excessive alcohol consumption was a significant explanatory variable for the expected future QALYs for women. Finally, the effect of physical inactivity

on expectations regarding remaining QALYs only held for men in the separate analyses. Overall, both gender models performed very similarly in terms of explained variance.

Sensitivity analyses

The final analyses were done to test our findings incorporating some adjustments. First, recall that we only used a QALY score of 0 at time of death for respondents who expected to live beyond 90, since we did not have any expected quality of life score beyond that age. We reran our analysis using a QALY score of 0 for all respondents at the expected age of death. This resulted in a lower mean of remaining future QALYs: 9.5 (SD=7.2). We repeated the fourth model regression analysis from Table 9.2 using this estimation. This regression model explained less variance than our original model (R^2=.25 vs R^2=.27) and, furthermore, the significant explanatory variables were less strong in this model than the results shown in Table 9.2. Replacing the QALY score at time of death with the QALY score at target age 90, instead of a score of 0 for those respondents who expected to live beyond 90 (n=129), slightly increased the mean expected QALYs from 65 onwards to 11.4 QALYs (SD=8.2). Since the impact of this adjustment seems limited, we did not use this estimate in any further analyses.

Second, our results showed that a few outliers were present both at the minimum and maximum endpoints. A 1% trimmed mean excluding these outliers resulted in a mean future QALY score of 11.0 (SD=7.2), ranging from -2.9 to 31.6. We repeated our main regression analysis and this resulted only in minimally lower robust standard errors compared to our original regression analysis from Table 9.2.

Third, in our analyses we integrated age simultaneously as a continuous variable and as a dummy variable differentiating between age groups 18-59 and 60-65. We tested for several variants of age, e.g., introducing age only as a continuous variable and only as a dummy variable in the regression. The regression model with only age as a continuous variable, which was significant (p<.001), performed slightly worse in terms of model performance (R^2=.26). No differences were observed for our most important explanatory variables (except for the age weight itself).

Fourth, we used several alternatives to our lifestyle index. The (beta) coefficient of the lifestyle index (as well as the other results) did not alter when we used the original 0-4 score in which the two final categories were not combined or when we applied an index in which the 0-3 score was squared. When we used dummy variables instead of a continuous score of 0-3, i.e. a dummy for score 1 (one lifestyle risk), score 2 (two lifestyle risks) and score 3 (three or four lifestyle risks), we found coefficients of -0.83 (0.573, n.s.), -1.83 (0.571, p=.001) and -3.56 (0.703, p<.001), respectively.

9.4 DISCUSSION

In this study, we have presented subjective expectations regarding the amount of QALYs left from 65 onwards until death in a representative Dutch sample of 18- to 65-year-olds in terms of age, gender and level of education. In contrast and addition to previous studies, we have combined expectations regarding length of life and future health-related quality of life into one single measure of healthy life expectation and investigated its relation to a relevant set of background, health and lifestyle variables.

The average amount of subjective expected QALYs from 65 onwards was 11 QALYs and ranged from -9 to 40 QALYs. The final multivariate model from Table 9.2 explained 27% of the variance in the amount of future expected QALYs. Lifestyle importantly explained variance in the amount of expected QALYs from 65 onwards. An unhealthier lifestyle was related to lower QALY expectations. Replacing the lifestyle index with the risky behaviours separately – see the first model from Table 9.3 – showed that only individuals who smoke or have poor nutritional habits expect less QALYs from 65 onwards. Interestingly, excessive alcohol consumption and physical inactivity did not lower respondents' subjective QALY expectation. However, interesting gender differences may exist (Table 9.3). Female heavy drinkers reported significantly lower expectations, but this did not hold for men. Smoking and physical inactivity, however, were only associated with a lower amount of expected QALYs for male respondents. It should be noted, however, that the relation of excessive alcohol consumption and smoking and QALY expectations showed a somewhat similar pattern for both genders (except for their statistical significance). In other words, both risky behaviours were associated with lower expectations for both men and women, but with a slightly different magnitude. Moreover, the group of female excessive alcohol consumers was rather small (n=40), which may have influenced our results. The impact of an unhealthy diet on the number of expected QALYs was similar for both men and women. The association between the expected future QALYs and lifestyle and possible differences between men and women in this respect, especially regarding alcohol consumption, warrant further investigation.

Another important point here is that the causality of the relation between QALY expectations and lifestyle may work in both directions. On the one hand, individuals with an unhealthy lifestyle may incorporate the adverse consequences of their behaviour into their QALY expectations and adjust their expectations downwards. On the other hand, individuals with low QALY expectations may adopt an unhealthy lifestyle since they may believe that unhealthy habits do not matter that much for them (given low expectations) or may feel unable to influence their expectations regarding length and future health-related quality of life. This may be related to the findings of Sarkisian et al.[3] regarding seeking medical treatment. It would be interesting to study this circular relationship in more detail.

Our multivariate regression analysis further showed that respondents with a severe disorder (now or in the past) or chronic disease expected fewer QALYs in the future compared to healthy respondents. Interestingly, being obese did not explain any variance in our outcome variable. Although respondents with a disorder (now or in the past) and/or chronic disease had significantly higher BMI scores, excluding obesity or, alternatively, the variables regarding having a disorder or chronic disease, did not alter any of the relevant coefficients. Finally, the average age of death of next of kin predicted our outcome variable as well, in the expected direction, as was found before[24,25].

Limitations

A few limitations of our study should be taken into account when interpreting our results. First, we excluded a considerable proportion (i.e., 13%) of initial respondents, largely based on supposed speeding through the online questionnaire. Consequently, the final sample available for analysis was no longer completely representative of the Dutch population, with younger and male respondents slightly underrepresented. However, since mean scores on our main outcome measure did not differ significantly between included and excluded respondents, we believe that elimination of respondents did not introduce a disturbing selection bias, and therefore does not greatly affect the generalisability of our results.

Second, the EQ-5D is a validated instrument and widely applied as health outcome measure. However, its use for eliciting expectations regarding health-related future quality of life is less common. We slightly adjusted the wording of the EQ-5D questions to make the instrument suitable for obtaining health expectations, analogous to the format used by Brouwer and van Exel[24] and Péntek et al.[25] These authors concluded that individuals seem to answer the questions as intended, since the scores for expected and actual health at age 60 were similar. The correlation of our outcome variable and the ERA provides some further validation for our application of the EQ-5D. Obviously, further validation is required and exploring other methods for obtaining expectations of future health is encouraged.

Third, the design of our survey and the questions posed to the respondents may have influenced our results. For example, in the expectation section of our questionnaire, respondents were first asked to indicate their subjective life expectancy. Then we administered the EQ-5D to elicit expectations regarding future health-related quality of life. It is unclear whether this sequence influenced respondents' answers. Moreover, respondents answered the future health questions successively for the target ages 60, 70, 80 and 90 years old. This may induce respondents to indicate a decline in health with age.

Fourth, respondents answered all questions regarding expectations of future health despite their subjective life expectancy. As Brouwer and van Exel[24] noted in this context, *"…one may expect that health-related quality of life expectations for ages at which one does not believe to be alive anymore are*

irrelevant and perhaps unrealistically low, because respondents try to indicate their expectation of longevity in the indicated health profile." Indeed, we found significantly lower quality of life expectations for 'non-survivors' vs 'survivors', which raises the question of the validity of answers to questions regarding future health-related quality of life beyond the expected age of death.

Another point is that more explanatory variables could have been included in this study. For instance, it could have been interesting to investigate the associations between future health expectations and choices related saving and insurance coverage. These are interesting options for future research.

A final limitation is that we did not explicitly ask about the expected quality of life close to the time of death. We therefore imputed these scores. The sensitivity analysis showed that using a QALY score of 0 did alter our findings somewhat. This may be investigated in more detail in future research.

Age

The role of age in our analyses should be interpreted with some caution. We found that respondents aged 60-65 reported significantly higher QALY expectations than younger respondents (see the coefficient of the age dummy in Table 9.2). For respondents in this older age group, we calculated the amount of expected QALYs for the time frame 65-70 differently, i.e., we used their current self-reported health state instead of their quality of life expectation at target age 60 (see Box 9.3). Nonetheless, we observed higher QALY expectations for the 60- to 65-year-old respondents also for the age periods of 70-80, 80-90 and 90-death, as well as higher expected quality of life scores at 70, 80 and 90 (Figure 9.2) and a higher subjective life expectancy. Therefore, our computation method does not explain the higher expectations for the older age group. A possible explanation for the fact that we found higher expectations for the age group 60-65 than for the other respondents is that achieving a certain age (in a certain health state) may increase expectations. Indeed, the expectations that young and middle-aged adults have about ageing may differ importantly from those of older adults who have more experience with ageing. The negative images associated with ageing such as illness, memory loss, dependence on others and loneliness may differ between age groups as well. Moreover, younger individuals may draw the line between young and old at a lower age than older people do.[33]

Interestingly, more than half of the respondents in the age group 60-65 (n=146) were retired. This group of 'early retirees' reported a better mean current health state and a significantly higher amount of expected QALYs compared to the other respondents in our sample, 15.8 QALYs vs 10.6 QALYs, respectively. Retirees' QALY expectation was also significantly higher than the other respondents *within* the age group 60-65. This effect on the amount of expected QALYs only held for men when conducting our multivariate regression analysis for men and women separately, which may be explained by the fact that 81% of the retirees were male.

Subjective life expectancy and future health-related quality of life

Explanatory variables may be associated with either subjective life expectancy or future health-related quality of life, or with both. Brouwer and van Exel[24] mainly found significant associations between age, health status and perception of own lifestyle compared to others and both types of expectations, whereas the average age of death of family members only related to subjective life expectancy. Péntek et al.[25] found similar results for expected health (but kin's age of death was also significantly related to expected health), whereas all included explanatory variables were significantly related to subjective life expectancy (also due to their large sample size).

Although our study methods and sample in some respects differed from the methods used in these studies, our analyses for our composite outcome indicator of expectations leads to similar conclusions.[2] We conducted separate regression analyses similar to those in Table 9.3 using subjective life expectancy and expected health as dependent variables. First, we found that having children and smoking became especially relevant in explaining the variance in subjective life expectancy. Second, having a chronic disease was only significantly related to expectations regarding future health-related quality of life. Drinking behaviour (both abstaining and drinking excessively) and physical inactivity were slightly negatively associated with future health at age 65, while an unhealthy diet mainly played a role regarding future health at older ages. Third, age of death of relatives was related to expectations regarding both length and quality of life. These results altered somewhat when the analyses were conducted for men and women separately. These additional analyses indicate that individuals relate different consequences in terms of life expectancy and future health-related quality of life to different behaviours. Moreover, apparently men and women perceive some risks differently. These are important implications for designing health promotion strategies targeted at specific unhealthy behaviours and groups.

Conclusion

In conclusion, we combined two concepts of expectations into one composite indicator of the expected amount of QALYs from the age of 65 onwards until death. With this, we extended the concept of subjective life expectancy by correcting expected longevity for the expected quality of life during these years. As such, it provides more information than subjective life expectancy alone and therefore may prove more valuable for understanding people's perceptions regarding ageing and, consequently, demand for health services and long-term care needs. It may also provide important information on the perceived impact of health behaviour on expectations (and vice versa), which could be relevant for health policy strategies aimed at improving lifestyles. More insight into individuals' subjective expectations remains warranted.

2 The average subjective life expectancy in our study was 1.5 year higher than the mean found by Péntek et al.[25], and two years lower than the mean found by Brouwer and van Exel[24]. Furthermore, our results showed a much more gradual decline in health with age than the expected sharp decline found in these previous studies, i.e. from around 0.8 at age 60 to around 0.06 at age 90. However, comparisons should be interpreted with caution due to the different study samples (for example, mean age was around eight years higher in the present study) and study design.

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Chapter 10

General Discussion

10.1 INTRODUCTION

This thesis aimed to explore two perspectives on future health: the policy perspective and individual perspective. The overall objective of this thesis was to increase our understanding of decision-making at the policy and individual level. Regarding the policy perspective, this thesis studied elements of decisions regarding the investment in future health. From the individual perspective, this thesis investigated in more detail (the measurement of) individuals' consideration of future consequences and individuals' own (health) expectations. In the following sections, the main findings of this thesis are highlighted, following the order of the research questions posed in the introduction of this thesis. Subsequently, study limitations, policy implications and future research areas are discussed.

10.2 MAIN FINDINGS

PART I: A POLICY PERSPECTIVE

The first research question of part I of this thesis, 'How does the operationalisation of the primary decision criteria for delineating the Dutch basic benefits package influence the evaluation of lifestyle interventions?, was the main focus of chapter 2 and further addressed in chapters 3 and 4. In order to allocate scarce healthcare resources in an optimal way, transparent and fair decision criteria are important. In the Netherlands, the debate on such criteria intensified in the last two decades following recommendations of the Committee on Choices in Healthcare (or Dunning Committee) on how to delineate the basic benefits package.[1] Three criteria are central in the debates on the allocation of healthcare resources: (i) necessity, (ii) effectiveness and, (iii) cost-effectiveness or efficiency.[2,3]

The first criterion, necessity, basically assesses whether some kind of (collectively financed) medical intervention is necessary given the severity of the illness or health problem involved (e.g., measured as disease burden). In other words, the criterion addresses the question whether a particular disease or health problem is serious enough to justify a claim on solidarity. The second criterion, effectiveness of an intervention, is the least controversial of the three criteria. It indicates whether an intervention achieves its goal, for instance, whether it improves health or prevents health deterioration. If an intervention is not effective in achieving desired outcomes, the rationale for financing it collectively is lacking. The third criterion, cost-effectiveness, which comprises the former effectiveness criterion, determines to what extent an intervention offers value for money. It balances the costs and (health) benefits of an intervention relative to a relevant comparator. The health gains are often expressed as quality adjusted life-years (QALYs).

In recent years, the operationalisation of the criteria in the decision-making framework has received more attention. This is important, since their operationalisation importantly defines their exact meaning and, therefore, directly influences decisions. In chapters 2 and 3, several discussions regarding

the operationalisation of the criteria necessity, effectiveness and cost-effectiveness were highlighted, in particular those issues relevant in relation to lifestyle interventions.

Issues when operationalising the decision criteria

In the Dutch policy context, necessity is operationalised using the concept of proportional shortfall.[2-9] This implies that the necessity of treatment increases with the proportion of remaining health (or QALYs) that will be lost due to an untreated disease. Two underexplored normative choices that need to be made to operationalise this concept are: (i) the (sub-)group in which proportional shortfall is measured and (ii) the moment that the measurement of proportional shortfall begins. Although several stances can be taken and defended in relation to both these issues, it is important to understand that ultimate choices may impact final decisions. In chapter 2, arguments were posed in favour of inclusion of only those individuals who (would) actually incur the health losses for which treatment is considered.[5] This will generally lead to a higher proportional shortfall and thus more priority to treating or preventing the involved illnesses. Regarding the second issue, the preferred option usually is to calculate proportional shortfall at the start of the treatment (instead of the point that the individual would potentially fall ill).[5] This leads to a lower proportion of health lost and therefore a lower necessity weight for many preventive interventions. Considering the fact that priority is generally given to the treatment of diseases with a higher proportional shortfall, the importance of these normative issues and explicit decisions is emphasised.

The second criterion, effectiveness, according to the National Healthcare Institute (ZiNL), is preferably assessed using Randomised Controlled Trials (RCTs). For lifestyle interventions, it may be particularly difficult to meet this standard of evidence. Reasons for this are the lack of controlled trial settings, the required long follow-ups to capture all treatment effects, and the use of intermediate outcomes (such as weight loss) instead of final health outcomes (i.e., QALYs) to report treatment effects. These difficulties can limit the availability of data on the effectiveness of lifestyle interventions. This may negatively influence the priority given to these treatments. Resolving the difficulties associated with collecting data on effectiveness for lifestyle interventions,[3] as well as further defining appropriate evidence in health policy making, remain important.

The cost-effectiveness criterion is usually operationalised using economic evaluations of healthcare, in particular cost-utility analyses (CUA).[10] Guidelines exist on how such evaluations should be performed, also in the Netherlands.[2] Some of the important normative, methodological choices regarding this criterion were addressed in chapters 2, 3, and 4 of this thesis. First, the Dutch guidelines advocate a societal perspective, which implies including all costs and (health) benefits, regardless of the sector in which they fall. Lifestyle interventions may involve costs and benefits outside the healthcare domain, for example, in the education sector. Those costs will be ignored if a narrower than societal (e.g., healthcare) perspective is chosen. This seems undesirable from a welfare-theoretical point of view.

Second, discounting is common practice in economic evaluations of healthcare.[10] However, the height of the discount rate, especially for health effects, is fiercely debated. The Dutch guidelines recommend different discount rates for costs (4%) and effects (1.5%). Hence, the weight placed on future health is higher than that placed on future costs. This practice of differential discounting favours lifestyle interventions that usually yield immediate costs, but future health benefits (compared to discounting costs and effects with 4%). However, differential discounting as prescribed in the Dutch guidelines is internationally speaking exceptional and discounting practices remain much discussed.

A final important and controversial issue in the operationalisation of the criterion of cost-effectiveness regards one particular type of costs: unrelated medical costs in life-years gained. This cost category comprises medical costs in gained life-years that are not directly related to the life-prolonging intervention (e.g., those related to hip replacements of people saved by lung transplants). The second research question of part I of this thesis, 'Should unrelated medical costs in life-years gained be included in economic evaluations of healthcare interventions?', was addressed in-depth in chapter 3. The Dutch guidelines for economic evaluations advocate the societal perspective as described above. Despite this, they also explicitly recommend the exclusion of these costs.[1] It is clear that their inclusion in economic evaluations may influence the outcomes of such evaluations. Examples in chapters 3 and 4 of this thesis illustrated this. Most international guidelines for economic evaluation of healthcare reviewed in chapter 3 currently recommend the exclusion of these unrelated medical costs in life-years gained. However, chapter 3 also highlighted that the international scientific literature appears to increasingly support their inclusion. Although some controversy remains, also on the practical issue of how to accurately estimate these costs, chapter 3 argued that excluding this important type of costs may lead to a sub-optimal allocation of healthcare resources.

Decision rule

As part of the decision-making framework, a combination of both the necessity and cost-effectiveness criteria leads to a preliminary recommendation regarding the reimbursement of a healthcare intervention. To this end, a relevant cost-per-QALY threshold is used. An important assumption underlying this decision rule is that society is willing to spend more (that is, allow a higher cost-per-QALY threshold) for an intervention that targets a disease with a higher disease burden. While it seems that the policy support in the Netherlands for such a decision rule in healthcare decision-making is fairly strong, the evidence that this decision rule reflects distributional preferences in society is weaker.[9]

What is more, the (implicit and explicit) decision rules used in the context of prevention may differ from those used for curative interventions. Healthcare expenditures are especially related to curative healthcare. In contrast, spending on preventive interventions and public health does usually not

1 Note that, very recently, the Dutch guidelines have been reviewed and revised. The inclusion of *all* indirect medical costs is prescribed for economic evaluations performed after July 1, 2016.

exceed 10% of total public expenditure on health.[11,12] This may reflect a tendency to judge preventive interventions more stringently than curative interventions. One noteworthy aspect in that context is the perception or claim that prevention may result in improved health as well as in lower healthcare expenditures. Prevention is therefore sometimes proposed as a cost saving strategy to tackle rising healthcare expenditures.[13,14] This not only is unlikely to hold for preventive interventions (see the examples throughout the first part of this thesis and in particular in chapter 5), also due to (unrelated) medical costs in the life-years gained. More importantly, prevention does not have to be cost saving to still be an attractive, that is cost-effective, strategy, to improve health. It is therefore crucial to judge prevention within the same decision-making framework and against the same thresholds as other curative interventions, with a stronger focus on value for money. This case is made in chapter 4 of this thesis, addressing the third research question of part I, 'Should prevention save costs in order to be an attractive healthcare strategy?'

Prevention and healthcare expenditures

The fourth and last research question of part I, 'What is the effect of obesity prevention on lifetime healthcare expenditures?' was addressed in chapter 5. This chapter investigates to what extent prevention offers value for money. Obesity is a major risk factor for a large range of chronic diseases. Its prevalence is increasing worldwide and, therefore, obesity is a rising public health concern. The relevance of developing and implementing strategies to reduce and prevent obesity is undisputed from a public health perspective.[15] However, the health economic impact of such strategies is less clear. Chapter 5 presents the effect of obesity prevention on annual and lifetime healthcare spending for the Netherlands. For this purpose, the Dutch National Institute for Public Health and the Environment (RIVM) Chronic Disease Model and Dutch Cost of Illness data were used.

The results in chapter 5 showed that lifetime drug expenses are higher for obese people than for 'healthy-living' people, despite shorter lifespans for the former group. Preventing obesity results in drug savings for diseases related to obesity. These savings outweigh any additional drug expenditures unrelated to obesity in life-years gained. Moreover, preventing obesity increases long-term care expenditures substantially. Savings in other healthcare segments are very small. Overall, obesity prevention may thus result in higher instead of lower lifetime medical expenditures. Using higher discount rates for costs will mediate this outcome since the present value of costs for the long-term segment will be lower. Therefore, whether obesity prevention is a cost-effective strategy will importantly depend on the amount of health gained.

Conclusion part I

The first part of this thesis focused on elements of decisions regarding investments in future health from a policy perspective. In particular, the operationalisation of the three main decision criteria to delineate the Dutch basic benefits package and some of the normative issues that arise in that

context were addressed and related to investments in future health. Furthermore, the extent to which such investments (through prevention) may offer value for money was explored and discussed in relation to allocation decisions in the healthcare sector.

It became clear that there is still no consensus regarding the operationalisation of the decision criteria and decision rule. Moreover, the inherently normative choices required to operationalise them may have a profound effect on the quantitative evaluation of future health investments. The inclusion of medical costs due to the treatment of unrelated diseases in life-years gained in health economic evaluations has been one of the most persistent controversies. However, the inclusion of *all* future medical costs is increasingly supported. Doing so may involve inclusion of additional costs that offset possible savings in related diseases. While this makes prevention a less attractive option in terms of efficiency, such future health investments may still provide good value for money compared to other (curative) healthcare interventions. In any case, inclusion offers decision-makers a complete overview of costs and benefits.

PART II: AN INDIVIDUAL PERSPECTIVE

This part of the thesis investigated in more detail the measurement of two conceptualisations of future time perspective (FTP), i.e. individuals' consideration of future consequences and subjective expectations regarding length and future health-related quality of life.

Consideration of future consequences

The first research question, 'How reliable and valid is the original 12-item Consideration of Future Consequences (CFC) Scale?', was addressed in chapter 6. The 12-item CFC Scale was developed by Strathman et al.[16] to measure the extent to which individuals consider and are influenced by the potential distant outcomes of their current behaviour. Although the CFC Scale is often applied in social psychological studies, little evidence was available about the performance of the scale in terms of reliability and validity. Therefore, in chapter 6 of this thesis, factor analysis was used to investigate the underlying factor structure of the 12-item CFC Scale among a Dutch sample of young adolescents.

Most research that employed the CFC Scale assumed it to be a uni-dimensional construct. However, the results in chapter 6 provided evidence for a multiple factor solution. The factor solution included one present-oriented factor consisting of all seven present-oriented items. This factor showed good internal reliability and reflects the extent to which individuals are influenced by the immediate consequences of their behaviour. In addition, one or two future-oriented factors were found containing the remaining five future-oriented items. The interpretation of the structure and content of these future-oriented factor(s) was less straightforward. This result raises questions about the construct validity of the original 12-item CFC Scale.

The main result from chapter 6 was similar to Petrocelli,[17] who also reported a multiple factor solution. Recent research also found evidence for distinguishing between two subscales: the CFC-Immediate and CFC-Future subscale.[18] More recently, two new future-oriented items were added to the future-oriented factor (i.e., the CFC-Future subscale).[19] The properties and importance of this 14-item Two Factor CFC Scale in the context of investments in future health are still being studied.

Subjective survival probabilities

The second research question of part II of this thesis, 'To what extent do subjective survival probabilities differ across Europe, also in relation to lifestyle?', was addressed in chapter 7. Research increasingly aims to understand (the formation of) subjective life expectancy and their relation to health behaviour. Subjective survival probabilities (SSPs), i.e. the expected probability of surviving to a certain target age, are increasingly elicited in large-scale household surveys, including the Survey of Health, Ageing and Retirement in Europe (SHARE). Evidence regarding the relevance of SSPs in the context of lifestyle decisions such as smoking is starting to come available.[20] Chapter 7 of this thesis adds to the existing literature and explored individuals' SSP in a population of elderly (i.e., 60 years and older) from 15 European countries using SHARE data. Moreover, the relation to a variety of health behaviours was addressed.

The total sample average subjective probability of surviving the next 9-15 years was around 57%. Important cross-country differences were found: from the lowest mean in the Czech Republic (42%) to the highest mean in Denmark (64%). The results further indicated that SSPs correlated with socio-demographic, socioeconomic and also strongly with objective health characteristics (except for obesity). Regarding lifestyle, smokers reported lower SSPs compared to non-smokers, but no difference was found between non-smokers and former smokers. Overall, less explicit and straightforward relationships were found for SSPs with alcohol consumption and physical activity. Again, large cross-country differences were observed here. These results emphasise that SSPs and their relevance in relation to lifestyle decisions may vary importantly across Europe.

Measuring subjective life expectancy

The third research question of part II, 'How do subjective survival probabilities relate to point estimates of subjective life expectancy?', was addressed in chapter 8. The definition and measurement of subjective life expectancy may differ across studies. Two commonly applied elicitation approaches are the probabilistic approach used in chapter 7 (SSPs) and the non-probabilistic approach (i.e., a point estimate). Directly providing a point estimate seems cognitively easier for respondents than providing SSP estimates, which may lead to less inconsistent data.[21,22] A fundamental difference between the two elicitation techniques is that SSPs allow expressions of uncertainty.[23] Very little research has focused on the comparison of both approaches. Chapter 8 compared both elicitation methods within the same sample and showed that the point estimate computed from the SSPs was, on average,

about 3.5 years higher than the directly elicited point estimate. This indicates that individuals seem more optimistic about their longevity expectation when this is expressed in a probabilistic format. The findings further indicated that specific groups of people, in particular older individuals or those with a lower socioeconomic status, express their longevity beliefs differently depending on the elicitation method used. Overall, the results are in line with previous research[24,25] and suggest that the two elicitation methods are not fully comparable.

Future health-related quality of life expectations

The final research question of part II of this thesis, 'How can subjective expectations regarding future health-related quality of life be measured and combined with subjective expectations regarding length of life?', was addressed in chapter 9. While subjective life expectancy is increasingly being studied, subjective expectations regarding future health-related quality of life are still underexplored. In chapter 9, subjective expectations regarding length and future health-related quality of life were combined into one single measure of subjective future health expectation: the subjectively expected amount of QALYs from the age of 65 onwards until (the expected age of) death.

The average amount of expected QALYs from 65 years onwards in a representative sample of the Dutch general public was 11 QALYs and varied from -9 to 40 QALYs. Individuals with a relatively unhealthy lifestyle or lower health status reported lower QALY expectations. Furthermore, additional analyses showed that demographic characteristics, health, and lifestyle were varyingly associated with either subjective life expectancy or future health-related quality of life, or both. These findings show that correcting subjective life expectancy for personal beliefs regarding the quality of life during these years seems to provide important additional information about people's thoughts on their future (health).

Conclusion part II

The second part of this thesis focused on (the measurement of) individuals' consideration of the future and individuals' own expectations regarding length and future health-related quality of life. For this purpose, some of the more commonly applied elicitation formats were explored in more detail and described in the context of future health investments.

This thesis has added to the existing literature by providing some evidence of the usefulness of future-focused thoughts and considerations in the context of future health investments. The extent to which individuals consider and are influenced by near and distant outcomes of current actions may vary and can provide meaningful information to further unravel individual decisions regarding future health investments. In that context, adequate measurement of subjective expectations regarding length and future health-related quality of life is important as well. The operationalisation and measurement of these FTP conceptualisations are still not resolved and more work in this area is needed.

10.3 LIMITATIONS

This thesis has attempted to further knowledge on future health from a policy perspective and an individual perspective. Several limitations of this thesis should be taken into account when interpreting the results from the different chapters.

Part I

From a policy perspective, this thesis aimed to increase understanding of decisions and the decision-making framework in relation to investments in future health. To that end, in the *first* part of this thesis, most research focused on the Dutch decision-making framework and its decision criteria. In particular, the assessment phase and the operationalisation of the corresponding criteria have been discussed in-depth in chapters 2 to 4. Two aspects that are important in this context have not been (fully) addressed.

First, in the Dutch decision-making framework the assessment phase is followed by an appraisal phase. In this phase, broader societal concerns (including ethical and cultural considerations) are discussed in relation to the assessed intervention. Considerations in this phase could alter the recommendations based on the assessment phase. Although important, this appraisal phase fell outside the scope of this thesis.

Second, this thesis studied the decision-making process within the Dutch context. In the discussion of the operationalisation of the criteria, practices from other countries were considered, in particular regarding the inclusion of unrelated medical costs in life-years gained in economic evaluations. However, this was not done systematically. Future work in this area could investigate decision-making frameworks in other countries (with other healthcare systems) to learn about their healthcare decision-making processes in relation to investments in future health.

Several aspects in the context of future health investments that are relevant from a policy perspective have not been addressed in this thesis. Some of these aspects are mentioned next. For example, many investments in future health in the Netherlands are not based on the decision criteria and decision rule discussed in this thesis. Thus far, the decision-making framework has been predominantly applied for the assessment of new pharmaceuticals for inclusion in the statutory insured basic benefit package. The unresolved, normative issues that arise when operationalising the decision criteria and the lack of clear decision rules add to the scarce utilisation of the framework in practice. Although the framework has received an increasing amount of support, it seems that it is predominantly used as a conceptual framework.[9]

Following on from this, other influential factors that drive or restrict future health investments may be in place since "*the policy process, irrespective of the nation or health system, is not a linear, rational model in which an idealised solution for a public problem can be ascertained and optimally implemented*".[26] Therefore, non-evidence-based drivers of policy decisions, for example, the influence of interest groups (e.g., consumer and patient organisations) and industry groups (e.g., tobacco and alcohol industries), should be taken into account as well in order to fully grasp healthcare policy decisions.[26,27-30] This thesis did not focus on such factors since it requires a different study design.

Moreover, future health investments may not only depend on the willingness to invest from a policy perspective (or macro level), but may also require investments at the meso level – i.e. from actors like health insurers, municipalities or hospitals, depending on the organisation of the healthcare system.[31] This level was not within the scope of this thesis, but deserves consideration in this context as well.

Part II

In the *second* part of this thesis, aspects of the individual perspective on longevity and future health were explored. In this context, some comments on the empirical data that was used, need to be made.

A first comment relates to the matter of generalisability of results. In chapter 6, the construct validity of the CFC Scale was assessed in a Dutch sample of young adolescents. Adolescence is a crucial "*life phase in which the opportunities for health are great and future patterns of adult health are established*".[32] Although this makes it worth investigating expectations and considerations of the future among adolescents, the use of data from such a specific age group may limit the generalisability of the results. In this respect it is sometimes claimed that young adolescents have *immaturity of judgement* and have less ability in foreseeing future consequences.[33-35] Hence, the degree of consideration of consequences (current and especially future) of present actions may be less strong in this group. Furthermore, the studies in chapter 6, 8 and 9 were performed in one single country (i.e., the Netherlands). This may (further) limit the generalisability of the findings based on these datasets.

Second, the questionnaires used in the research presented in chapters 6 and 9 included instruments to elicit conceptualisations of future time perspective. For purposes of the research in these chapters, some of these instruments were slightly altered or used in another setting than for which they were originally intended. For example, the wording of the CFC Scale in chapter 6 was slightly simplified in order to make it more appropriate for use among young adolescents. Moreover, the CFC Scale consists of general statements and was not specifically designed for use in the health context. The EQ-5D instrument employed in chapter 9 for measuring expectations regarding future health-related quality of life, is a validated and much applied health outcome measure.[36] However, its use in the context of expectations is not very common, with Brouwer and van Exel,[37] and Péntek et al.[38] as notable exceptions. Moreover, to make elicitation of expectations possible, the wording of the EQ-

5D had to be adjusted. The exact consequences of these adjustments have not been tested and therefore, the validity of the answers remains contestable.

Third, all chapters from the second part, except for chapter 7 which used SHARE data, relied on data from web-based surveys. These surveys consisted of mostly close-ended questions and were designed for self-completion. This gave the opportunity to collect data in relatively large samples. A drawback was that no specific (qualitative) information was gathered on the way individuals actually think about the issues presented to them. For example, rounding and focal point answers were common phenomena in chapters 8 and 9, as more often observed.[39,40] In some cases, such as in the case of a "50%" answer to a probability question, it may even be unclear what a respondent's answer actually reflects: a 50% chance or ambiguity? The same accounts for inconsistent answers (e.g., a higher SSP for target age 70 than for 60 years). The research in these chapters could have benefited from face-to-face data collection or follow-up questions asking for clarifications. It should be noted, however, that in the SHARE data used in chapter 7, which is gathered using Computer-assisted personal interviewing (CAPI), rounding and focal point answers were found as well.

A final important limitation of the research from part II of this thesis concerns the use of cross-sectional data, especially in chapter 7. Panel data might have increased the understanding of the formation of SSPs and their relation with lifestyle decisions. However, it should be stressed that even with panel data, causal relationships between expectations and behavioural decisions would have been difficult to establish, due to endogeneity issues. Nevertheless, future research should aim for this and longitudinal SHARE data is now available (at the time of the research in chapter 7 only two prospective waves with a relatively short interval were available). Exploring this in more detail would offer additional information on the individual decision-making process and provide more opportunities to study the incentives for investing in future health at the individual level.

Similar to part I, it should be noted that many other interesting questions could have been addressed in part II as well. For example, it would have been relevant to investigate the subjective trade-off between quitting smoking and possible health gains. In other words, how much do people *think* they can gain from smoking cessation? These perceived health benefits may determine the commitment to stop smoking from an individual point of view. But many other factors may influence such decisions as well. More generally, investments in future health from an individual perspective will depend on many different factors apart from the factors addressed in this thesis. A notable example in this respect is healthcare insurance. Such knowledge is important for the development of healthcare strategies aimed at improving future health from a policy point of view, the actual uptake of such strategies, and therefore the materialisation of the potential benefits of future health investments. This thesis could have benefitted from bringing together and interacting views from both the policy and individual perspective. This remains an important future research area.

10.4 IMPLICATIONS FOR POLICY AND FUTURE RESEARCH

Several health policy implications and areas for future research that follow from the main findings of this thesis are highlighted below.

Part I

Transparent and fair healthcare policy decisions require a consistent use of a broadly supported decision-making framework. However, it seems that many inherently normative issues still need to be (explicitly) resolved before the Dutch decision-making framework and its criteria are fully operationalised. Only then it can be successfully applied in practice (as discussed in chapters 2, 3 and 4). Moreover, it seems that parts of the Dutch framework are still only predominantly applied for reimbursement decisions about pharmaceuticals. Therefore, an important issue is extending the scope of the decision-making framework to other (or all) types of healthcare interventions and technologies. A further quantification of the decision criteria in the assessment phase of the framework is required, also in order to make the decision-making framework suitable for this purpose. As shown in this thesis, this may strongly affect the priority given to investments in future health (for better or for worse).

An important aspect of the framework concerns the guidelines on how to perform economic evaluations of healthcare. These guidelines should have a proper theoretical foundation. Important arguments have been put forward in this thesis regarding one of the issues that has been fiercely debated, i.e. the inclusion of unrelated medical costs in life-years gained (chapter 3). This cost category is especially relevant for the proper evaluation of future health investments. Knowledge and tools to incorporate these costs in economic evaluations are coming available,[41] but future research could aim to measure and model these costs even more precisely.

The decision rule that should be used to decide whether some intervention should be included in the basic benefits package, i.e. the threshold value of costs per QALY, is also still a much-debated issue. It is unclear what the threshold represents or should represent. The same applies to the height of the threshold. Moreover, there is an increasing desire in this context to relate equity and efficiency considerations, linking the necessity criterion to that of efficiency. This reflects the assumption that society is willing to adopt a higher threshold value for cost-per-QALY for interventions that target a disease with a higher disease burden. In this respect, it seems that prevention is required to meet higher standards than other healthcare interventions. A stronger theoretical and empirical foundation should come available to establish the (exact form of) relationship between necessity and cost-effectiveness, applicable to all types of healthcare interventions. More research and explicit debate in this area is most certainly warranted.

The appraisal phase constitutes an important part of the Dutch decision-making framework, allowing the evaluation of more normative, non-quantifiable judgments to take place. Some of

these considerations may be of particular interest in case of future health investments, such as the culpability argument and own responsibility argument discussed in chapters 2 and 4 of this thesis. Other relevant (public) preferences and attitudes, such as those related to the fact that prevention is often targeted at statistical lives (rather than 'identifiable victims'), the 'rule of rescue' that gives priority to those most urgently at risk of severe health loss, and the uncertainty of the costs and benefits of prevention, should be discussed openly. The important point here is that such considerations in this (less quantifiable) phase could decisively alter the recommendations based on the assessment phase. Moreover, arbitrariness, inconsistency and lack of transparency should be avoided.

It is also important to emphasise that further improvement of the decision framework need not necessarily promote investments in future health. The goal is rather to support an optimal allocation of scarce resources, in terms of public health and healthcare expenditures. Promoting prevention as an instrument to reduce healthcare spending is contestable. Prevention need not be cost saving, nor needs to be so in order to be an attractive option. Prevention should be judged in the same way as other healthcare interventions, within the same framework and using the same criteria and decision rule. This implies a strong focus on value for money. Other potential barriers to future health investments, such as the influence of relevant stakeholders and public opinion, should also be addressed.[30]

Part II

The success of interventions aimed at improving future health may importantly depend on decisions made at the individual level. As discussed throughout the second part of this thesis, it is increasingly shown that future health investments at this level may be related to the extent to which individuals consider the consequences of current behaviour and (the formation of) subjective expectations regarding length and future health-related quality of life.

Many health behaviours and lifestyle decisions involve a trade-off between short-term and long-term consequences. The degree to which individuals are influenced by immediate and/or future consequences is considered one of the factors that may predict health behavioural decisions.[19] The findings from chapter 6 of this thesis (and recent further work in this area) provided more insight into the multi-dimensional conceptualisation of temporal orientation. In other words, "*concern with future and concern with immediate consequences are not polar opposites*".[19] The proposed two-factor solution of the CFC Scale (i.e., the distinction between the consideration of immediate and future consequences) enables better understanding of individual health behaviour. For example, Adams[42] only found associations between (higher) consideration of *immediate* consequences and body mass index (BMI) and smoking. The distinction between the consideration of immediate and future consequences may therefore be important, for example, in the context of temporal framing of health promotion strategies (e.g., framing health communication, smoking bans and pricing of tobacco). This

is particularly interesting in light of recent work showing that health messages focusing on the *benefits* of preventive behaviour seem to be more effective than 'loss-framed' messages.[43] Future research could further examine the structure of the two CFC subscales and "*identify [underlying] mechanisms through which CFC predicts various health behaviours*."[19]

The relevance of subjective life expectancy in relation to lifestyle behaviour is also increasingly acknowledged. In chapter 7 significant cross-country differences were found, in terms of actual height of the subjective survival probability (SSP), and in relation to health behaviour. For instance, overall, smokers reported lower survival chances compared to non-smokers. However, with few exceptions (e.g., the Netherlands and Belgium), this pattern did not hold at country level. Although this thesis did not investigate this any further, this may signal that in some countries people are better informed about or aware of the adverse health effects of smoking than in other countries. This may be the result of health communication strategies (or the lack of success of such strategies). More generally, it shows that tailored healthcare strategies for improving future health could be required; a successful strategy in one country may not need to work in another country.

Subjective longevity expectations are increasingly elicited but different elicitation techniques are used in the literature, e.g. point estimates and probabilities (as discussed in chapter 8). The extent to which individuals are able to express such expectations using probabilities, which determines the usefulness of such information, is still unclear. The measurement of subjective expectations regarding future health-related quality of life is an under-explored topic, but may well provide additional information to subjective length of life expectations (as shown in chapter 9). People who believe that deteriorating health is an unavoidable aspect of ageing, may be less prone to invest in future health. Especially when such expectations are inaccurate (for instance, too pessimistic), this may induce non-optimal future health decisions at the individual level.

If measured validly and reliably, subjective expectations, regarding both length and future health-related quality of life, may contain valuable private information, also compared to actuarial data.[44] As a result, important insights into health behavioural decisions and future healthcare needs and demands may come available. Hence, future work on how to measure subjective expectations is warranted. Understanding the interaction between personal beliefs and expectations and the willingness to invest in future health, may well be crucial in that context.

Bridging the gap between both perspectives

The willingness to invest in future health at the individual level seems crucial for the uptake of policy strategies aimed at improving future health. Nowadays, healthcare decision-makers frequently appeal to individuals' autonomy and own responsibility. An important question is to what extent individuals are able and willing to make healthy choices and on which factors such decisions depend.

At the individual level, removing the barriers to participate in healthcare programs (i.e., to invest in future health) and facilitating access can be achieved through lowering the individual level of participation costs. This raises important questions on defining prevention reimbursements schemes, from a governmental perspective as well as insurer perspective. Other policy strategies to increase participants' responsiveness to preventive strategies are price and subsidisation policies, taxes and 'nudging of healthy behaviour'. Regarding the latter, 'nudging' reflects the notion of improving health behaviour without compulsion.[45] In other words, the government can stimulate individuals to make the 'right' (i.e., most healthy) choice or can create an environment that increases the possibility that people behave in a desired way. Such more subtle government interference can take multiple forms. For example, public health campaigns aimed at enhancing knowledge and awareness of health risks, changing attitudes and motivations towards them (through information) or changing (incorrect) assumptions or beliefs about 'normal behaviour'. Following on from the latter, focusing on resolving the possible discrepancy between individuals' expectations and perceptions and reality may be an important direction as well.

From a policy point of view, designing an effective intervention to change health-related behaviour (one that is eligible for public reimbursement) does not automatically lead to its implementation. Proper implementation of a reimbursed intervention will be very important in determining whether or not any health behavioural intervention is a success. This may depend on many factors.[46] However, as Lombard et al.[47] highlight in the context of obesity prevention, "*a gap in research that translates evidence-based interventions from isolated trials toward broad effective population strategies is evident [48,49]*". This also applies to other lifestyle-related interventions, for example, in case of preventing diabetes.[50] Implementation research tries to reconcile science and practice but still requires more attention. One important aspect that determines successful implementation is the extent to which participants adhere to and comply with the intervention. Many public health interventions only take effect if individuals are willing to make the necessary investments (in terms of money, time, inconvenience, foregoing pleasures, etc.). This holds for vaccination and screening programs, but even more for lifestyle-related interventions (e.g., losing weight, quitting smoking, etc.). From an individual point of view, lifestyle interventions usually entail more drastic sacrifices for a longer period of time, in order to avoid relapses. The above is indicative of the importance of bridging the gap between the policy and individual level in order to ensure a longer life in good health.

10.5 FINAL REMARK

Investing in a long life in good health may require a focus on future health and actions at different levels. In this thesis, elements of decisions at two levels, i.e. the policy and the individual level, have been studied. Although this thesis contributed to the knowledge at both levels, there is still much unknown. Therefore, studying the incentives for investing in future health from different perspectives remains an important research area in the near future. After all, citing Virgilio: *"La più grande ricchezza è la salute."*

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Summary

SUMMARY

A long life in good health is considered one of the most important goals in human life. New healthcare interventions play an important role in attaining this goal. They allow diseases previously associated with high morbidity and mortality to be prevented or cured, adding to the length and quality of life of individuals. Nonetheless, new challenges emerge, such as the rise of non-communicable (and often more chronic) diseases, including those related to lifestyle. This raises important questions on how to counter such diseases and further improve (future) population health. Delaying or preventing the onset of diseases requires, among other things, a focus on future health. Therefore, the main objective of this thesis was to increase knowledge on the decision-making process regarding future health, taking two perspectives: a policy perspective and an individual perspective. The first part of this thesis studied decisions regarding the investment in future health from a policy perspective (Part I, chapters 2-5). The second part of this thesis explored individuals' considerations of the future consequences of their health behaviour and their expectations about their future health (Part II, chapters 6-9).

Part I

The trends of ageing populations and rising healthcare expenditure may undermine the future sustainability of healthcare systems. The claim is sometimes made that investment in future health through prevention or lifestyle modification strategies could alleviate the financial pressure on healthcare budgets. However, the willingness to invest in future health is not self-evident from a policy point of view, since it requires trading off short-term costs and long-term benefits. Indeed, investments in prevention are relatively low. To assess whether prevention is a preferable strategy and to allocate scarce resources appropriately, it is important that (i) the decision criteria in this context are clear, transparent and justified and (ii) good information on the costs and benefits of prevention is available. Therefore, in the first part of this thesis, the Dutch decision-making framework and (the operationalisation of) its criteria to delineate the basic benefits package were discussed in relation to the costs and benefits of prevention.

Chapter 2 investigated how the operationalisation of the primary decision criteria for delineating the basic benefits package influences the evaluation of lifestyle interventions. Three decision criteria that are central in this decision-making framework are 'necessity', 'effectiveness' and 'cost-effectiveness'. Necessity is operationalised using the concept of 'proportional shortfall', effectiveness using appropriate studies such as Randomised Controlled Trials (RCTs) and cost-effectiveness using economic evaluations of healthcare interventions, in particular cost-utility analyses (CUAs). It became clear from chapter 2 that several normative issues in order to operationalise these criteria still need to be resolved. First, the use of proportional shortfall requires determining the (sub)group in which proportional shortfall is measured as well as the appropriate measurement moment. Second, there are various reasons why determining the effectiveness of an intervention using RCTs is particularly

difficult in the context of lifestyle interventions. Third, there are still fiercely debated normative, methodological issues regarding CUAs, such as the perspective of the analyses, the costs and effects to be included in the analyses and the discount rates to be applied for costs and effects. These normative choices can have a profound impact on the evaluation of lifestyle interventions but need to be made explicit and transparent. Therefore, chapter 2 concluded that improvements of the decision-making framework in the Netherlands are required to guarantee sound evaluations of lifestyle interventions aimed at improving (future) health.

As stressed in chapter 2, the economic evaluation of healthcare interventions is an important component of the Dutch decision-making framework. In chapter 3, a controversial issue in the operationalisation of the criterion of cost-effectiveness was further addressed: the inclusion of unrelated medical costs in life-years gained. This cost category is normally ignored in economic evaluations, irrespective of the perspective chosen for the analysis. National guidelines for pharmacoeconomic research typically endorse this practice. However, the inclusion of unrelated medical costs in life-years gained appears to have gained support in the literature for reasons of consistency and optimality. Examples in chapters 3 and 4 of this thesis illustrated the impact of including these costs in CUAs. Whether or not to include unrelated future medical costs may have important distributional consequences, especially for interventions that substantially increase length of life. Practical objections against inclusion of future costs are mitigated by the fact that accurately estimating unrelated medical costs in life-years gained is increasingly feasible. Chapter 3 concluded that the inclusion of unrelated future medical costs should become standard.

Prevention (of unhealthy behaviour) has sometimes been promoted as simultaneously reducing costs and improving public health. However, this will unlikely prove to be true, as shown in several examples throughout part I of this thesis and in particular in chapter 5. Among other things, additional medical costs in life-years gained due to treatment of unrelated diseases may offset possible savings in related diseases. The exclusion of unrelated medical costs in gained life-years may result in too favourable estimations of cost-effectiveness, feeding the unjustified optimism among policymakers regarding lifestyle interventions as a cost saving option. However, even when prevention does not save costs, it may still be a (very) cost-effective way to improve public health. This should be judged taking all future costs into account and be based on the true value for money provided by lifestyle interventions. This case was made in chapter 4.

Chapter 5 assessed to what extent prevention indeed results in cost savings, using obesity prevention as example. Obesity is a major contributor to the overall burden of disease (also reducing life expectancy) and is associated with high medical costs due to obesity-related diseases. Therefore, the relevance of developing and implementing effective strategies to reduce and prevent obesity is supported from a public health perspective. However, the health economic consequences of such strategies are less

well documented. Chapter 5 investigated the effects of obesity prevention on annual and lifetime healthcare expenditures for different segments of the healthcare sector, i.e. hospital care, long-term care, pharmaceutical care and primary healthcare segments. For this purpose, the Chronic Disease Model of the Dutch National Institute for Public Health and the Environment (RIVM) and Dutch Cost of Illness data were used. Lifetime drug expenditures were higher for obese people than for people with normal weight, despite shorter life expectancy for the obese. Obesity prevention resulted in savings on drugs for obesity-related diseases until the age of 74, which outweighed additional drug costs for diseases unrelated to obesity in life-years gained. Furthermore, obesity prevention increased long-term care expenditures substantially while savings in the other healthcare segments were, at best, small. Obesity prevention will thus entail savings in the pharmaceutical segment, but also substantial additional costs for long-term care. Therefore, chapter 5 concluded that whether preventing obesity is a cost-effective strategy will to a large extent depend on the amount of health gained. Moreover, balancing realistically estimated costs and benefits of all types of healthcare interventions is needed to allocate healthcare resources in an optimal way.

Part II

Most individuals will have some idea or expectation of whether they will grow old and how they will grow old. Such thoughts on future health are likely to vary across individuals. Moreover, the extent to which individuals' present actions are influenced by these future thoughts may vary as well. These notions can be considered part of a broader construct often referred to as 'Future Time Perspective' (FTP). The importance of FTP in the context of health behaviour is increasingly acknowledged. However, the operationalisation and measurement of future-focused thoughts and considerations has led to various debates and more work in this area has been advocated. Therefore, the second part of this thesis focused on two important conceptualisations of FTP and their measurement in the context of health behaviour: (i) the extent to which individuals consider the future (versus immediate) consequences of their decisions and (ii) individuals' beliefs about their remaining lifetime and health status at later stages in life.

The Consideration of Future Consequences (CFC) Scale is a measure of the extent to which individuals consider and are influenced by the distant outcomes of current behaviour. This concept is increasingly believed to be important in the context of health behaviours, since such behaviours often entail a trade-off between immediate benefits in terms of satisfaction or reduced stress and long-term costs in terms of chronic disease and premature mortality. However, little empirical evidence existed on the exact properties of the CFC Scale in terms of factor structure, reliability and validity. Chapter 6 investigated these aspects of the 12-item CFC Scale using secondary data of Dutch young adolescents. Factor analysis revealed a multiple factor solution including one completely present-oriented factor consisting of all seven present-oriented items, and one or two future-oriented factors consisting of the remaining five future-oriented items. Further analyses indicated that the present-oriented factor and

the 12-item CFC Scale performed similarly in terms of internal consistency and convergent validity. The structure and content of the future-oriented factor(s) remained unclear. This raises questions about the validity of the original 12-item CFC Scale. Recently, more evidence pointed in the direction of a multiple factor solution and, therefore, two new future-oriented items were added to the future-oriented factor. More work is needed to assess the properties of the new 14-item Two Factor CFC Scale and its importance in the context of future health investments.

Subjective longevity expectations are increasingly considered relevant in relation to lifestyle decisions as well. In chapter 7, subjective survival probabilities (SSPs) across Europe were studied, in particular in relation to unhealthy behaviours. Data on European elderly (i.e., 60 years and older) from the second wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) was used for this purpose. The sample average subjective probability of surviving the next 9–15 years was around 57% and varied considerably across country samples and age categories. Smokers reported significantly lower SSPs compared to non-smokers, but less explicit correlations were found between other lifestyle behaviours and SSPs. However, large cross-country differences were found here as well. Chapter 7 concluded that SSPs are informative and relevant in relation to lifestyle decisions, can be validly obtained in elderly people and show interesting cross-country variation.

Different elicitation formats for subjective life expectancy are used across studies. A common approach next to SSPs is the direct elicitation of a subjective point estimate of life expectancy. While providing a point estimate seems cognitively less demanding than providing probabilities and results in a clear-cut number, SSPs allow for expression of uncertainty. The study in chapter 8 is one of the few studies that investigated SSPs in relation to such a subjective point estimate of life expectancy. Data of Dutch people aged 18-65 years was gathered using a web-based survey. The questionnaire contained both elicitation formats. It turned out that, on average, estimates of longevity using SSPs were higher compared to point estimates (83.6 years vs. 80.2 years, respectively). Individual differences between elicitation methods were smaller for younger respondents and for respondents with a higher socioeconomic status. The correlation between the subjective longevity estimations was moderate, but their associations with respondents' characteristics were similar. The main conclusion from chapter 8 was that findings from both elicitation methods may not be directly comparable, especially in certain subgroups of the population. Implications of inconsistent and focal point answers, rounding and anchoring require further attention. More research on the measurement of subjective expectations is therefore still required.

In contrast to the increasing attention for subjective longevity expectations (independent of the elicitation format), subjective expectations regarding quality of life remain understudied. However, such future health expectations arguably are equally important. Chapter 9 investigated individuals' subjective quality adjusted life-year (QALY) expectation from age 65 onwards using the same data as

in chapter 8. The EQ-5D instrument was used to elicit respondents' expected future health states and subjective life expectancy was expressed as a point estimate. Information on subjective expectations regarding length and quality of life were combined into one single measure of subjective expected QALYs from age 65 onwards. The average number of subjective expected QALYs from age 65 onwards was 11 QALYs (range -9 to 40 QALYs). Individuals with an unhealthier lifestyle, a chronic disease or a severe disorder reported lower QALY expectations. The same outcome was found among individuals whose next of kin had a lower average age of death. Indicators were varyingly associated with either subjective life expectancy, expectations regarding quality of life, or both. Extending the concept of subjective life expectancy by correcting for expected quality of life appears to generate important additional information contributing to our understanding of people's perceptions regarding ageing and lifestyle choices.

In conclusion

This thesis focused on (elements of) decisions regarding investments in future health from two perspectives, i.e. a policy perspective and an individual perspective. The general discussion in chapter 10 reflected on the main findings of this thesis. From a policy perspective, the decision-making framework for the allocation of healthcare resources requires further operationalisation of the decision criteria and decision rule. This includes the consideration of all future medical costs in economic evaluations of healthcare interventions, including unrelated medical costs in gained life-years. Although the latter may reveal that some investments in future health will not result in cost savings, such investments may still provide good value for money. From an individual perspective, this thesis aimed to further knowledge on future-focused considerations and subjective expectations. The consideration of future consequences and subjective longevity expectations seem to provide important information on the individual decision-making process in the context of future health investments. However, the operationalisation and measurement of these concepts is still unresolved. This holds even more for subjective expectations regarding quality of life.

Chapter 10 addressed several limitations of the data and methods used in this thesis as well as important healthcare policy implications and directions for future research. Although this thesis contributed to our understanding of the decision-making process at the policy level and the individual level, more work in this research area is warranted. Therefore, investigating the incentives for investing in future health from different perspectives, and *connecting* those perspectives, remains important.

Samenvatting

SAMENVATTING

Een lang leven in goede gezondheid wordt beschouwd als een van de belangrijkste doelen in het leven. Nieuwe gezondheidszorginterventies spelen een belangrijke rol in het bereiken van dit doel. Zulke interventies stellen ons namelijk in staat om ziekten die eerder gepaard gingen met een hoge mate van mortaliteit en morbiditeit te voorkomen of te genezen, hetgeen vervolgens bijdraagt aan de lengte en kwaliteit van ons leven. Desalniettemin dienen nieuwe uitdagingen zich aan, zoals de opkomst van niet-overdraagbare (en vaak meer chronische) ziekten, waaronder leefstijl gerelateerde ziekten. Dit roept belangrijke vraagstukken op omtrent hoe zulke ziekten tegen te gaan en een verdere verbetering van de (toekomstige) gezondheid van populaties te bewerkstelligen. Het uitstellen of voorkomen van ziekten vereist, onder andere, een focus op toekomstige gezondheid. Het voornaamste doel van deze dissertatie is dan ook om meer inzicht te krijgen in de wijze waarop keuzen ten aanzien van toekomstige gezondheid tot stand komen, bezien vanuit twee perspectieven: een beleidsmatig perspectief en een individueel perspectief. Het eerste deel van dit proefschrift bestudeerde keuzen ten aanzien van investeringen in toekomstige gezondheid vanuit een beleidsmatig perspectief (Deel I, hoofdstukken 2-5). Het tweede deel van dit proefschrift onderzocht individuele overwegingen ten aanzien van toekomstige gevolgen van gezondheidsgedrag en individuele verwachtingen ten aanzien van toekomstige gezondheid (Deel II, hoofdstukken 6-9).

Deel I

De trends van vergrijzing en stijgende zorguitgaven kunnen de toekomstige houdbaarheid van gezondheidszorgsystemen ondermijnen. Soms wordt gesteld dat investeringen in toekomstige gezondheid middels preventie en leefstijlinterventies de financiële druk op de zorguitgaven kunnen verlichten. De bereidheid om te investeren in toekomstige gezondheid is echter geen vanzelfsprekendheid vanuit een beleidsmatig perspectief, omdat er een afweging dient te worden gemaakt tussen kosten op korte termijn en baten op lange termijn. En inderdaad, uitgaven aan preventie zijn relatief laag. Om te beoordelen of preventie een voorkeursstrategie zou moeten zijn en om schaarse middelen zo optimaal als mogelijk toe te wijzen, is het belangrijk dat (i) de criteria waarop keuzen worden gebaseerd duidelijk, transparant en gerechtvaardigd zijn en (ii) goede informatie over de kosten en baten van preventie beschikbaar is. In het eerste deel van dit proefschrift is daarom nader ingegaan op het Nederlandse besluitvormingskader en (de operationalisatie van) de bijbehorende criteria bestemd om het basispakket af te bakenen, bezien in relatie tot de kosten en opbrengsten van preventie.

Hoofdstuk 2 onderzocht in hoeverre de operationalisatie van de primaire besliscriteria voor pakketafbakening invloed heeft op de beoordeling van leefstijlinterventies. Drie besliscriteria vormen een centraal element in het afwegingskader: noodzakelijkheid, effectiviteit en kosteneffectiviteit. Noodzakelijkheid wordt geoperationaliseerd door het concept 'proportional shortfall', effectiviteit aan de hand van geschikte studies zoals gerandomiseerde klinische trials (RCTs) en kosteneffectiviteit door

het gebruik van gezondheidseconomische evaluaties, in het bijzonder kostenutiliteitanalyses (KUAs). Hoofdstuk 2 heeft laten zien dat er nog steeds verscheidene, normatieve keuzen dienen te worden gemaakt om te komen tot volledig geoperationaliseerde criteria. Ten eerste vereist de toepassing van proportional shortfall dat de (sub)groep waarbinnen de proportie verloren gezondheid wordt gemeten, evenals het moment waarop de meting van proportional shortfall begint, eenduidig worden vastgesteld. Ten tweede zijn er verschillende redenen aan te wijzen waarom juist het vaststellen van de effectiviteit van leefstijlinterventies middels RCTs lastig is. Ten derde is er nog steeds een hevig debat gaande over normatieve, methodologische kwesties ten aanzien van KUAs, zoals het perspectief van de evaluatie, de kosten en effecten die dienen te worden meegenomen en de disconteervoeten voor kosten en effecten. Deze normatieve keuzen kunnen vergaande implicaties hebben voor de beoordeling van leefstijlinterventies, maar dienen weliswaar expliciet en in alle transparantie te worden gemaakt. Hoofdstuk 2 concludeerde daarom dat investeringen in het afwegingskader nodig zijn om te komen tot zuivere beoordelingen van leefstijlinterventies die gericht zijn op het verbeteren van (toekomstige) gezondheid.

In hoofdstuk 2 van dit proefschrift is reeds benadrukt dat de economische evaluatie van gezondheidszorginterventies een belangrijk onderdeel is van het Nederlandse besluitvormingskader. In hoofdstuk 3 is een controversiële kwestie ten aanzien van de operationalisatie van het kosteneffectiviteitscriterium in meer detail geadresseerd: de inclusie van medische kosten in gewonnen levensjaren die niet gerelateerd zijn aan de behandeling. Deze kostencategorie wordt normaal gesproken, onafhankelijk van het perspectief dat voor de evaluatie wordt ingenomen, genegeerd in gezondheidseconomische evaluaties. Dit uitgangspunt wordt veelal ondersteund door de nationale richtlijnen voor farmaco-economisch onderzoek. Echter, het meenemen van niet-gerelateerde medische kosten in gewonnen levensjaren lijkt op steeds meer steun te kunnen rekenen in de literatuur, vanwege het consistentie argument en optimalisatie argument. Voorbeelden in de hoofstukken 3 en 4 van deze dissertatie hebben de impact van het includeren van deze kosten in KUAs geïllustreerd. Het al dan niet meenemen van niet-gerelateerde toekomstige medische kosten kan belangrijke consequenties hebben voor de verdeling van middelen, vooral voor interventies die het leven aanzienlijk verlengen. Praktische bezwaren tegen de inclusie van niet-gerelateerde medische kosten in gewonnen levensjaren kunnen in toenemende mate worden weggenomen doordat deze kosten steeds nauwkeuriger kunnen worden geschat. Hoofdstuk 3 concludeerde dat de inclusie van alle toekomstige medische kosten de nieuwe norm dient te worden.

Preventie (van ongezond gedrag) wordt soms gepromoot als strategie omdat het tot lagere gezondheidszorgkosten *en* een betere volksgezondheid zou leiden. Dit is echter geen vanzelfsprekendheid, zoals is gebleken uit de voorbeelden in het eerste deel van dit proefschrift en in het bijzonder in hoofdstuk 5. Dit komt onder meer doordat additionele medische kosten in gewonnen levensjaren door de behandeling van niet-gerelateerde ziekten mogelijke besparingen met betrekking

tot gerelateerde ziekten kunnen overtreffen. Het uitsluiten van niet-gerelateerde medische kosten in gewonnen levensjaren kan resulteren in te gunstige schattingen van de kosteneffectiviteit, waardoor het ongerechtvaardigde optimisme onder beleidsmakers over preventie als kostenbesparende strategie wordt gevoed. Maar zelfs wanneer preventie niet leidt tot kostenbesparingen, kan het nog steeds een (zeer) kosteneffectieve manier zijn om de volksgezondheid te verbeteren. Dit dient te worden vastgesteld door alle toekomstige kosten mee te nemen en te worden gebaseerd op de werkelijke 'value for money' die leefstijlinterventies genereren. Dit punt is beargumenteerd in hoofdstuk 4.

In hoofdstuk 5 is nader onderzocht in welke mate preventie zou kunnen leiden tot kostenbesparingen, waarbij preventie van obesitas als voorbeeld is gebruikt. Obesitas draagt in belangrijke mate bij aan de totale ziektelast (evenals aan het verminderen van de levensverwachting) en gaat gepaard met hoge medische kosten door aan obesitas gerelateerde aandoeningen. Het belang om effectieve strategieën die obesitas kunnen terugdringen en voorkomen te ontwikkelen en te implementeren, wordt daarom vanuit het perspectief van de volksgezondheid onderstreept. De gezondheidseconomische gevolgen van dergelijke strategieën zijn echter minder goed gedocumenteerd. Hoofdstuk 5 onderzocht de effecten van obesitaspreventie op jaarlijkse en levenslange gezondheidszorguitgaven voor verschillende segmenten van de gezondheidszorg, te weten ziekenhuiszorg, langdurige zorg, farmaceutische zorg en huisartsenzorg. Hiervoor is gebruikt gemaakt van het Chronisch Ziekten Model van het Rijksinstituut voor Volksgezondheid en Milieu (RIVM) en Nederlandse Kosten van Ziekten data. Levenslange uitgaven aan medicijnen waren hoger voor obese mensen dan voor mensen met een normaal gewicht, ondanks de kortere levensverwachting voor de eerste groep. Preventie van obesitas resulteerde in besparingen op medicijnen voor aan obesitas gerelateerde ziekten tot de leeftijd van 74 jaar. Deze besparingen waren hoger dan de additionele medicijnkosten in gewonnen levensjaren voor ziekten die niet gerelateerd waren aan obesitas. Daarnaast stegen de uitgaven aan langdurige zorg aanzienlijk als gevolg van obesitaspreventie terwijl de besparingen in de andere segmenten hooguit klein waren. Preventie van obesitas zal dus enerzijds leiden tot besparingen in het farmaceutische segment, maar anderzijds leiden tot substantieel hogere uitgaven in de langdurige zorg. In hoofdstuk 5 werd daarom geconcludeerd dat de vraag of obesitaspreventie een kosteneffectieve strategie is in belangrijke mate zal afhangen van de hoeveelheid gezondheidswinst die wordt behaald. Bovendien is het nodig om realistisch geschatte kosten en effecten voor alle soorten gezondheidszorg tegen elkaar af te wegen om te komen tot een zo optimaal mogelijke verdeling van gezondheidszorgmiddelen.

Deel II

De meeste individuen zullen bepaalde ideeën of verwachtingen hebben over hoe oud zij zullen worden en hoe zij die leeftijd zullen bereiken. Dergelijke voorstellingen van toekomstige gezondheid zullen waarschijnlijk variëren tussen personen. Daarnaast zal de mate waarin het gedrag van individuen wordt beïnvloed door deze toekomstgedachten ook niet voor iedereen gelijk zijn. Deze noties kunnen

gezien worden als onderdeel van een breder construct dat vaak wordt aangeduid als 'Future Time Perspective' (FTP). De relevantie van FTP in de context van gezondheidsgedrag wordt in toenemende mate onderschreven. Echter, de operationalisatie en meting van toekomstgerichte gedachten en afwegingen hebben tot verscheidene discussies geleid en meer werk op dit vlak is bepleit. Het tweede deel van dit proefschrift richtte zich derhalve op twee belangrijke conceptualiseringen van FTP en de metingen daarvan in het kader van gezondheidsgedrag: (i) de mate waarin individuen de toekomstige gevolgen van hun beslissingen afwegen tegen de directe gevolgen en (ii) individuele verwachtingen ten aanzien van de resterende levensduur en gezondheid in latere levensstadia.

De Consideration of Future Consequences (CFC) Scale is een maatstaf voor de mate waarin individuen rekening houden met en beïnvloed worden door de gevolgen van huidig gedrag op lange termijn. Het belang van dit concept in de context van gezondheidsgedragingen wordt mede ingegeven doordat dergelijke gedragingen vaak tot stand komen na een afweging tussen directe opbrengsten in termen van bevrediging en verminderde stress en lange termijn kosten in termen van chronische ziekte en vroegtijdige sterfte. Er bestond echter weinig empirisch bewijs over de precieze eigenschappen van de CFC Scale in termen van factor structuur, betrouwbaarheid en validiteit. Hoofdstuk 6 onderzocht deze aspecten van de 12-item CFC Scale door gebruik te maken van secundaire data van Nederlandse jonge adolescenten. Uit de factor analyse kwam een meervoudige factoroplossing naar voren, waaronder een volledig op het heden gerichte factor bestaande uit alle zeven op het heden gerichte items en één of twee op de toekomst gerichte factoren bestaande uit de resterende vijf toekomstgerichte items. Verdere analyses lieten zien dat de op het heden gerichte factor en de 12-item CFC Scale vergelijkbaar presteerden in termen van interne consistentie en convergente validiteit. De structuur en de inhoud van de toekomstgerichte factor(en) bleef onduidelijk. Dit resultaat roept vragen op over de validiteit van de originele 12-item CFC Scale. Onlangs wees meer onderzoek in de richting van een meervoudige factoroplossing, waarna twee nieuwe, toekomstgerichte items aan de toekomstgerichte factor zijn toegevoegd. Meer onderzoek is nodig om de eigenschappen van de nieuwe 14-item Two Factor CFC Scale vast te stellen en het belang ervan in het kader van toekomstige gezondheidsinvesteringen te beoordelen.

Subjectieve verwachtingen ten aanzien van levensduur worden ook steeds belangrijker geacht in relatie tot leefstijlkeuzen. In hoofdstuk 7 werden subjectieve overlevingskansen (SSPs) uit heel Europa bestudeerd, in het bijzonder in relatie tot ongezond gedrag. Hiervoor werden gegevens gebruikt over Europese ouderen (d.w.z. 60 jaar en ouder), verzameld gedurende het tweede meetmoment van de Survey of Health, Ageing and Retirement in Europe (SHARE). De gemiddelde, subjectieve kans in de totale steekproef om de komende 9 tot 15 jaar te overleven was afgerond 57%, en varieerde aanzienlijk tussen steekproeven uit verschillende landen en tussen leeftijdscategorieën. Rokers rapporteerden significant lagere SSPs vergeleken met niet-rokers, terwijl de correlaties tussen andere leefstijlgedragingen en SSPs minder eenduidig waren. Er werden echter ook hier grote verschillen

gevonden tussen landen. Hoofdstuk 7 concludeerde derhalve dat SSPs informatief en relevant zijn in relatie tot leefstijlkeuzen, dat dergelijke informatie goed kan worden verzameld onder ouderen, en dat interessante verschillen zijn te zien tussen landen.

Er worden verschillende technieken toegepast om de subjectieve levensverwachting van individuen uit te vragen. Een veelgebruikte aanpak naast die van SSPs is de elicitatietechniek waarbij een puntschatting van de subjectieve levensverwachting wordt verkregen. Het geven van een puntschatting lijkt voor respondenten cognitief minder veeleisend en levert een eenduidig getal op, maar SSPs geven meer inzicht in de onzekerheid van de verwachting. De studie in hoofdstuk 8 is één van de weinige studies die heeft gekeken naar SSPs in relatie tot een puntschatting van de levensverwachting. Middels een online vragenlijst zijn gegevens verzameld van Nederlanders in de leeftijd van 18 tot 65 jaar. De vragenlijst bevatte beide elicitatietechnieken. De resultaten lieten zien dat schattingen verkregen via SSPs gemiddeld genomen hoger lagen dan de puntschattingen (respectievelijk 83.6 jaar versus 80.2 jaar). Individuele verschillen tussen de resultaten van de twee elicitatietechnieken waren kleiner voor jongere respondenten en respondenten met een hogere sociaaleconomische status. De correlatie tussen beide schattingen van subjectieve levensverwachting was middelmatig, maar hun associaties met kenmerken van respondenten waren vergelijkbaar. De belangrijkste conclusie uit hoofdstuk 8 was dat resultaten verkregen via de verschillende elicitatietechnieken mogelijk niet direct vergelijkbaar zijn, hetgeen met name geldt voor bepaalde subgroepen van de populatie. Implicaties van inconsistente en zogenaamde 'focal point' antwoorden, afronding en verankering zijn zaken die verdere aandacht behoeven. Verder onderzoek naar het meten van subjectieve verwachtingen is dan ook nog steeds nodig.

In tegenstelling tot de toenemende aandacht voor subjectieve verwachtingen ten aanzien van levensduur (los van de gebruikte elicitatietechniek), zijn subjectieve verwachtingen ten aanzien van kwaliteit van leven nog maar weinig bestudeerd. Zulke toekomstige gezondheidsverwachtingen zijn echter misschien wel net zo van belang. Hoofdstuk 9 onderzocht de individuele subjectieve quality adjusted life-year (QALY) verwachting vanaf de leeftijd van 65 jaar, gebruikmakend van dezelfde data als in hoofdstuk 8. Het EQ-5D instrument werd gebruikt om de verwachte toekomstige gezondheidstoestanden te verkrijgen en subjectieve levensverwachting werd uitgedrukt middels een puntschatting. Informatie over subjectieve verwachtingen ten aanzien van lengte en kwaliteit van leven werden gecombineerd om te komen tot één maatstaf van het te verwachte aantal subjectieve QALYs vanaf de leeftijd van 65 jaar. De gemiddelde QALY verwachting vanaf 65 jaar was 11 QALYs (range tussen -9 en 40 QALYs). Personen met een ongezondere leefstijl, een chronische ziekte of een ernstige aandoening rapporteerden lagere QALY verwachtingen. Ditzelfde gold voor personen waarvan de naaste familie gemiddeld genomen op jongere leeftijd was komen te overlijden. Indicatoren toonden in verschillende mate associaties met subjectieve levensverwachting, verwachtingen ten aanzien van aan toekomstige gezondheid gerelateerde kwaliteit van leven, of beide. Het uitbreiden van het

concept van subjectieve levensverwachting door te corrigeren voor verwachte kwaliteit van leven lijkt belangrijke, aanvullende informatie te genereren hetgeen meer inzicht oplevert in hoe mensen aankijken tegen het ouder worden en leefstijlkeuzen maken.

Afsluitend

Deze dissertatie richtte zich op (elementen van) keuzen ten aanzien van investeringen in toekomstige gezondheid vanuit twee perspectieven, namelijk het beleidsmatige perspectief en het individuele perspectief. De algemene discussie in hoofdstuk 10 reflecteerde op de belangrijkste bevindingen van dit proefschrift. Vanuit een beleidsmatig perspectief behoeft het besluitvormingskader voor het toewijzen van middelen in de gezondheidszorg verdere operationalisering van de besliscriteria en de beslisregel. Dit omvat de inclusie van alle toekomstige medische kosten in de economische evaluatie van gezondheidszorginterventies, waaronder de niet-gerelateerde medische kosten in gewonnen levensjaren. Alhoewel dit tot gevolg kan hebben dat bepaalde investeringen in toekomstige gezondheid niet tot kostenbesparingen zullen leiden, kunnen dergelijke investeringen nog steeds waar voor ons geld opleveren. Vanuit een individueel perspectief heeft dit proefschrift getracht meer inzicht te genereren in toekomstgerichte overwegingen en subjectieve verwachtingen. Het overwegen van toekomstige gevolgen en subjectieve levensverwachtingen lijken relevante informatie op te leveren over het individuele besluitvormingsproces in het kader van toekomstige gezondheidsinvesteringen. De operationalisering en het meten van deze concepten is echter nog niet uitgekristalliseerd. Dit geldt zelfs nog meer voor subjectieve verwachtingen ten aanzien van kwaliteit van leven. Hoofdstuk 10 is nader ingegaan op een aantal beperkingen ten aanzien van de data en methoden die in dit proefschrift zijn gebruikt alsmede op belangrijke beleidsimplicaties en richtingen voor vervolgonderzoek. Hoewel dit proefschrift heeft getracht meer inzicht te geven in het besluitvormingsproces op beleidsniveau en individueel niveau, is meer werk op dit onderzoeksgebied aangewezen. Het onderzoeken van de prikkels om te investeren in toekomstige gezondheid vanuit verschillende perspectieven, en het verbinden van deze inzichten, blijft daarom van groot belang.

Dankwoord

DANKWOORD

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About the Author

ABOUT THE AUTHOR

David Rappange was born in Velletri (Italy) on August 9, 1980. After completing secondary school in Haarlem in 2001, he studied at the Erasmus University Rotterdam where he obtained a Bachelor's degree in Health Sciences, Health Policy and Management in 2005 and a Master's degree in Health Economics, Policy and Law in 2007.

After his Master's graduation, he worked as a PhD candidate from 2007 until 2011 at the Institute of Health Policy and Management (iBMG) of the Erasmus University Rotterdam. His research project *Incentives for investing in a long and healthy life* was part of the research theme *Living longer in good health: Prospects, strategies and consequences,* which was supported by the Network for Studies on Pensions, Aging and Retirement (Netspar). During this PhD period, he was involved in teaching activities including the (co-)supervision of Bachelor and Master Theses.

After his period at the Erasmus University Rotterdam, he worked for over three years as a policy advisor at the Dutch Healthcare Authority (NZa) where his main focus was on the long-term care market. Currently, he works as a senior policy advisor at the Unit for Financial Arrangements for Pharmaceuticals at the Ministry of Health, Welfare and Sport (VWS). In these recent years, he continued working on his PhD thesis. His work has been published in a wide range of international, peer-reviewed journals, such as PharmacoEconomics, Journal of Public Health, The European Journal of Health Economics and Health Expectations.

PhD Portfolio

PHD PORTFOLIO

PhD Student: David Rappange
Department: Institute of Health Policy and Management
PhD period: 2007-2016
Promotor: prof.dr. Werner Brouwer
Copromotor: dr. Job van Exel

Training	**Year**
Game Theory and its Applications (MSc course Erasmus University Rotterdam)	2007-2008
Discrete Choice Experiments (by prof.dr. John Rose)	2008
Basic course didactic skills	2009
Academic writing in English	2010
Regression Analysis – Erasmus Summer Program (by prof.dr. Stanley Lemeshow)	2010
Primary and Secondary Prevention Research – Erasmus Summer Program (by prof.dr. Harry de Koning)	2010
Market forces and regulation in healthcare (by dr. Misja Mikkers and dr. Rein Halbersma of the Dutch Healthcare Authority)	2012
Introduction in R (programming language)	2012
Healthcare Law (in-house course Dutch Healthcare Authority)	2013
SIR Institute for Pharmacy Practice and Policy Pharma Course	2016

Presentations	**Year**
Netspar theme Kick-off meeting, Rotterdam (the Netherlands)	2007
7th European Conference on Health Economics (ECHE), Rome (Italy)	2008
8th European Conference on Health Economics (ECHE), Helsinki (Finland)	2010

Teaching	**Year**
Bachelor in Health Sciences, Health Policy and Management: *Methods and Techniques of Scientific Quantitative Research*	2009-2011

Thesis supervision and co-supervision	**Year**
Supervision and co-supervision of several theses in the Bachelor program Health Sciences, Health Policy and Management and Master program Health Economics, Policy and Law	2008-2011

Conferences and symposia (selection)	**Year**
Netspar theme conference *Subjective Expectations of Health*, Rotterdam (the Netherlands)	2008
1st Lowlands Health Economics Study Group (LoLa HESG), Maastricht (the Netherlands)	2009
Netspar theme conference *Longevity Risk*, Tilburg (the Netherlands)	2009
VGE-NVTAG Congress *Health Economics of Prevention*, Antwerp (Belgium)	2010
The National Healthcare Institute Symposium *Fair Decision-Making in Healthcare*, Hilversum (the Netherlands)	2013
3rd International PPRI Conference *Pharmaceutical Pricing and Reimbursement Policies: Challenges Beyond the Financial Crisis*, Vienna (Austria)	2015

Publications not included in thesis

Rappange DR, van Baal PHM, van Exel NJA, Feenstra TL, Rutten FFH, Brouwer WBF. I costi sanitari indiretti (non correlati) durante gli anni di vita guadagnati: Devono essere inclusi nelle valutazioni economiche degli interventi sanitari? PharmacoEconomics Italian Research Articles. 2009; 11: 55-70

Al-Janabi H, Frew EJ, Brouwer WBF, Rappange DR, van Exel NJA. The inclusion of positive aspects of caring in the Caregiver Strain Index: Tests of feasibility and validity. Int J Nurs Stud. 2010; 47: 984-93