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# ECONOMIC EVALUATION OF PUBLIC HEALTH PROGRAMMES – CONSTRAINTS AND OPPORTUNITIES

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## Abstract

The decision-making basis in health and medicine needs to be expanded by economic evaluations on public health programmes, to avoid that these are rejected without grounds when priorities are established. The first aim of this thesis is thus to assess the cost-effectiveness of three public health programmes, which were implemented in the Metropolitan area of Stockholm, Sweden during the period 1995-2004. The programmes evaluated represent different stages in the historical development of public health programmes, where the focus has shifted from healthcare sector-based to community-based that seek to create supportive environments for health.

The smoking cessation program (Quit smoking, Gals; study I) was estimated to lead to societal cost-savings four times the programme costs and to health gains measured in QALYs (quality-adjusted life-years). The elderly safety promotion programme (Safe Seniors in Sundbyberg; study II) was estimated to impose zero societal costs and QALY gains. The diabetes prevention programme (SDPP; study III) might have been cost-effective in one programme area, cost-saving but without health gains in another area, and not cost-effective in the third programme area. The analyses were performed with the methodology recommended for economic evaluations of pharmaceuticals in Sweden to enable comparisons with other medical technologies. The thesis has shown that different types of public health programme can be cost-effective and that similar programmes potentially constitute a good way to use societal resources.

Cost-effectiveness, however, is not a necessary condition for implementation of public health programmes, but financing is. The financing of community-based programmes was explored from two angles: the economic on incentives and resource allocation and the public health on whether local community participation had been achieved. Programme costs might be used as an indicator of local community participation, whereas a subsector financial analysis showed that the key local collaborator in Sweden, the municipalities, have clear financial incentives to collaborate in community-based elderly safety promotion programmes (study IV).

The second aim of the thesis is to explore the appropriateness of the cost-effectiveness methodology for public health programmes, and both constraints and opportunities with the methodology were revealed. The monetary consequences of the programmes revealed opportunities to discuss the financing of community-based programmes. The constraints were found in the programme effects included in the cost-effectiveness analyses. Several valued outcomes from public health programmes that affect societal welfare and individual wellbeing are not reflected adequately, which lead to underestimates of the societal value of successful public health programmes.

There are alternative methods for economic evaluations which might better reflect the societal value of public health programmes, currently discussed internationally and in Sweden. It remains an important task for future research to investigate whether, and which, alternative methods are more appropriate for public health programmes.



*Keywords*: public health, health promotion, prevention, community-based, smoking cessation, elderly injuries, type 2 diabetes, cost-effectiveness analysis, economic evaluation, incentives, participation

# Sammanfattning

Beslutsunderlag inom hälsosektorn bör inkludera ekonomiska utvärderingar av folkhälsoprogram, så att dessa inte nedprioriteras utan goda skäl. Det första syftet med denna avhandling är därför att undersöka kostnadseffektiveten i tre folkhälsoprogram som genomfördes i Stockholms län under åren 1995-2004. Programmen representerar olika epoker i folkhälsoarbetets utveckling, där tyngdpunkten har förskjutits från individ-inriktade insatser inom hälso- och sjukvården till lokalområdesbaserat folkhälsoarbete som söker skapa hälsofrämjande miljöer.

Rökslutsprogrammet (Fimpa tjejer!; studie I) beräknades leda till besparade samhällskostnader som var fyra gånger större än kostnaderna för att genomföra programmet samt till hälsovinster mätta i QALYs (livskvalitets-justerade levnadsår). Det äldreskadeförebyggande programmet (Säkra Seniorer i Sundbyberg; studie II) skattades medföra noll samhällskostnader och QALY-vinster. Det diabetesförebyggande programmet (SDPP; studie III) kan ha varit kostnadseffektivt i en programkommun, kostnadsbesparande men med hälsoförluster i en annan, och inte kostnadseffektivt i den tredje kommunen. Analyserna genomfördes med den rekommenderade metodiken för ekonomiska utvärderingar av läkemedel, för att underlätta jämförelser med andra medicinska teknologier. Avhandlingen har visat att olika typer av folkhälsoprogram kan vara kostnadseffektiva och att liknande program kan vara ett bra sätt att använda samhällets resurser.

Kostnadseffektivitet är dock inte en nödvändig förutsättning för att genomföra folkhälsoprogram, men finansiering är det. Finansiering av lokalområdesbaserat folkhälsoarbete studerades från två utgångspunkter: den ekonomiska över incitament och resursallokering och den folkhälsovetenskapliga på huruvida lokalt deltagande hade uppnåtts. Programkostnaderna kan användas som en indikator på lokalt deltagande, medan en finansiell sektorsanalys visade att den viktigaste lokala aktören, kommunerna, har klara finansiella incitament att samverka inom lokalområdesbaserade äldreskadeförebyggande program (studie IV).

Det andra syftet med avhandlingen är att studera om kostnadseffektivitets-analyser är lämpliga för folkhälsoprogram, och både problem och möjligheter med metodiken uppenbarades. De monetära konsekvenserna av programmen gav möjligheter att diskutera finansiering av folkhälsoprogram. Problemen uppstod med de effekter av program som kan inkluderas i kostnadseffektivitets-analyser. Flera högt värderade effekter av folkhälsoarbete kunde inte avspeglas i tillräcklig grad, vilket leder till en underskattning av det samhälleliga värdet i framgångsrika folkhälsoprogram.

Det finns alternativa metoder för ekonomiska utvärderingar som bättre skulle kunna avspegla det samhälleliga värdet av folkhälsoprogram, och som diskuteras i Sverige och internationellt. En återstående viktig uppgift för framtida forskning är att undersöka om, och isåfall vilka, alternativa metoder som skulle passa bättre för folkhälsoarbete.

## List of publications

The thesis is based on the following four articles, which are referred to by their Roman numerals:

I. Johansson PM, Tillgren PE, Guldbrandsson KA, Lindholm LA. A model for cost-effectiveness analyses of smoking cessation interventions applied to a Quit-and-Win contest for mothers of small children. Scand J Public Health 2005;33:343-352.

II. Johansson P, Sadigh S, Tillgren P, Rehnberg C. Non-pharmaceutical prevention of hip fractures – a cost-effectiveness analysis of a community-based elderly safety promotion program in Sweden. CERA (Cost Eff Resourc Alloc) 2008, 6:11.

III. Johansson P, Östenson C-G, Hilding A, Andersson C, Rehnberg C, Tillgren P. A cost-effectiveness analysis of a community-based diabetes prevention program in Sweden. *Submitted.*

IV. Johansson P, Eriksson L, Sadigh S, Rehnberg C, Tillgren P. Participation, resource mobilisation and financial incentives in community-based health promotion - An economic evaluation perspective from Sweden. Health Promot Int, *in press*.

## Abbreviations

| | |
|---|---|
| BMI | body mass index |
| CBA | cost-benefit analysis |
| CEA | cost-effectiveness analysis |
| CHD | coronary heart disease |
| COPD | chronic obstructive pulmonary disease |
| CVD | cardiovascular disease |
| DRG | diagnosis-related groups |
| FPG | fasting plasma glucose |
| ICER | incremental cost-effectiveness ratio |
| LFN | Swedish Pharmaceutical Benefits Board (Läkemedelsförmånsnämnden) |
| NICE | UK National Institute for Health and Clinical Excellence |
| NGOs | non-governmental organisations |
| QALYs | quality-adjusted life-years |
| YLS | life-years saved |
| SEK | Swedish Krona |
| TTO | time trade-off |
| UK | United Kingdom |
| US | United States |
| WHO | World Health Organization |
| WTP | willingness-to-pay |

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# 1. Introduction

Economic evaluations have become an increasingly popular vehicle internationally and in Sweden for decision making within health and medicine. This trend reflects the need for decision-making bases that recognise that resources are scarce and explicit choices among alternative uses of resources thus have to made, even within the health sector.

Since the first economic evaluations within medicine were performed in the 1970s, pharmaceuticals have been the most frequent subject for economic evaluations (Neumann et al, 2005a; Carlsson et al, 2006). This circumstance is partly due to requirements in several jurisdictions, including Sweden, for economic evaluations before the introduction of new pharmaceuticals into benefits schemes. There are, however, other medical technologies, e.g. medical devices and preventive measures, that are supplements and/or complements to pharmaceuticals to achieve the objective of health care, namely a good population health. To avoid that these measures are rejected without grounds when priorities are established the decision-making basis in health and medicine needs to be expanded by economic evaluations on other types of health-affecting measure (Rosén, 2003; Drummond et al, 2008).

Economic evaluations are performed in several sectors of the economy, not only in the health sector. Whenever there is a situation of administrative decision making, i.e. when resource allocation is not determined by market forces, explicit decision-making bases with specific decision-making criteria are needed. The decision-making basis in the health sector, however, differs from that found in other sectors of the economy. In the health sector the most frequent, and also recommended (Gold et al, 1996; LFN, 2003), methodology is the cost-effectiveness analysis.

Several authors have previously claimed that cost-effectiveness analyses of public health programmes might be complicated (Cribb & Haycox, 1989; Rosén & Lindholm, 1992; Drummond & Stoddart, 1995; Burrows et al, 1995; Craig & Walker, 1996; Shiell & Hawe, 1996; Borghi & Jan, 2008; Drummond et al, 2008). In this thesis constraints but also opportunities encountered with cost-effectiveness analyses of public health programmes are presented, based on three cases of performed analyses of implemented programmes. Another aspect of decision making on public health programmes is the financing of community-based programmes, which is discussed in a fourth study.

# 2. Theoretical background

## *2.1 Decisions on resource allocation*

The aim of economic evaluations is to provide a basis for administrative decisions on how to use resources, the resource allocation. Administrative decisions on resource use are needed when, for a number of reasons, the more common market-based allocation is not feasible.

In most parts of the economy resource allocation is determined by consumer choices in a market situation. The situation is characterised by sellers that offer a good at a price and consumers that accept that price by buying the good, if they think that the price is below or at their valuation of the good, which depend on the utility[1] they derive from it. Resource allocation under market conditions is thus determined by the interaction of consumer purchases and producer offers. If there is a perfect market, i.e. one that fulfils a number of prerequisites according to economic theory, the resources then become used in the most efficient way, also called a Pareto efficient resource allocation (Varian, 1992; Barr, 1998).

Decisions on resource allocation are taken by all producers at all times; in daily life situations (Becker, 1981) such as which family member is responsible for the dish-washing after dinner, to whether a multinational commercial company should initiate production in a new country. The commercial company decision is probably taken after a formal decision-making process, including a calculation of possible changes in revenues that is due to the decision. As the overall objective for the market-based commercial sector is to maximise profits, given a number of restrictions such as consumer choices, the decision criterion in the sector is whether (expected) monetary profits increase or not, i.e. if revenues are estimated to increase more than costs.

However, production decisions outside the market-based sector cannot rely on the monetary profit criterion. In other sectors of the economy, including the family and the public sector, the overall objective is not to maximise monetary profits. Instead, according to welfare economics, the objective is to maximise the wellbeing of the individuals affected by the decision. Within welfare economics it is assumed that welfare, at the aggregate level, is derived in the same manner as individual wellbeing (Mueller, 1979, p. 184). This implies that the social welfare function contains the sum of the individuals´ wellbeing, maybe complemented with some societal value judgement (Mueller, 1979). This value judgement is often called justice (Barr, 1998, p. 69) or, within public health, equity. In non-commercial sectors the objective is to maximise this societal welfare, which thus contains the wellbeing of the individuals affected. The decision-making criterion thus becomes whether (expected) welfare increases or not, i.e. if the societal valuation of the decision consequences is higher than the costs.

[1] Utility is the correct term within economics, but it tends to be misunderstood by non-economists. I prefer, and will use in this thesis, the words wellbeing for utility at the individual level, and welfare for utility at an aggregated level, such as society.

### 2.1.1 Public sector decision making

In most parts of the public sector economic evaluations seek to investigate the social desirability of decisions by a similar mechanism to that used in the commercial sector decision making, i.e. whether the monetary valuation of the decision consequence is higher than the costs of the decision. The aim of the analysis is to achieve economic efficiency also in the allocation of scarce resources to public projects (Johannesson, 1996). The analysis is commonly known as cost-benefit analysis (CBA) and is distinguished by its use of a monetary valuation of the outcome, called willingness-to-pay (WTP) (Drummond et al, 2005).

The cost-benefit analysis is firmly rooted in the theory of welfare economics. Within welfare economics, the Pareto efficiency, i.e. the situation when no person might become better off without another person becoming worse off, is often complemented with the potential Pareto criterion (or Hicks-Kaldor criterion). This criterion, also called the compensation principle (Johannesson, 1996), posits that if the person who becomes better off can compensate the person that becomes worse off and still be better off than before, then societal welfare has increased. Because the compensation does not need to be paid, the principle is the basis for the willingness-to-pay estimate of societal benefits: the sum the winners is prepared to pay for the change and still be better off (Johannesson, 1996). As long as the societal benefits exceed the costs, the proposed change increases societal welfare. Note that the distribution of benefits between individuals is not an issue, i.e. the criterion does not consider any equity aspects but only efficiency.

The cost-benefit analysis is widely used in particularly two areas of the public sector, namely the transport sector and the environmental sector (Johannesson, 1996; Drummond et al, 2005). In Sweden, cost-benefit analyses have been used since the 1960s for decisions regarding road and traffic investments, where factors such as savings in transportation time and increased traffic safety are valued in monetary terms. For example, in 2005 transportation time for private individuals was valued at SEK 44 an hour (for shorter journeys) and a traffic casualty at SEK 18.4 million, of which SEK 17.1 million was the value of a (statistical) life (Swedish Road Administration, 2006). In the environmental sector most advances during recent decades regarding methods on how to value outcomes in monetary terms have taken place (Carson & Hanemann, 2005; Bockstael & Freeman, 2005). In Sweden, the approach is considered for analyses of the national environmental objectives (Forslund et al, 2007; Sjöström, 2007).

Within health economics, the number of cost-benefit analyses has increased during recent years, in particular contingent valuation studies, even though the majority is pilot studies that merely investigate the feasibility of the method and not analyses aimed to inform decision making (Drummond et al, 2005, p. 221). There are however several early Swedish studies, performed by Swedish authors, that investigate different aspects of health and the healthcare system with the willingness-to-pay approach (Johannesson et al, 1991a; Johannesson & Jönsson, 1991; Eckerlund et al, 1995; Johannesson & Johansson, 1997; Blumenschein & Johannesson, 1999; Zillich et al, 2002).

### 2.1.2 Health sector decision making

In the health sector the predominant form of economic evaluation is the cost-effectiveness analysis (CEA), in which some decision consequences are valued with a health-related, non-monetary, measure. The reason for the substitution of cost-benefit analyses in the health sector was heavy criticism on the methodology employed in the analyses, both from a theoretical perspective and from decision makers (Johannesson, 1996; Drummond et al, 2005, p. 217).

The cost-effectiveness analysis contains two measures: monetary for the costs and non-monetary for the health outcomes. The measures are compared in a ratio, called the cost-effectiveness ratio, which consists of three parts. The first is the costs of implementing the programme, called programme costs. The remaining two parts measure the consequences of the programme: if ill-health is avoided there are changes in resource consumption, called costs avoided, and changes in health. The costs avoided are expressed in monetary terms, whereas the changes in health are expressed in some health outcome. The result of the cost-effectiveness ratio is costs per health outcome.

The use of a ratio leads to another difference to the cost-benefit analysis: the result can only be assessed in comparison with the cost per health of alternative interventions. In the absence of an accepted cost per health (see, however, below on thresholds) the result of the analysis is a relative measure, i.e. an intervention is only cost-effective in comparison with some other intervention. Consequently, the decision criterion for cost-effectiveness analyses is a lower cost per health than alternatives, which supposedly leads to a maximisation of health given the budget. The cost-effectiveness analysis thus seeks to achieve production efficiency, i.e. how to reach a given objective as efficiently as possible (Drummond et al, 2005, p. 214).

## *2.2 Methodology recommendations for cost-effectiveness analyses*

The need for comparisons to establish cost-effectiveness soon led to calls for transparency in employed methods as well as to methodology recommendations for cost-effectiveness analyses. Well-known examples include the British Medical Journal requirements for publication of analyses (BMJ Economic Evaluation Working Party, 1996), the 10-point checklist by Drummond & co-authors (Drummond et al, 1987) and the "reference case" proposed by the US Panel (Gold et al, 1996). The methodology recommendations, as well as the requirements introduced by different jurisdictions, are to a large extent identical (Hjelmgren et al, 2001). Over time, since the first analyses in the 1970s, a fairly coherent standard methodology for cost-effectiveness analyses within health and medicine has thus evolved.

In Sweden, the Pharmaceutical Benefits Board (LFN)[2] has issued recommendations for the economic evaluations it requires for decisions on whether to include pharmaceuticals into the Benefits Scheme. The recommendations are only applicable to the

[2] The LFN changed its name to TLV (Tandvårds- och läkemedelsförmånsverket; in English Dental and Pharmaceutical Benefits Agency ) in September 2008, when its responsibilities were extended to dental care.

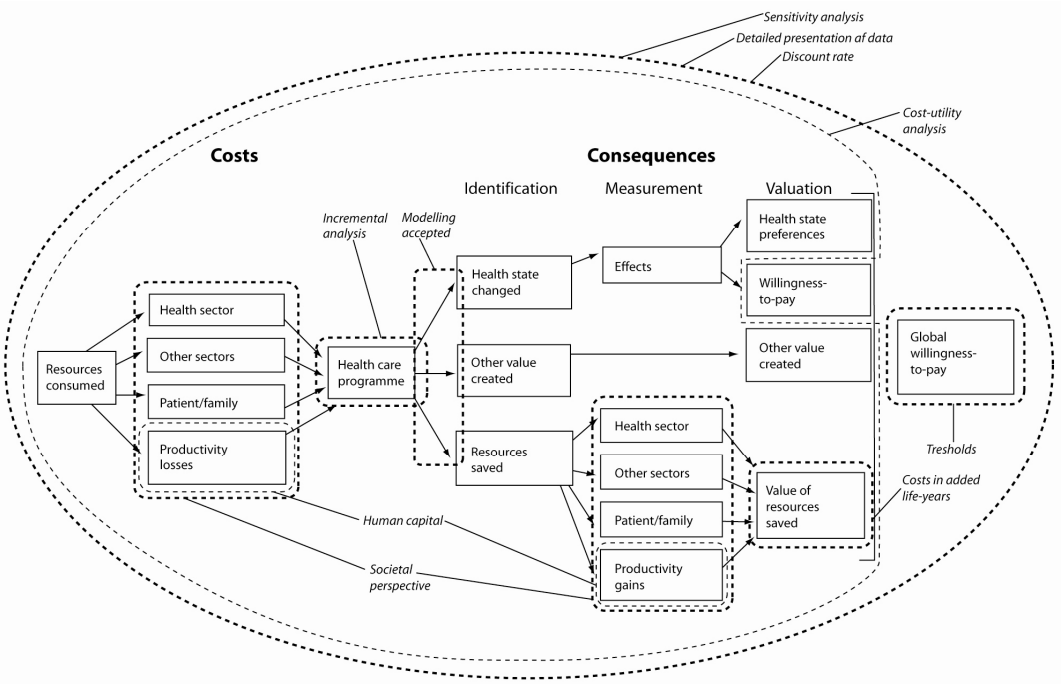


*Figure 1. The LFN methodology recommendations applied to the Drummond & co-authors (2005, p. 32) Components of economic evaluations in health care.*

Board's decisions, but, to my knowledge, there are no other Swedish recommendations and they are very similar to international methodology recommendations. The LFN recommendations for economic evaluations (LFN, 2003) can be divided into 10 sub-headings. In figure 1, these have been imposed upon the wellknown figure from Drummond & co-authors (2005) on the components of economic evaluations in health care. The recommendations apply to different levels of the components, from specifying e.g. that the Human capital method should be used to value productivity costs to overall methodology aspects such as Detailed presentation of data.

*Societal perspective*

LFN requires that the analysis should be performed with a societal perspective, which includes all relevant costs and effects regardless of payer or beneficiary. This means that also costs and revenues for other sectors than the health caresector, such as local authorities, participants in programmes, and family of patients should be included in the analysis. The societal perspective is often recommended (Drummond et al, 2005, p. 87; Gold et al, 1996) because it gives a broad description of the consequences of choices and recognises that budgets are arbitrary divisions of resources (Brouwer et al, 2001). Thus, the societal perspective discourages cost-shifting between sectors.

The LFN, however, is the only reimbursement agency that demands the societal perspective, according to the agency itself. The recommended perspective in the UK is the health sector for clinical interventions (NICE, 2008a) and the public sector for public health programmes (NICE, 2008b), whereas the most frequently used is the healthcare sector perspective, at least in Australia (Dalziel et al, 2008). One issue with the societal

perspective is the difficulty to value non-marketed resources in monetary terms, notably time for participants, patients and relatives. There are several options for valuing time used for informal unpaid care (van den Berg et al, 2004) but in Sweden a valuation of leisure time of 35% of average wages has become customary (Claesson et al, 2000).

*Cost-utility analysis*
As most international recommendations (Hjelmgren et al, 2001), LFN recommends cost-effectiveness analyses using the health measure quality-adjusted life-years (QALYs), i.e. cost-utility analysis (Drummond et al, 2005). Drafted UK NICE recommendations for economic evaluations of public health interventions (NICE, 2008b), however, state that if there are not enough data to estimate QALYs, or if there are important non-health benefits from the interventions, alternative or complementary measures could be used.

The QALY is a health measure that takes into account both life-years (mortality) and health-related quality-of-life (morbidity). A year lived in full health is valued at 1 QALY, while death is 0. Intermediate health states are valued, with quality-of-life weights, according to their relative desirability between 0 and 1. There are a number of ways to obtain the weights, i.e. whether based on choices or scaling and whether uncertainty is incorporated or not (Drummond et al, 2005, p. 143), but the weights should be preference-based to accord with economic theory. LFN recommends that weights are obtained via the standard gamble or time trade-off (TTO) methods, and prefers weights obtained from patients with first-hand experience of the condition. However, others recommend the use of community weights, i.e. weights obtained from the general population (Gold et al, 1996; NICE 2008a). To obtain weights from the general population, which has no experience of the health condition, health measure instruments such as the EQ-5D (EuroQol Group, 1990), HUI (Horsman et al, 2003) and SF-6D (based on SF-36; Brazier et al, 2002) are used to describe the health conditions. Connected to these instruments are scoring formulas used to translate the health conditions into quality-of-life weights. In Sweden, a frequently used instrument is the EQ-5D valued with the UK social tariff (Dolan, 1997), which is based on community preferences and thus contrary to the LFN recommendations. The choice of instrument, population group and eliciting method might considerably affect the health-related quality-of-life weight obtained.

LFN also states that if the treatment mainly affects survival, gained life-years (YLS) should also be reported, leading to a cost-effectiveness analysis (Drummond et al, 2005). Moreover, if there is evidence that the health effects are identical to those from an alternative treatment, a cost comparison may suffice, i.e. a cost-minimisation analysis. If it is difficult to use QALYs as health measure, a cost-benefit analysis may be used. Another method, not mentioned by the LFN, is the cost-consequences analysis (Drummond et al, 2005, p. 3) that presents a range of different outcome measures, so decision makers can choose which they consider relevant.

*Incremental analysis (ICER)*
After the publication of the analysis on the sixth stool test to detect colon cancer (Neuhauser & Lweicki, 1975), all recommendations demand that cost-effectiveness ratios should be calculated as differences in costs and in health effects between alternatives, i.e. an incremental cost-effectiveness ratio (ICER). That means that the

result, in comparison with a stated alternative, is reported as extra costs per extra health effect achieved. If the ratio is calculated without a comparison, it is called the average cost-effectiveness ratio. LFN also posits that the comparison alternative should be the most appropriate alternative treatment in Sweden, clarified as the most used, which might be no treatment at all, i.e. the null or do-nothing alternative. In effect, if the null alternative is used, which of course means zero costs and zero health effects, the incremental ratio is identical to the average ratio.

In many cases there are several relevant comparison alternatives, which thus have to be compared in a series of incremental analyses. To tease out the appropriate comparisons the concepts of dominance, i.e. an alternative leads to fewer effects and higher costs, and extended dominance, when an alternative has a higher ICER than another more effective alternative, are used (Karlsson & Johannesson, 1996; Drummond et al, 2005). The paper by Karlsson & Johannessson (1996) also explores the different decision rules based on ICERs in situations of fixed or variable budgets.

*Productivity costs*

Given that the LFN recommends a societal perspective, productivity costs should be included in the analysis. These productivity costs have become one of the most controversial areas of cost-effectiveness analyses (Sculpher, 2001). It is widely accepted that an individual's time is a scarce resource, and thus if that time is affected by an intervention, a valuation of the time should be included in the analysis. Yet, the valuation of the costs, the equity implications and which time to include have caused considerable debate.

Early economic evaluations included productivity costs, then frequently named indirect costs or production losses, for lost working time that was due to both morbidity and mortality, often in a denoted cost-benefit framework (Sculpher, 2001). The US Panel (Gold et al, 1996) however, pointed out that it is double-counting to include mortality productivity costs if the health outcome includes life-years (i.e. also QALYs). Since then, mortality productivity costs are often recommended against. The US Panel, however, stated that it was double-counting to also include productivity costs when a valuation of normal activities was included in the health outcome (Gold et al, 1996). The reason is that the Panel feared that individuals, if not clearly instructed not to, would take into account income effects of ill-health when asked about valuations of health states. This assumption became heavily debated (Brouwer et al, 1997; Weinstein et al, 1997; Meltzer & Johannesson, 1999).

Concerning the valuation of the costs, LFN recommends the human capital approach, which in theory might value all time uses (Sculpher, 2001), but in practice often only includes market production until retirement age valued as wages. An alternative valuation is the so-called friction cost method (Koopmanschap et al, 1995) that only considers temporary, i.e. during a friction period, costs that are due to reduced working capacity. The equity considerations stem from the practice of valuing the costs as market wages, which differ between population groups but might be mitigated by the use of average wages (Drummond et al, 2005), and from the implied zero costs for individuals above the age of retirement.

*Costs in added life-years*
As the only jurisdiction, LFN recommends that analyses include costs in added life-years, i.e. the difference in market consumption and production during gained life-years, in order to fully reflect the societal perspective (Meltzer, 1997; Meltzer & Johannesson, 1999; Lundin & Ramsberg, 2008). These costs include future unrelated medical costs as well as unrelated non-health costs. The costs are negative for individuals aged 20 to 64 years, but positive for individuals before entering the labour market and for individuals above the retirement age (www.tlv.se), i.e. a life-year gained among the young and the elderly carries an extra cost as compared with a life-year gained among the middle-aged. As LFN requires analyses on patient subgroups, based on e.g. age, gender and disease severity, these costs imply that the same therapies result in differential cost-effectiveness in different age groups. The equity implications and social welfare aspects of these costs have been discussed (Olsen & Richardson, 1999; Richardson & Olsen, 2006) but not the limitation to market consumption and production. Methodology text books assert that the costs might be considered in sensitivity analyses (Gold et al, 1996, p. 186; Brouwer et al, 2001; Drummond et al, 2005, p. 64).

*Discount rate*
Following the US Panel (Gold et al, 1996), LFN recommends a 3% discount rate for both costs and health effects as a means to reflect society's preference for current events in comparison with future events, i.e. the assumed societal time preference. In sensitivity analyses no discounting and a 5% rate should be used, as well as one analysis with differential discounting of costs and health effects. Before the US Panel recommendation, a rate of 5% was common (Drummond et al, 2005; Neumann et al, 2005b). Previous UK NICE recommendations (Hjelmgren et al, 2001) required different discount rates for costs and health effects to account for the probable different valuation of future health and future costs.

*Modelling accepted*
In the LFN recommendations the need for modelling is mentioned in several contexts, including extrapolating from surrogate or clinical endpoints to include effects on life-time mortality and morbidity, and adapting clinical trial data to Swedish conditions. The use of modelling was previously contended (Buxton et al, 1997; Halpern et al, 1998; McCabe & Dixon, 2000) but has become very common (Drummond et al, 2005, p. 308). Most models used in cost-effectiveness analyses are health state transition models, especially Markov models (Kuntz & Weinstein, 2001). These models are particularly suitable when there is a continuous risk for events, when events might occur repeatedly and when the timing of events is important (Sonnenberg & Beck, 1993).

*Sensitivity analyses*
Regarding the uncertainty in the results, LFN only insists that sensitivity analyses of central assumptions and parameters are an important stage in the analyses, without specifying which type of sensitivity analysis should be performed. The uncertainty and methods to report and analyse the uncertainty are the area of cost-effectiveness analyses that has developed most during recent years (Drummond et al, 2005, p. 331). Previously, good practice (Gold et al, 1996; Drummond et al, 1987, pp. 82-83) indicated that important parameters and methodological choices should be changed one at a time, named univariate analyses, to investigate if the cost-effectiveness ratio changed considerably, i.e. was sensitive. These univariate analyses ought to be supplemented by

multivariate analyses, i.e. changing several parameters simultaneously, and sometimes by scenarios, such as choosing data to construct a "worst case" or a "best case", although the US Panel (Gold et al, 1996, p. 252) advised against such scenarios. Issues with these types of sensitivity analysis are the ranges chosen for the analyses, which preferably should be taken from alternative data sources and the lack of rules to determine whether the result is sensitive or not to a parameter.

When the use of models became common, the extent of uncertainty, the sources of uncertainty and the possibilities to reflect and analyse the uncertainty increased markedly. Different types of uncertainty were identified (Briggs, 2000) and later classified into parameter, structural and methodological (Philips et al, 2006). Although univariate and multivariate sensitivity analyses are adequate for some of these, probabilistic sensitivity analyses are deemed more suitable to reflect the parameter uncertainty (Briggs, 2001). These analyses are based on either trial patient-level data on individual costs and effects or on model simulations, from which the two alternatives' cost and effect pairs are sampled via a bootstrap (Briggs et al, 2001). The bootstrapped differences in costs and effects are then plotted on the cost-effectiveness plane, together with a 95% confidence interval. The 95% confidence interval can be calculated in a number of ways, but the easiest is to arrange the bootstrapped differences in order and then choose the 2.5% and 97.5% as the intervals, called the percentile method (Briggs, 2001). Alternatively, the result might be presented in a cost-effectiveness acceptability curve, which shows the proportion of bootstrapped differences that are considered cost-effective given different accepted costs per QALY (Drummond et al, 2005).

*Detailed presentation of data*

To enable transparency LFN demands that the methods, the assumptions and the data used for analyses should be clearly described, with unit costs and quantities separately reported, if possible. If the analysis employs a model, detailed data on the probabilities, costs, etc should be tabulated. The detailed reporting of methods and data was also stressed by the US Panel, which proposed that "technical reports" be published alongside scientific journal publication (Gold et al, 1996). To increase comparability among cost-effectiveness analyses, the US Panel also proposed a "reference case", employing the methods preferred by the Panel. To my knowledge, this "reference case" never came into use, probably because the controversies surrounding some of the US Panel proposals. A very frequently used checklist for reporting cost-effectiveness analyses is the Drummond 10-point checklist, first published in 1987 (Drummond et al, 1987).

When models are employed in the analyses, LFN also demands that they should be validated internally and externally, but without specifying the methods to be employed. During recent years, a number of checklists and recommendations on reporting models have emerged (Drummond et al, 2005; Philips et al, 2006). One of the early checklists suggested that model validity be discussed in four sections: Model structure, Model inputs, Model results and Usefulness of model to decision makers (McCabe & Dixon, 2000). Other checklists contain a large number of items, also on technical details (Weinstein et al, 2003; Philips et al, 2006).

*Cost-effectiveness thresholds*

Like most agencies that base decisions on cost-effectiveness analyses, LFN has not stated when it considers an intervention cost-effective, i.e. the limit, or threshold, of

costs per health effect. In Sweden, a frequently quoted acceptable cost per life-year saved, which was derived from the valuation of traffic casualties, has been SEK 500,000 (Carlsson et al, 2006). In 2004, the Swedish National Board of Health and Welfare published guidelines on medical practice that included statements of thresholds: a cost below SEK 100,000 per QALY or life-year gained was considered low and between SEK 500,000 and 1 million high (Swedish National Board of Health and Welfare, 2004). These thresholds became frequently quoted in Sweden. International empirical evidence (Eichler et al, 2004) and statements from officials (Persson & Ramsberg, 2007; NICE, 2008a) suggest that there are no fixed thresholds, but decisions are based on several criteria, of which costs per QALY is only one.

As a side effect of the thresholds, cost-effectiveness analyses can be transformed into cost-benefit analyses (Johannesson, 1996; Sculpher, 2001) by recalculating the health effect into monetary values. This approach, called the net benefit (Stinnet & Mullahy, 1998; Tambour et al, 1998), renders a number of benefits from a statistical point of view (Hoch et al, 2002). This is because the ratio, with unknown statistical properties, is converted to a straight line, which is very well known statistically. The net benefit, coupled with estimates of the uncertainty, can also be used to calculate the expected value of perfect information, called EVPI (Claxton, 1999), which allegedly can be used to prioritise research efforts.

In summary, during the past 20-30 years a fairly coherent mainstream methodology for economic evaluations within medicine has evolved. This is reflected in the similarities of most methodology recommendations (Hjelmgren et al, 2001), shared also by the Swedish LFN recommendations which were followed in the three cost-effectiveness analyses included in this thesis.

## *2.3 Public health*

The term public health programme has been used to characterise the three cases subjected to cost-effectiveness analyses included in the thesis. Public health has been defined as a "...social and political concept aimed at improving health, prolonging life and improving the quality of life among whole populations through health promotion, disease prevention and other forms of health intervention." (WHO, 1998, p. 3). Public health thus encompasses programmes that promotes health, i.e. health promotion programmes, and prevents disease, disease prevention programmes.

Health promotion was defined in the Ottawa Charter from 1986 as: "…the process of enabling people to increase control over, and to improve, their health." (WHO, 1986). The focus is on promoting health, which by no means is the absence of disease, following the WHO constitution: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (WHO, 1948). This definition of health distinguishes health promotion from disease prevention, which has been characterised as: "…action which usually emanates from the health sector, dealing with individuals and populations identified as exhibiting identifiable risk factors, often associated with different risk behaviours." (WHO, 1998, p. 4).

Health promotion is mainly concerned with the circumstances under which people live, defined as "… the context of everyday life: where people live, love, work and play." (Mittelmark et al, 2008, p. 5), often called living conditions. However, living conditions also affect health behaviours, also called risk factors or lifestyles, which often are the targets of disease prevention programmes (WHO, 1998). In practice, the distinction between health promotion and disease prevention might be less clear (Mittelmark et al, 2008), as implemented programmes often combine the two approaches. Furthermore, in recent years the concept "New public health" has emerged, which is stated to entail a "… comprehensive understanding of the ways in which lifestyles and living conditions determine health status, and a recognition of the need to mobilize resources…/ to /… create, maintain and protect health by supporting healthy lifestyles and creating supportive environments for health." (WHO, 1998, p. 3). The New public health thus encompasses both health promotion and disease prevention.

During recent decades, most of the theoretical and methodological advances have taken place within the health promotion discourse. Important concepts, relevant for this thesis, are empowerment, participation, community and "valued health promotion outcomes".

### 2.3.1 Empowerment and participation

As evident in the Ottawa Charter, health promotion should seek to achieve a process by which people are enabled to increase control over decisions and actions that affect their health. This process is often called empowerment (WHO, 1998) and is seen by many as the cardinal principle of health promotion (Rootman et al, 2001).

Empowerment presupposes participation (Tones & Green, 2004, p. 37), i.e. an empowering programme requires that the people concerned are involved in the programme implementation. The "principle of participation" declares that the people affected by a problem should be involved in defining the problem, in planning and taking steps to resolve it and in establishing structures to ensure that changes are maintained (Thompson & Kinne, 1999, p. 30). At the individual level, social involvement and participation might even act as psychological factors with positive effects on perceived control, individual coping strategies, health behaviour and health status (Minkler & Wallerstein, 1997). Participation is thus often seen as another key principle of health promotion and valued both as a process and as an outcome (Potvin, 2007).

### 2.3.2 Community participation

Community has been connected to the key concepts empowerment and participation (Stephens, 2007). Community participation is seen by some authors (Nutbeam, 1998; Rootman et al, 2001, p. 14; Bracht et al, 1999), but not all (Laverack & Wallerstein, 2001), to be a means to achieve empowerment through partnerships with local organisations and citizen groups. Furthermore, if local partners are involved local conditions are taken into account in the planning and programme delivery is perceived as legitimate among the local population (Bracht et al, 1994). Moreover, community participation enhances the chance of programme institutionalisation in ordinary community practice and increases local competence on how to address similar health issues in future endeavours (Potvin & Richard, 2001). The effectiveness of health promotion programmes is therefore enhanced by local community participation.

Community participation is thus considered important both as an end in itself and as a means to achieve other goals. There are, however, few examples of quantitative measures of community participation. Previous examples have counted the number of programme components run by collaborators coupled with descriptions of the types of programmes (Weisbrod et al, 1992) or with the types of collaborating organisation (Bracht et al, 1994; Tillgren et al, 1995), or the number of changes in local practice and policy (Fawcett et al, 2001, p. 252). None of these measures disclose the intensity of the community participation. Rifkin & co-authors (1988), however, have developed a categorical, i.e. using categories that enable comparisons of intensity, measure of community participation. The measure is called the pentagram method and has been applied in several countries and contexts (Bjärås et al, 1991; Schmidt & Rifkin, 1996; Naylor et al, 2002; Eyre & Gauld, 2003; Andersson et al, 2005). The level of participation is examined based on five process indicators: Needs assessment, Leadership, Organisation, Resource mobilisation and Management, which are considered the important components of successful community-based programmes.

### 2.3.3 "Valued health promotion outcomes"

Even if the ultimate aim of health promotion is increased population health, the process in itself is a highly valued part. "Valued outcomes of health promotion", as termed by Nutbeam (1998), are thus not confined to increases in health, measured in terms of mortality, morbidity and/or quality-of-life. The complex and rather distant relationship between the activities in health promotion programmes and health outcomes, e.g.

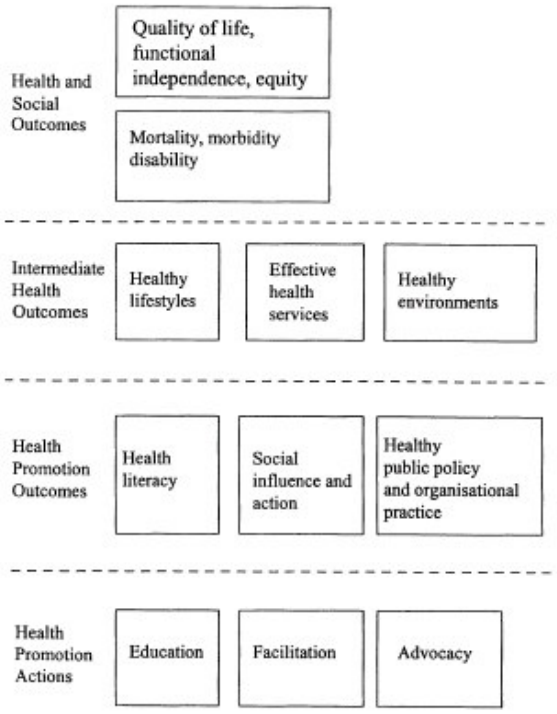


*Figure 2. An outcome model for health promotion, from Nutbeam (1998).*

increased physical activity enabled by bicycle lanes and heart disease incidence, often hinders firm conclusions on programme efficiency using those measures (Nutbeam, 1998; Lindholm & Rosén, 2000).

Instead, a four-level hierarchy of valued outcomes for health promotion has been proposed (Nutbeam, 1998). The highest level, Health and Social Outcomes, contains measures on mortality and morbidity as well as on quality-of-life and equity, see figure 2. A description of the work performed is contained in the lowest level, Health Promotion Actions, divided into different types of action. Between these two levels are Health Promotion Outcomes, which describe the immediate result of the actions in terms of changes in individual, social and environmental factors, which are means to improve on the determinants of health in the next level, called Intermediate Health Outcomes. Headings in this third level are healthy lifestyles, effective health services and healthy environments, which ultimately lead to changes in Health and Social Outcomes. The author stresses the links between the levels and the level indicators, as well as the differential timing of indicator changes.

There are, however, other valuable outcomes from health promotion and disease prevention programmes (Rosén & Lindholm, 1992). One is the social diffusion of health behaviours, i.e. changes in health habits tend to spread to other individuals. The changes might occur among those in the near proximity, such as the family or peer group, but also among more distant individuals, such as those in neighbouring communities. This last phenomenon is sometimes called secular trends. Another valuable outcome is the wellbeing that individuals might derive from changing unhealthy lifestyles because of reduced anxiety and fear of future ill-health, termed utility in anticipation (Cohen, 1984). Consequently, more healthy lifestyles increase individual wellbeing not only from (expected) reductions of future illness but also from decreased anxiety experienced now. The actual lifestyles also affect wellbeing, positive or negative, called utility in use. It is also plausible that the increased self-esteem following from a change of unhealthy lifestyles results in increased wellbeing, and that close friends and family also experience reductions in anxiety that affect their wellbeing.

### 2.3.4 Classification of public health programmes

During the past three or four decades, the approaches and methods in public health have changed markedly (Eriksson, 2000; Catford, 2004). Eriksson (2000) has divided the evolution of public health programmes into four generations, see figure 3, even though he primarily described cardiovascular prevention programmes.

During the 1960s, the clinical generation treated one risk factor at the time in high-risk individuals within the healthcare sector, often including pharmaceuticals. At times the interventions were expanded with some health education approaches. The next generation, the bioepidemiological during the 1970s, acknowledged that several risk factors often contribute to disease, leading to the multifactorial approach. These programmes always included some health education. Eventually this individual and high-risk approach was expanded with structural interventions targeted at the whole population, often called community-based interventions, which aimed to change the risk factor distribution in the population. Since the middle of the 1980s, the multifactorial,

| Generation | Basic approach | Expanded approach |
|---|---|---|
| I. Clinical | High-risk, single factor<br>Medical science | + Information, education and communication strategies |
| II. Bioepidemiological | Multiple risk factors<br>Preventive medicine | + Population approach, health education |
| III. Socioepidemiological | Local prevention<br>Public health actions | + Community development, mobilization strategies |
| IV. Environment & policy-oriented | Health sector policy<br>Health promotion | + Inter-sectoral action, policy analysis |

*Figure 3. Four generations of public health work, from Eriksson (2000).*

community-based interventions have focused on small-scale, action-oriented work in collaboration with local organisations and networks. This generation, the socioepidemiological, emphasises that programmes have to be adapted to local conditions and that supportive environments should be created to enable healthy choices (Catford, 2004). When local networks are weak, the expanded version includes community organising and development. The last generation, called environment and policy-oriented, seeks to counteract processes that undermine the health of the population through policy changes, the healthy public policy. Settings and arenas where people live and meet (Haglund et al, 1996) became important concepts, and movements such as Healthy Cities were started. The expanded version of the fourth generation stresses the importance of general political decisions on the population health and the need for system analyses. The author stresses that the four generations build on different scientific traditions and theories, which, in turn, lead to different evaluation strategies (Eriksson, 2000).

## 2.4 Economic evaluations of public health programmes

Interest in the economic evaluation of public health programmes has increased markedly during recent years in the UK after a series of government reports on the efficiency of the healthcare system, the Wanless reports. One consequence was the expanded responsibilities of NICE, to also provide guidance on the effectiveness and cost-effectiveness of public health measures, as well as clinical guidance (Kelly, 2005). Another consequence was a review that sought to include all studies ever published which identified nearly 1,700 economic evaluations and related studies on a very wide range of public health measures (McDaid & Needle, 2006). In the 2004 Wanless report one chapter was devoted to investments in public health, which concluded: “Economic evaluation of public health interventions is not inherently different from the evaluation of other health interventions. Standard principles of good practice are the same. It is true that the practical difficulties associated with designing rigorous and convincing evaluations of public health interventions are greater. ... But it is not impossible to overcome, or at least minimise, these practical difficulties... a similar method of cost-effectiveness analysis needs to be applied to public health and clinical interventions. ... This would demonstrate the respective merits of investment in public health measures or in clinical services...” (Wanless, 2004, pp. 146-147).

This view, that economic evaluations of public health programmes are not inherently different to other health interventions was, however, challenged by a very recent

methodology review (Drummond et al, 2008). The authors of the review identified four particularly challenging areas: Attribution of outcomes, Measuring and valuing outcomes, Equity considerations and Intersectoral costs and consequences. The area Attribution of outcomes was mainly concerned with the design of the effect evaluations and proposed an increased use of methods to analyse non-experimental data as well as more sophisticated econometrics and structural simulation modelling. In Measuring and valuing outcomes the authors called for a debate on the appropriateness of various forms of economic evaluations for public health interventions and research into different generic measures of wellbeing. Given the importance attached to Equity within the field of public health, the review suggested that health inequality impact assessments and that equity-related subgroup analyses should be performed, as well as research on interventions designed to tackle health inequality. The area Intersectoral costs and consequences acknowledged that many public health programmes have implications for several parts of society, and called for analyses of costs and consequences by beneficiary groups, also taking into account impacts on the voluntary sector and private individuals. In the review 154 economic evaluations of public health interventions published during years 2000-2004 were identified. Its disappointed conclusion was that existing studies provided few insights into methods to meet the challenges: "...very few studies considered costs and consequences outside the health care sector and the measures of outcome were normally confined to various measures of health gain. ... Equity considerations were rarely mentioned and never addressed formally." (Drummond et al, 2008, pp. 8-9).

Only one Swedish economic evaluation was included in the methodology review, on rehabilitation after stroke (von Koch et al, 2001), but there have been a number of studies published on Swedish programmes. Here, I review one study each from the Eriksson (2000) classification of the four generations of public health programmes, complemented with two studies treating other important public health areas.

The first generation according to Eriksson (2000), the clinical that targets individuals with a single risk factor, is exemplified by advice to high-risk consumers of alcohol within primary care (Lindholm, 1998). The cost-effectiveness analysis was based on a hypothetical estimate of the effects from screening for heavy consumers and offering advice to those identified during a number of follow-up visits given by physicians or nurses. The programme costs varied considerably with personnel category. Converting a male heavy drinker to a moderate drinker was assumed to lead to a reduction of 50% of annual mortality risks in ages 40-70 years and of annual health care costs. The analysis showed that the programme could be cost-effective; if 2% of the heavy consumers changed drinking habits, the costs per life-year would amount to Euro 10,000 while it would be cost-saving in a healthcare perspective if 10% changed into moderate alcohol consumption.

The second generation of programmes, the bioepidemiological that targets several risk factors, might be represented by a type 2 diabetes prevention programme aimed at individuals with impaired glucose tolerance, i.e. with a high risk of developing diabetes. The programme was developed in Finland; the Finnish Diabetes Prevention programme. In the cost-effectiveness analysis the programme effects were applied to a cohort of 60-year-old men and women in Stockholm, Sweden (Lindgren et al, 2007). The programme consisted of physician and nutritionist visits for advice on food and physical activity

habits, and physical activities. The changes in risk factor levels were converted to decreased risks of diabetes, myocardial infarction and stroke in a Markov model. The programme costs were estimated to Euro 2,614 per patient, which were offset by savings in disease-related costs. The result of the analysis was thus societal cost-savings and a gain of 0.2 QALYs per patient.

One of the examples of the third generation of programmes in Eriksson (2000) is the Norsjö project, a local community-based programme aimed to prevent cardiovascular disease. The programme included invitations to health examinations as well as structural changes and health education. In the cost-effectiveness analysis the changes in risk factors were converted to decreases in cardiovascular disease during 8 years. Despite the very short effect period, the programme was cost-effective or cost-saving, according to different assumptions. The study also investigated the equity consequences of the programme, finding that all social classes had benefited (Lindholm et al, 1996a).

The fourth generation of programmes, the environment and policy-oriented, is represented by a study on a policy that does not aim to affect health. This policy is the Swedish social security programme that enables parents to take paid leave to tend to their young children, called parental leave. The cost-effectiveness analysis was based on a decreased overall mortality during 20 years of 16% among males that had had parental leave in 1978-79 (Månsdotter et al, 2007a). The programme costs included information on and administration of the parental leave and productivity costs during the leave, while costs avoided included inpatient care and productivity costs because of sick leave. The base case cost-effectiveness ratio amounted to Euro 8,000 per QALY, which is cost-effective in Sweden.

Vaccinations are another public health area, and were among the first public health measures to be subjected to economic evaluations, reviewed in Jönsson (1975; 1976). These economic evaluations were performed within a cost-benefit framework, where losses in health were valued as productivity costs. The Jönsson books (1975; 1976) criticise the method, suggesting instead a willingness-to-pay approach for influenza vaccination. Later studies on vaccination, however, employs a standard cost-effectiveness framework, e.g. vaccination against pneumococcal pneumonia among elderly which resulted moderately cost-effective in Sweden, with a cost per QALY of around SEK 300,000 (Örtqvist et al, 2000).

Supportive environments for health are often created outside of the healthcare system. One example is bicycle lanes that increase the availability of physical activities, which have been investigated in an explorative cost-benefit analysis (Swedish Environmental Protection Agency, 2005) on some measures to convert Linköping to "The bike city". The measures, with annualised investment and maintenance cost of SEK 630,000, were estimated to lead to an increase of around 55 bicycle journeys per day; 10 among existing bikers, 39 among former car travellers, and the remainder substituting bus journeys. The benefits were estimated to SEK 4.2 million, mainly arising from increased comfort and safety among the existing bikers, valued at SEK 12.80 per journey. The willingness-to-pay for a new bicycle journey was estimated at SEK 6.60 while time cycling on a lane was valued at SEK 70 per hour. Health effects, only estimated for new bikers, included decreased societal costs for type 2 diabetes, cardiovascular disease and

elevated blood pressure, but amounted to less than 1% of the total benefits. Overall, the benefits amounted to seven times the costs.

## *2.5 Financing public health programmes*

As stated above by Eriksson (2000), the focus of public health programmes have shifted over time, from healthcare sector-based to community-based interventions that are implemented in collaboration with local organisations and at times aiming to change policies towards more health supportive environments. This change reflects the shift from disease prevention to health promotion, i.e. public health has become more concerned with population wellbeing than with preventing specific diseases. This change is also evidenced by the view within public health that determinants of health extend well beyond the individual and individual-level lifestyle factors into general socio-economic, cultural and environmental factors, see figure 4.

Thus, the need for other sectors of society, apart from the healthcare sector, to assume responsibility for the public health and related measures arises. In Sweden, the sector of society that is most concerned with population wellbeing is the local authorities (the municipalities). These local authorities are responsible for basic schooling (until age 18 years), the care of the elderly and disabled as well as for pre-school children and for the local infrastructure, including construction and maintenance of the local road system, recreational areas and sports facilities. The local authorities thus have at their disposal many of the means to affect population health by creating supportive environments for health. Another sector of society that has been proposed as a local collaborator are the NGOs (non-governmental organisations), i.e. the voluntary organisations sometimes referred to as the "third sector", with a long tradition in Swedish society. This sector contains organisations for e.g. tenants and old age pensioners, trade unions, in particular their study organisations, and sports clubs. Yet another area with substantial possibilities to affect health is the workplace.

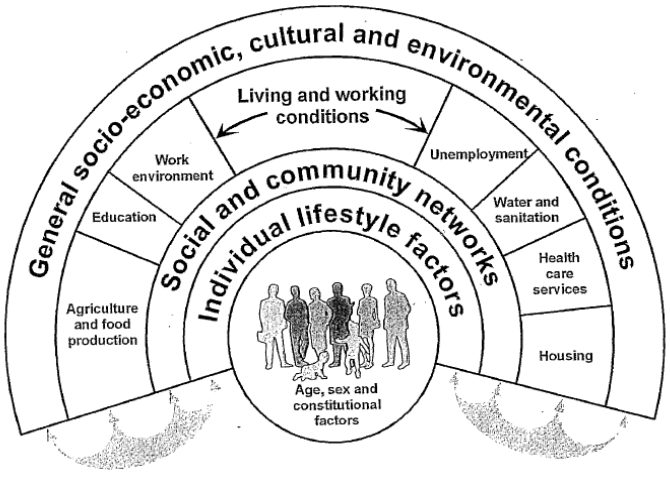


*Figure 4. The main determinants of health, from Dahlgren & Whitehead (2007).*

The need for collaboration between sectors has also been acknowledged in Swedish national working parties, where it has been claimed: "…it is necessary that public health issues are coordinated at all levels in society and that the state, the healthcare authorities and the local authorities need to cooperate to achieve results. …there are difficulties inherent in the fact that the responsibility is divided between several organisations and that no organisation has public health issues as its main task." (Swedish government, Prop. 2002/03:35, p. 26; author's translation)[3].

The financing of public health programmes is thus an acknowledged issue. According to economic theory, the only reason to spend resources is that there are incentives, i.e. reasons to do so. The incentives are normally assumed to be financial gains, i.e. that one can derive a monetary benefit from the action. This would presumably only apply to the commercial sector, in that the aim of that sector is to maximise profits. For several reasons, the healthcare sector does not operate under market conditions (Dranove & Satterthwaite, 2000), and nor do most other sectors concerned with public health. In these sectors, maximising profits is thus not a viable objective.

If organisations are reluctant to finance public health programmes, implementation might be hindered. In economic theory this aspect would be called lack of incentives which might lead to suboptimal resource allocation, i.e. the resources are not used in the best available way. Another aspect is the possibilities of cost-shifting, i.e. that one organisation has the possibility to affect the costs accrued to another organisation. This risk is enhanced when there are two organisations with different payment systems, substitutable services and a common output, such as the healthcare authority and the local authority concerning health. The technical efficiency of the organisations, i.e. if they use their resources in the best available way, as well as the social efficiency, if resources overall are used in the best way, might be adversely affected (Banks et al, 2001).

Cost-shifting and inappropriate incentive structure seem to have been important reasons underlying a recent structural reform in Denmark: "...incentives to strengthen preventive efforts, when the benefits accrue to the same organisation. Less risk for cost-shifting and clear incentives to perform tasks at the lowest, effective level..." (Struktur-kommissionen, 2003, p. 146; author's translation)[4]. In the reform the local authorities were given full responsibility for health promotion and prevention coupled with decreased payments to the regional healthcare if hospitalisations are avoided (Möller Pedersen et al, 2005). At intra-organisational levels, lack of incentives might also hinder public health programmes. This is exemplified by calls for targeted reimbursement for alcohol preventive work in Swedish primary care, as benefits in terms of avoided alcohol-related hospitalisations will fall on other budgets, although within the same organisation (Leifman et al, 2008). Thus, even if public health programmes might be beneficial overall for the healthcare sector, implementation might be hindered by narrow budget concerns within the sector.

[3] In Swedish: "… det är nödvändigt att folkhälsofrågorna samordnas på alla nivåer i samhället och att staten, landstingen och kommunerna måste samverka för att kunna nå resultat. ...det finns svårigheter förknippade med att ansvaret är utspritt mellan ett flertal aktörer och att ingen på verksamhetsnivå har folkhälsofrågor som sitt kärnområde"

[4] In Danish: "... incitamenter til at styrke den forebyggende indsats, når gevinsten kommer samme myndighed til gode. Mindre risiko for kassetänkning og klare incitamenter till opgavevaretagelse på laveste, effektive niveau..."

# 3. Aims and objectives

This thesis investigates constraints and opportunities of economic evaluations of public health programmes, exemplified with cases of cost-effectiveness analyses of implemented programmes. The first aim is to assess the cost-effectiveness of three public health programmes. The second aim is to explore whether the cost-effectiveness methodology is appropriate for public health programmes.

The first specific objective addresses the need for decision-making bases on public health programmes:

- To assess the cost-effectiveness of a smoking cessation programme, an elderly safety promotion programme and a diabetes prevention programme (study I, II, III)

The three cases represent different phases of approaches within health promotion, which could affect the appropriateness of the cost-effectiveness analyses. Two objectives therefore address the applicability of mainstream economic evaluation methodology within medicine on the programmes:

- To determine whether it is feasible to perform mainstream cost-effectiveness analyses on public health programmes (study I, II, III)
- To explore whether mainstream cost-effectiveness analyses are appropriate as a basis for decision making on public health programmes (study III)

Cost-effectiveness, however, is not a necessary condition for implementation of community-based public health programmes, but financing is. The financing implication of community participation in terms of resource mobilisation among collaborators has previously been acknowledged, and the issue is addressed in two objectives:

- To propose a quantitative measure of community participation based on programme costs (study IV)
- To assess the financial incentives of local community collaborators to participate in a community-based public health programme (study IV)

# 4. Material and methods

## *4.1 The programmes*

In this thesis three public health programmes are studied, see table 1. All three programmes were implemented in the Stockholm Metropolitan area during the years 1995-2004, and initiated and partly financed by the Stockholm County Council.

*The smoking cessation programme (study I)*
The programme, called Quit smoking, Gals (Fimpa, tjejer!) was a "Quit-and-Win" contest, i.e. a contest for smoking cessation, implemented in a healthcare district in Stockholm in 1995-1996. The programme was aimed at smoking mothers to small children. The mothers were primarily recruited via personally addressed direct mail, aided by information by local newspapers and key informants. The programme included support to the participants: five personally addressed letters, two occasions of smoking cessation telephone hotline support and one get-together. Nicotine replacement products were allowed. To be eligible for a prize the participant had to be smoke-free for 7 months.

A pre- and post-evaluation model, including process and outcome, was used to evaluate the programme (Eriksson et al, 1997; Tillgren et al, 2000). Based on a mailed questionnaire to all participants, quitters were defined as sustained tobacco-free at 12 months. The survey participation rate was 76%, with dropouts defined as smokers. In total, 238 women participated in the contest, with 14% (34 women) quitters.

The programme might be classified according to Eriksson (2000) as a second generation public health programme, designed to target a single risk factor in a high-risk group but implemented in a non-clinical setting.

*Table 1. Overview of the three public health programmes*

| | **study I** | **study II, IV** | **study III** |
|---|---|---|---|
| Time period | 1995-1996 | 1995-1999 | 1995-2004 |
| Geographical area | 1 healthcare district in Stockholm county | 1 community in Stockholm county | 3 municipalities in Stockholm county |
| Programme target | tobacco smoking | elderly injuries | type 2 diabetes |
| Target group | mothers to pre-school children | elderly: aged 65+ years | whole population |
| Public health generation | 2nd | 3rd | 4th |
| Effect evaluation design | pre-post | pre-post, quasi-experimental | pre-post, quasi-experimental |
| Effect evaluation outcomes | quitters | first hip fracture | risk factors: blood pressure, BMI, glucose levels |
| Markov model aim | tobacco smoking cessation | first hip fracture avoided for 1 year | metabolic syndrome |

*The elderly safety promotion programme (study II and IV)*
The programme, called Safe Seniors in Sundbyberg (Säkra Seniorer i Sundbyberg), was a community-based elderly safety promotion programme implemented in a community in Stockholm county over 5 years, 1995-1999. The programme was based on principles for community organisation and intersectoral collaboration (Bracht et al, 1999). The organisation included a full-time project coordinator, a steering group containing executives from the regional healthcare management and the municipal elderly care organisation, as well as a reference group in which local representatives from public organisations, business companies and several NGOs participated.

The programme combined structural changes in the environment with individually based measures for the elderly, using both safety promotion and injury prevention methods. Some activities were initiated for the elderly, e.g. study circles on measures to increase safety, group balance exercises, qigong and other suitable physical activities and an annual outdoor fair. Other activities focussed on environmental safety and included home visits, safety rounds in neighbourhoods, new routines in housing reconstructions, as well as monitoring of occurred falls in seniors' accommodation (Sadigh Andersson & Hökby, 2000; Hökby & Sadigh, 2002).

The effect evaluation was designed as a quasi-experimental 12-year time-series analysis with six control areas (Johansson et al, 2008). The years 1990-1995 were regarded as the pre-intervention period and the years 1996-2001 the post-intervention period. The outcome was hip fractures that were obtained from the national Swedish Hospital Discharge Register. The study group was divided into females and males in two age groups, 65-79 and 80+ years, for each area, which resulted in 28 panels. The panels enabled a longitudinal multivariate analysis that considered the in-group and the between-group variation during the period. The effect evaluation estimated that 14 hip fractures had been avoided in the programme area during the 6-year post-intervention period: 8 for women 65-79 years old and 3 each for the men in the two age groups.

The programme might be classified as an third generation programme, according to Eriksson (2000), i.e. a community-based programme implemented in collaboration with local organisations. The programme targeted several risk factors for elderly accidents, combining injury prevention and safety promotion approaches.

*The diabetes prevention programme (study III)*
The programme, called Stockholm Diabetes Prevention programme (SDPP), was a community-based programme aiming to promote healthy lifestyles in order to prevent type 2 diabetes. It was implemented during 1995-2004 in three municipalities in Stockholm. The programme focused on the preventable risk factors for type 2 diabetes, i.e. physical inactivity, poor dietary habits, obesity and tobacco use, via both individual lifestyle and community change. The main strategy was community organisation and participation (Bracht & Kingsbury, 1990) to develop community relations and to educate and implement activities with local representatives from various sectors. Activities sought to increase awareness of the risk factors and the availability of physical activities, healthy food, a non-smoking environment and professional guidance to loose weight or start exercising. The organisational structure, selection of strategies and activities varied between the programme municipalities, but networking and partnerships were central in most activities.

The programme organisation included a project leader in each programme municipality, a central support unit with a coordinator of the local work and a central and local intersectoral steering groups. The programme has been described previously (Sanderson et al, 1996; Bjärås et al, 1997; Lindvall et al, 2004) and subjected to extensive implementation evaluations (Bjärås et al, 2001; Andersson et al, 2002; 2003; 2005; 2007; Andersson, 2006).

The effect evaluation was performed with a quasi-experimental cohort design, i.e. the results from a survey and a health examination of people aged 36-56 years at baseline and 8-10 years later (Eriksson et al, 2008) in the programme municipalities and in two control municipalities were compared. The study group with both baseline and follow-up data, excluding individuals that had migrated from the baseline municipality, comprised 2,149 men and 3,092 women, i.e. about 500 men and 600 women from each municipality, 16% of the total baseline population. Because of lack of data for men in one programme municipality, only the changes among women in that municipality could be included. The two control municipalities, merged into one control area, were selected to match the programme municipalities based on geographical and demographic characteristics. The outcome was changes in metabolic syndrome risk factor levels. The metabolic syndrome is a combination of biological risk factors related to lifestyles, such as physical activity and dietary habits, the lifestyles most affected by programme activities. The risk factors, i.e. blood pressure, body mass index (BMI) and fasting plasma glucose (FPG), affect the risk of cardiovascular disease and diabetes (Alberti, 2006).

The programme might be classified as a fourth generation public health programme, according to Eriksson (2000), which seeks policy and environmental changes to create supportive environments via a healthy public policy.

## *4.2 The cost-effectiveness analyses*

The three cost-effectiveness analyses (study I, II, III) employed similar methods, facilitating comparison between them. The analyses followed the recommendations issued by the Swedish LFN (LFN, 2003), as described in section 2.2, to enable comparisons with other medical technologies.

*Societal perspective*
The analyses were performed with the societal perspective, aiming to include costs and consequences for all sectors of society, including participants' time (study I, II, III). The programme costs, i.e. the costs of implementing the programmes, were based on document analyses, self-reports by key persons in collaborating organisations and in close cooperation with the project coordinators. For study I, the costs were collected by the project personnel, however consulting me, as a part of the process evaluation (Eriksson et al, 1997). In studies II and III the programme costs were collected within the economic evaluation, but pro-spectively for study II and retrospectively for study III, in the last programme year (Eriksson & Johansson, 2005).

Wage costs for all involved were valued at the average wage for the personnel group (study I), whereas wage costs for employed within the programmes were taken from the project accounts (study II, III) and wage costs for collaborators were estimated by occupation in seven (study II) and five (study III) categories, including payroll taxes of 40%. The value of the work by unsalaried voluntary workers was handled differently in the two programmes that consumed such resources: valued at the average Swedish wage excluding payroll taxes (study III) or at 35% of the average Swedish wage (study II), i.e. the customary Swedish valuation of leisure time (Claesson et al, 2000). Likewise, the time costs for participants were valued differently: at the average Swedish wage (study I) or at the leisure time valuation (study II, III). The different valuations of voluntary work and participant time are due to the absence of a standard valuation at the time of the costing of study I (i.e. in year 1996). Other resource consumption was taken from project accounts or quantified from standards, such as 3 hours for each meeting including travelling time (study II). Standards were also used for valuing resources, such as 20% of wages for running costs, such as office space, computers, etc (study I, II, III), and SEK 200 (study II, III) for a meeting room.

The disease-related costs, i.e. the avoided costs because of the programmes, were also collected from the societal perspective (study I, II, III). The medical treatment costs were taken from the Stockholm County Council databases, the VAL databases that include all medical care consumption for the inhabitants of the county (1.9 million people in 2004). These databases enable calculation of diagnosis-specific (study I, III) or operation code-specific (study II) costs per individual during specified periods. The individuals included in the medical treatment costs estimates were selected according to specific criteria. For example (study I), all patients admitted to hospital with a specific disease as recorded diagnosis (primary, secondary or tertiary) during 1996 but not in 1995 were regarded as incident cases. Costs during the first 6 months after first admission were regarded as initial costs; the average of costs during 4 years (1996-1999) excluding the year of death, were regarded as annual costs; whereas death costs were accumulated during the 6 months before date of death, but only for patients admitted to hospital with the specific disease as recorded diagnosis during the last week before death. Detailed selection criteria as well as cost estimates are reported elsewhere (Johansson, 2004; Johansson, 2008; Feldman et al, *forthcoming*). The medical treatment costs included inpatient and outpatients costs, valued by the Stockholm County Council DRG-based prices, and some primary care, valued as standard costs per visit. Other disease-related costs were taken from previously published studies from 1995 – 2006 on Swedish patients, apart from some lung cancer costs (study I) which were not available from Sweden.

The societal perspective, however, was not fully reflected because the analyses only included some of the diseases presumably affected by the programmes. The smoking cessation study (study I) included the three most smoking-related disease groups: lung cancer, COPD (chronic obstructive pulmonary disease) and cardiovascular disease (CVD) including stroke. The elderly safety promotion programme (study II) included only hip fractures. For the diabetes prevention study (study III), the diseases considered were extended to the diseases related to the metabolic syndrome, i.e. type 2 diabetes and CVD including stroke.

*Cost-utility analysis*
All studies (I, II, III) were reported as cost-utility analyses, i.e. using QALYs as health effects. The average age- and gender-specific quality-of-life weights during healthy years were taken from studies on Swedish patients (studies I, II, III). Quality-of-life during disease was either based on average quality-of-life among patients with respective disease (study I) or on disease-specific decrements from the average age- and gender-specific quality-of-life (study II, III). The weights were obtained via the EQ-5D instrument with health states valued by community preferences obtained by the TTO method (study I, II, III),if available. The decrements in quality-of-life because of disease were life-long (study I, II) or divided into initial, for the acute phases of myocardial infarction and stroke, and annual during the remainder of life (study III).

In all analyses (study I, II, III) the estimated costs avoided were deducted from the programme costs to obtain the net costs of the programme. If the net costs were positive, the result was expressed as cost per QALY. If the net costs were negative, the cost-savings along with the gains in QALYs were reported. Some other outcomes, such as programme costs per quitter, were also reported (study I).

*Incremental analysis*
The comparison alternative in the studies were the null alternative (study I) or standard care (study II, III), but mistakenly stated as the null alternative in study II. When programme effects are calculated net of changes in control communities (study II, III), the effects from the standard care in the controls is deducted from the programme communities. No costs or effects from this standard care were included in the calculations, however. The null alternative is acceptable when interventions towards the issue are not regularly implemented, such as smoking cessation interventions (study I) at the time of the programme. Note that the article (study I) mistakenly uses the term incremental analysis in connection with marginal analyses.

*Productivity costs*
All studies included morbidity productivity costs (study I, II, III) although the elderly safety promotion study (study II) only included estimated non-market productivity costs in a sensitivity analysis, because the programme was aimed at people above the usual age of retirement. These non-market productivity costs consisted of informal care given to others, valued as leisure time. The market productivity costs were valued with the human capital approach using average (neither age- nor gender-specific) wages (study II, III). No mortality productivity costs were included.

*Costs in added life-years*
Sensitivity analyses included the LFN recommended costs in added life-years (study I, II, III), but using different estimates: Ekman & co-authors (2001) for study I and those published at the LFN webpage (www.tlv.se) for studies II and III.

*Discount rate*
The base case discount rate in all studies was 3% per year for both costs and health effects (study I, II, III), whereas sensitivity analyses included no discounting (study I, II, III) and a 7% (study I) or 5% rate (study II, III). When programmes were implemented over several years (study II, III), the programme costs were also discounted 3% to a common year.

*Modelling accepted*
All cost-effectiveness analyses employed modelling to estimate future disease and connected costs and health effects (study I, II, III). The need for modelling was evident for the smoking cessation programme (study I) and the diabetes prevention programme (study III) as the programme effects were measured as changes in risk factors which affect disease in the longer run. The elderly safety promotion programme (study II), however, measured effects as first hip fractures avoided, which might be regarded as a final outcome. The interpretation of the effect evaluation result, however, was that the first hip fractures had been avoided for 1 year. Only including 1-year effects in the analysis would have been contrary to recommendations, and the programme would have appeared not cost-effective.

The models were Markov models, constructed in DATA (Treeage Inc) for Monte Carlo simulations. The models that simulate the effects from risk factors (study I, III) were complex, incorporating nine health states each in addition to the initial health state, called Healthy in the smoking cessation model and At risk in the metabolic syndrome model, and two termination states, Death in the model diseases and Death unrelated. One of the reasons for the complex models is the use of the Framingham CVD risk function, which includes five coronary heart diseases (merged into four in the metabolic syndrome model). In contrast, the hip fracture model (study II) was very simple, only incorporating three health states, with the hip fracture modelled as a transition between Healthy and Post-hip fracture. All models are partly stochastic: the smoking cessation and the metabolic syndrome model (study I, III) only sampled from the actual distributions (in study III the bootstrapped distribution) of medical treatment costs, whereas all costs in the hip fracture model (study II) were sampled during simulations.

*Sensitivity analyses*
Extensive sensitivity analyses were performed in all three studies. Most model parameters were varied (in study I, III) or all model parameters were replaced by alternative Swedish data (study II) in univariate and multivariate analyses. Some programme-specific analyses on programme costs and programme effects were also included (study II, III). Probabilistic sensitivity analyses performed via bootstraps from the model simulations were reported on the cost-effectiveness plane (study I, II, III), even though one analysis (study I) was reported elsewhere (Johansson, 2004). Break-even analyses on the programme effectiveness required to consider the programmes cost-effective (study II) or cost-saving (study I) were also reported.

*Detailed presentation of data*
The models employed in the analyses are described in technical reports (Johansson, 2004; Johansson, 2008; Feldman et al, *forthcoming*) which detail all data sources, assumptions and outcomes. These reports also contain a thorough discussion on the model validity according to a checklist (McCabe & Dixon, 2000). Programme costs (study I, III) have been reported elsewhere (Eriksson et al, 1997; Eriksson & Johansson, 2005) whereas the programme costs for study II are more fully described in study IV.

*Cost-effectiveness thresholds*
Thresholds of SEK 100,000 and 250,000 per QALY (Swedish National Board of Health and Welfare, 2004) were used to discuss results of the sensitivity analyses (study II).

## *4.3 Financing and resource mobilisation*

The aim of study IV was to discuss the financing of community-based public health programmes. The discussion started at one stated objective of community-based health promotion: resource mobilisation among collaborators in the local community. However, there might be few incentives for collaborators to commit their resources to programmes, which could hinder the implementation. The study thus discussed and reported an empirical example of the financing of public health programmes from two angles: the economic on incentives and allocation of resources and the public health on the possibilities to describe to what extent the resource mobilisation objective had been fulfilled.

The study used data from the cost-effectiveness analysis of the elderly safety promotion programme (study II). The total programme costs, collected with a societal perspective and therefore seeking to include all resource consumption, were divided into project funds, local collaborator contributions and participant costs. The proportion of total costs paid by local collaborators was proposed as a quantitative indicator of resource mobilisation among local community collaborators. The financial incentives of local collaborators were investigated in a subsector financial analysis. The analysis compared the programme costs paid by a sector of society with the estimated financial benefits for respective sectors resulting from the programme. The financial benefits were obtained from the societal costs avoided because of hip fractures avoided, as estimated within the cost-effectiveness analysis (study II).

# 5. Main findings

*The cost-effectiveness of the smoking cessation programme (study I)*
The programme led to 34 female quitters (14% of the participants) aged 15 to 49 years. The smoking cessation model estimates amounted to a gain of 0.34 to 0.55 QALYs (discounted 3%) and cost-savings of SEK 20,000 to 35,000 per female quitter in these age groups, see table 2. The cost-utility analysis resulted in cost-savings of about SEK 800,000, around four times the programme costs, and a gain of 16 QALYs. The sensitivity analyses showed that the programme would lead to cost-savings under all investigated assumptions, apart from the inclusion of costs during added life-years, and that it would have been cost-saving even if only 9 women quit smoking.

The substantial cost-savings because of smoking cessation estimated by the model indicate that most tobacco control programmes would result in cost-savings.

*The cost-effectiveness of the elderly safety promotion programme (study II)*
The elderly safety promotion programme was estimated to result in 14 avoided hip fractures (8 among women aged 65-79 years, 3 each among men aged 65-79 and 80+ years) in comparison with the control areas. These avoided hip fractures were estimated to lead to costs avoided that balanced the programme costs and to 35 QALYs, see table 3. All sensitivity analyses, including some based on very conservative assumptions, give costs per QALY below SEK 250,000 whereas a break-even analysis showed that 9 hip fractures (4 among men and 5 among women aged 65-79 years) were sufficient to obtain a cost per QALY below SEK 100,000.

The programme was cost-effective and at least as cost-effective as osteoporosis pharmaceuticals. Accordingly, similar community-based elderly safety promotion programmes should be implemented on a large scale.

*Table 2. Smoking cessation model results per age group, women. Costs in SEK year 2000.*

| Age group | QALYs | | | YLS* | | | Costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | Smoker | Quitter | Diff. | Smoker | Quitter | Diff. | Smoker | Quitter | Diff. |
| 15-19 | 22.39 | 22.73 | 0.34 | 3.79 | 1.66 | 2.13 | 102 517 | 82 338 | 20 178 |
| 20-24 | 21.25 | 21.68 | 0.42 | 3.83 | 1.71 | 2.12 | 119 334 | 90 658 | 28 676 |
| 25-29 | 20.04 | 20.49 | 0.44 | 3.86 | 1.62 | 2.24 | 131 369 | 105 941 | 25 428 |
| 30-34 | 18.63 | 19.17 | 0.55 | 3.80 | 1.78 | 2.02 | 150 447 | 115 210 | 35 236 |
| 35-39 | 17.08 | 17.55 | 0.47 | 3.74 | 1.97 | 1.76 | 166 838 | 131 720 | 35 118 |
| 40-44 | 15.43 | 15.95 | 0.52 | 3.63 | 2.04 | 1.59 | 177 308 | 146 439 | 30 870 |
| 45-49 | 13.77 | 14.16 | 0.39 | 3.39 | 2.19 | 1.20 | 172 984 | 149 461 | 23 523 |

* until age 85 years and undiscounted

*Table 3. Summary of the cost-effectiveness analysis of the elderly safety promotion programme. Costs in SEK 2004.*

| | Cost item | Total |
|---|---|---|
| Programme costs | | |
| Project wage costs | 1 783 889 | |
| Other wage costs | 1 920 119 | |
| Volunteers | 76 025 | |
| Running costs | 308 959 | |
| Other costs | 1 527 409 | |
| Participants' costs | 834 748 | |
| *Total Programme costs* | | *6 451 149* |
| Costs avoided | | |
| Medical care | 2 350 551 | |
| Pharmaceuticals | 140 257 | |
| Community care | 3 694 309 | |
| Informal care | 337 017 | |
| *Total Costs avoided* | | *6 522 134* |
| **Net costs** | | **-70 985** |
| Health effects | | |
| Life-years saved (YLS)* | | 42.23 |
| QALYs | | 35.16 |

* until age 100 years and undiscounted

*The cost-effectiveness of the diabetes prevention programme (study III)*
In the analysis smaller increases in costs and smaller decreases in QALYs in the programme areas (programme municipalities I1, I2, I3) *vs.* the control area would be interpreted as positive effects of the programme. The Markov model estimates of risk factor levels before the programme and after, called pre and post in table 4, showed decreases in costs but also larger decreases in QALYs in municipality I2, over the genders, in comparison with the control, i.e. it was probably cost-saving but without health gains. The lack of data for men in municipality I1 hinders conclusions on the cost-effectiveness in that area, but if the developments among men were similar as in the other areas, the large difference in costs and QALYs *vs.* the control area for the women would offset less favourable changes among the men. In programme municipality I3, the programme was not cost-effective. Sensitivity analyses performed on men in area I2 and the control area demonstrated that under no investigated assumption was the programme cost-effective among men in I2, except when costs in added life-years were included.

Conflicting results on the programme cost-effectiveness were thus obtained, but community-based diabetes prevention programmes promoting population lifestyle changes might be cost-effective, as evidenced by the result from programme municipality I1. If we had been able to include all potential beneficial effects from the programme, the programme might have turned cost-effective in the other municipalities as well.

*Table 4. Programme costs, model estimates on societal costs and QALYs per individual (in programme municipalities I1, I2, I3), and differences to control area. Costs in SEK 2004.*

| | WOMEN | | | | MEN | | | |
|---|---|---|---|---|---|---|---|---|
| | **Costs** | | **QALYs** | | **Costs** | | **QALYs** | |
| | | **diff. to control** | | **diff. to control** | | **diff. to control** | | **diff. to control** |
| **Control area** | | | | | | | | |
| Model estimates | | | | | | | | |
| pre | 128 759 | | 12.49 | | 121 359 | | 11.93 | |
| post | 199 155 | | 12.25 | | 197 490 | | 11.52 | |
| *diff* | *70 396* | | *-0.24* | | *76 132* | | *-0.41* | |
| **I1** | | | | | | | | |
| Programme costs | 1 328 | | | | 1 328 | | | |
| Model estimates | | | | | | | | |
| pre | 132 279 | | 12.87 | | na | | na | |
| post | 172 355 | | 12.75 | | na | | na | |
| *diff* | *40 075* | *-30 320* | *-0.12* | *0.12* | *na* | *na* | *na* | *na* |
| Net costs | 41 403 | -28 992 | | | na | na | | |
| **I2** | | | | | | | | |
| Programme costs | 1 371 | | | | 1 371 | | | |
| Model estimates | | | | | | | | |
| pre | 129 936 | | 12.90 | | 108 743 | | 11.96 | |
| post | 177 734 | | 12.72 | | 199 209 | | 11.48 | |
| *diff* | *47 797* | *-22 598* | *-0.18* | *0.05* | *90 466* | *14 334* | *-0.48* | *-0.07* |
| Net costs | 49 168 | -21 227 | | | 91 837 | 15 705 | | |
| **I3** | | | | | | | | |
| Programme costs | 1 113 | | | | 1 113 | | | |
| Model estimates | | | | | | | | |
| pre | 119 342 | | 12.93 | | 129 492 | | 12.29 | |
| post | 203 332 | | 12.60 | | 215 574 | | 11.81 | |
| *diff* | *83 990* | *13 594* | *-0.33* | *-0.10* | *86 082* | *9 951* | *-0.48* | *-0.07* |
| Net cost | 85 103 | 14 707 | | | 87 195 | 11 064 | | |

na = not available

*Financing and resource mobilisation (study IV)*

The division of total programme costs between the project funds and the collaborators in the local community showed that 37% were paid by project funds, about 13% were participants' costs and the remainder, 50%, was paid by local (and partly regional) collaborators. The 50% of resources would thus be a measure of resource mobilisation among collaborators, which could easily be compared with the proportions achieved in other programmes.

The financial subsector analysis showed that one sector of society is a net beneficiary, i.e. is estimated to avoid more costs than expended in the programme, see table 5. The local authority, i.e. the municipality, was estimated to avoid costs, i.e. obtain financial benefits, of about SEK 3.7 million, which can be compared with programme costs of about SEK 1 million. The healthcare system, i.e. the County Council, and the

*Table 5. Subsector financial analysis. In SEK 2004.*

| Payer | Programme costs | Financial benefits | Net costs |
|---|---|---|---|
| Project funds | 2 395 798 | | |
| Local health care | 1 489 533 | | |
| *Total health care* | *3 885 331* | 2 490 808 | 1 394 522 |
| Local authority | 1 019 405 | 3 694 309 | -2 674 903 |
| Local commercial companies | 433 063 | 0 | 433 063 |
| NGOs | 143 358 | 0 | 143 358 |
| Other | 135 245 | 0 | 135 245 |
| Participants and relatives | 834 748 | 337 017 | 497 731 |
| ***Total*** | ***6 451 149*** | ***6 522 134*** | ***-70 985*** |

participants and their relatives were expected to avoid some costs but not enough to balance the costs invested in the programme. The other local collaborators: the commercial companies, the NGOs and some other organisations, were not expected to draw any financial benefits.

Thus, in this case, there seemed to be no contradiction between the health promotion objective of participation by local collaborators and the financial incentives, at least for the most obvious local collaborator in Sweden, the local authorities.

# 6. Discussion

Public health programmes are often seen as complex programmes that evolve over time in interaction with their context. A fair assessment of the programmes thus requires a range of evaluations, previously classified as programme monitoring, process evaluation and effect evaluation (Potvin et al, 2001), or further divided into six categories of evaluation models: results, process, system, economic, actor or programme theory (Foss Hansen, 2005). In this thesis only some types of evaluation are considered: the extent of community participation as part of process evaluations and effect evaluations that are required for economic evaluations.

The first objective of the thesis is to investigate whether three public health programme were cost-effective. During the work, however, two opportunities were revealed that are related to the health promotion process objective community participation and the incentives for financing public health programme. However, a number of constraints associated with the effects or outcomes of public health programmes that are included in the cost-effectiveness analyses were also revealed.

## *6.1 The cost-effectiveness of three public health programmes*

The overall conclusion from this thesis is that economic evaluations conforming to recommendations and standards developed within medicine are feasible also on public health programmes. The three cost-effectiveness analyses sought to follow the only Swedish methodology recommendations available, by the LFN (LFN, 2003), to enable comparison with other Swedish analyses.

The cases represent different public health issues with different target groups as well as different levels of complexity reflecting different phases of public health history, see table 1 (paragraph 4.1). However, they were implemented in the same geographical area during the same time period and they are evaluated with the same economic evaluation methodology, which enables comparison between the studies.

The smoking cessation programme (study I) was the most cost-effective of the programmes, as it was estimated to lead to cost-savings four times the programme costs. The result is supported by previous studies: tobacco control programmes are generally considered cost-effective public health interventions (Grosse et al, 2007). The elderly safety promotion programme (study II) appeared to claim no societal costs, as the estimated costs avoided balanced the programme costs. The effectiveness of similar programmes has been doubted (Gates et al, 2008) and asserted (Järvinen et al, 2008), but a similar Swedish programme that was implemented within Lidköping Safe Community reported cost-savings (Ferraz Nunes & Ader, 2005). The diabetes prevention programme (study III) showed conflicting results in the programme municipalities, but was estimated to be cost-saving but with negative health effects in one municipality and possibly cost-effective in another municipality. To my knowledge it is the first economic evaluation of a programme that seeks to prevent diabetes and pre-diabetes in whole populations, which is why the result cannot be validated by

previous studies. The thesis has therefore shown that different kinds of public health programmes can be cost-effective and that similar programmes potentially constitute a good way to use societal resources.

A limitation, however, is that I cannot state that public health programmes are cost-effective, only the particular ones investigated. Given that effective community-based work should be adapted to local conditions (Bracht et al, 1999), the programmes will never be implemented again in exactly the same manner. This is one major difference with other types of medical intervention that are subjected to economic evaluations: public health programmes cannot become standardised routine work, which restricts the generalisability of the work reported.

Nevertheless, a large number of public health programmes have been subjected to economic evaluations internationally (as reviewed in Kreis & Bödeker, 2004; Rush et al, 2004; Hagberg & Lindholm, 2006; McDaid & Needle, 2006; Dalziel & Segal, 2007; Grosse et al, 2007; Dalziel et al, 2008; Zechmeister et al, 2008) and in Sweden (Jönsson, 1976; Jonsson, 1980; Tillgren et al, 1993; Lindholm et al, 1996a; Ramsberg & Sjöberg, 1996; Lindholm, 1998; Lindqvist & Lindholm, 2001; Hagberg, 2002; Lindgren et al, 2003; Oscarson et al, 2003; Tomson et al, 2004; Ferraz Nunes & Ader, 2005; Lindgren et al, 2007; Månsdotter et al, 2007a; Månsdotter et al, 2007b; Sahlén et al, 2008). Some Swedish studies report that lifestyle programmes are not cost-effective in comparison with pharmaceuticals (Johannesson & Fagerberg, 1992) and that the Malmö Preventive Project gave returns well below the opportunity cost, valued as the market rate of return of financial investments (Norinder et al, 2002). The overall impression from the literature, however, is that a wide range of public health programmes are cost-effective. Yet some types of public health programmes are probably more cost-effective than other types, just as among other medical technologies. These most cost-effective public health methods and public health areas have not yet been identified. Another issue is how to transfer the cost-effectiveness evidence to local circumstances and to different settings and population groups (Rush et al, 2004; McDaid & Needle, 2006).

## *6.2 Methodological challenges*

Numerous authors have claimed that there are difficulties in performing economic evaluations of public health programmes (Cribb & Haycox, 1989; Rosén & Lindholm, 1992; Drummond & Stoddart, 1995; Burrows et al, 1995; Craig & Walker, 1996; Shiell & Hawe, 1996; Borghi & Jan, 2008; Drummond et al, 2008). A recent methodology review reported that four areas might be particularly difficult for economic evaluations of public health programmes: Attribution of outcomes, Measuring and valuing outcomes, Equity considerations and Intersectoral costs and consequences (Drummond et al, 2008). During the work on this thesis, some of the aspects included in the area Intersectoral costs and consequences were identified as opportunities, whereas some aspects in Measuring and valuing outcomes were identified as constraints.

*Attribution of outcomes*
The first area in the methodology review (Drummond et al, 2008), Attribution of outcomes, deals mainly with the design of the effect evaluations. None of the three cases in this thesis included a randomised design, but two (study II, III) used quasi-

experimental effect evaluations, i.e. they compared the intervention groups with control groups. One of the studies (study II) required an elaborate statistical analysis (Johansson et al, 2008) to discern programme effects, whereas the other (study III) sought to employ similar methods to those often employed in pharmaceutical trials, except for the randomisation of groups.

Effect evaluations of public health programmes should match the objectives of public health programmes, making evaluations based on changes in morbidity and mortality in the population unsuitable (Lindholm & Rosén, 2000; Tones & Tilford, 2001, p. 468). This is also evident from the Nutbeam model (see figure 2). Public health effect evaluations thus often measure intermediate outcomes (also called surrogate endpoints), i.e. in terms that are directly related to the aim of the programmes, such as tobacco quitters (study I), hip fractures avoided (study II) or decreases in medical risk factors (study III). Just as in economic evaluations based on clinical trials with a short follow-up, these short-term outcomes need to be converted to costs and QALYs accumulated during the relevant time period to fulfill requirements for cost-effectiveness analyses. A frequent method to estimate long-term effects is via simulation models, also called decision analytic modelling, often performed with Markov models (Drummond et al, 2005, p. 291), which were used in all three cases (study I, II, III).

The models used for public health programmes, however, are frequently more complex as these programmes often target risk factors that affect several diseases, such as tobacco smoking (study I) or physical activity (study III). To estimate the long-term effects of such risk factors accurately, several risk functions are needed, one for every disease that is affected by the risk factor. Furthermore, estimates of the cost, mortality and quality-of-life consequences following each disease are required. Fortunately, the Markov model methodology is widespread and thus there are often previously reported models from which data and inspiration can be taken (Johannesson et al, 1991b for studies I and III; Caro et al, 2007 for study III; Borgström et al, 2006b and Zethraeus et al, 2007 for study II). Even though model construction is time-consuming, the same model can be used for several studies if the model fits the outcome and aim of the programmes, which was the case with the smoking cessation model (Tillgren et al, 2007) and the metabolic syndrome model (Engman et al, 2008).

In summary, in the three cases included here Attribution of outcomes did not pose a serious difficulty, even though the effect evaluations required elaborate evaluation designs and extensive data collection via surveys (in study I, III) or registers (study II). The Markov model methodology appears to be well suited to estimate long-term effects from public health programmes to be included in the cost-effectiveness analyses.

*Equity considerations*

Another challenging area identified by Drummond & co-authors (2008) is equity. Within public health, equity and health inequalities are major concerns (Dahlgren & Whitehead, 2007; Mittelmark et al, 2008). Within health economics, the issue is often discussed as a trade-off between efficiency and equity. Efficiency is then related to gains of health and equity to levels of health (Hurley, 2000, p. 107), i.e. efficiency considerations strive for maximisation, either of health or wellbeing according to the extra-welfarist or welfarist approaches; equity, on the other hand, concerns the distribution of this health or wellbeing among individuals.

The rationale behind cost-effectiveness analyses is to achieve technical efficiency, i.e. to reach a given objective in the optimal way. This objective underlying most cost-effectiveness analyses is to maximise health, i.e. QALYs, given budgets, which some authors propose is the overall aim of the health sector (see Hurley, 2000 for a thorough review of the normative discussions within health economics). In practice, this aim is not always pursued (Eichler et al, 2004; NICE Methods Working Party on the Cost Effectiveness Threshold, 2007). There are also numerous examples that the general population (Hurley, 2000, p. 88; Dolan et al, 2005) reject the QALY maximisation objective for equity aspects, as well as Swedish decision makers (Lindholm et al, 1996b) and public health workers (Månsdotter et al, 2006).

In the analyses reported here (study I, II, III) the criterion for assessing programme desirability is the number of QALYs obtained in comparison with resources consumed. The analyses take no account of, nor discuss how these QALYs are distributed in the population, i.e. no equity aspects are considered. The analyses, however, do not include any age- or gender-specific cost items, but average costs are used throughout, except for one sensitivity analysis which included gender-specific productivity costs for informal care (study II), as well as the age- and gender-specific average mortality risk and quality-of-life weights during healthy years used within the models (study I, II, III). All studies (study I, II, III) report gender-specific outcomes, mainly because the epidemiological data used to simulate future effects report different relations between risk factors and disease over the genders. The findings in one study (study III) showing that the risk factor changes were beneficial among women but not among men in one programme municipality could have been used to discuss gender health inequalities and whether the programme reinforced these. However, the aspect was not considered. The focus on production efficiency, disregarding any equity considerations, is a major limitation of the studies.

### 6.2.1 Opportunities: Community-based programmes and the societal perspective

The fourth of the Drummond & co-authors (2008) challenges is Intersectoral costs and consequences, which, however, was found to constitute two opportunities in this thesis. The opportunities stem from the societal perspective adopted in all three cases (study I, II, III). This is the only possible perspective for community-based programmes, in that they are implemented in collaboration with local organisations. A more restricted perspective, such as a health care perspective, would seriously underestimate the programme costs and thus give a false impression of the amount of resources required for successful community-based programmes.

However, public health programmes are often implemented during extended periods (5 years in study II and 10 years in three municipalities in study III). Furthermore, the community-based approach (study I, II, III) included a large number of collaborators, making the collection of programme cost data complex and time-consuming. There is a risk of underestimating the true programme costs, especially when the data collection is performed retrospectively (study III) in comparison with prospectively (study II).

A cost item that is certainly underestimated is the resource consumption for the participants, i.e. the target group (Weinstein, 1990), particularly time used in measures to enhance health. Because of practical issues regarding data collection the only time

consumed for participants included is that used in activities organised within the programmes (studies I, II, III), which is a serious underestimate. Many economic evaluations on medical technologies however ignore participant or patient resources altogether. There are also examples of economic evaluations on public health programmes that do not include participant time, particularly restrictive for programmes that aim to increase physical activity (Hagberg & Lindholm, 2006). One reason for the omission might be the difficulties to value leisure time. One of the first economic evaluations on public health programmes (Hatziandreu et al, 1988) used a differential valuation of the time spent for physical activity depending on whether the participants disliked, liked or were neutral towards physical activity. When the valuation of time for physical activity was investigated empirically in Sweden, experienced exercisers valued the exercise time at an average of 7% of wages, whereas inexperienced exercisers valued the time at 26% of wages (Hagberg, 2007), i.e. considerably lower than the customary Swedish valuation of leisure time of 35%.

*Community participation*

One of the opportunities revealed was that the programme costs might be used to describe the fulfilment of one of the stated objectives of community-based health promotion: participation of the local community. The financing implication of the objective local community participation has previously been acknowledged by Rifkin & co-authors (1988). In her pentagram model, resource mobilisation is one of the five process indicators for successful community participation and organisation: it has even been quoted as the key indicator (Naylor et al, 2002).

If resources mobilised from the collaborators can be regarded as an indicator of local participation, the proportion of programme costs paid by project funds and local collaborators might be used as a measure of local participation (study IV). This share was 50% in the elderly safety promotion programme, which might be compared to the shares obtained in the diabetes prevention programme of 33%, 33% and 20% in the three programme municipalities (Eriksson & Johansson, 2005). The advantage of the measure, as compared to previously used measures (Weisbrod et al, 1992; Bracht et al, 1994; Tillgren et al, 1995; Fawcett et al, 2001), is that it measures the intensity of the collaborator work. A disadvantage is that the definition of community contribution, and thus community participation and collaborators, is affected by institutional arrangements that differ between nations.

*Financial incentives*

Another opportunity stemming from the societal perspective concerns analyses as to which sectors of society can draw financial gains from public health programmes. An implication of community-based work is that local organisations are willing to participate in the work, i.e. to dedicate their resources. If incentives are lacking for local collaborators, it might not be possible to induce them to collaborate. The effectiveness of community-based programmes would be affected and implementation even hindered, resulting in suboptimal societal resource utilisation. The end result might be that interventions that are desirable from a societal point of view are not implemented at all, or if they are, in an inefficient way because the most capable organisations are not taking part in the work. It might thus not matter that programmes are deemed cost-effective for society as a whole if incentives for pivotal organisations to participate are lacking.

The financial incentives for the collaborating local organisations were described in a subsector financial analysis (study IV). This analysis highlights those organisations having financial incentives that might induce them to commit resources. Because institutional arrangements differs between nations the incentives structures differ as well. In Sweden, after the structural changes in the 1990s when the care for the elderly and disabled were transferred from the healthcare system to the local authorities, the healthcare system is not the only organisation that might derive financial benefits if disease is avoided. A reliable subsector analysis, however, demands comprehensive cost data, which were available for only one of the studies (study II) taken from Borgström & co-authors (2006a). For the other studies, the lack of several sector costs, in particular for the coronary heart diseases that are included in the models on the metabolic syndrome (study III) and smoking cessation (study I), hinders a reliable subsector analysis. If important cost items are not reflected in the analysis, it is not appropriate to report a financial subsector analysis, as it would give a false picture.

The disadvantage of subsector financial analyses is that they might support the "budget silo mentality", i.e. that organisations only consider their own costs, disregarding costs and benefits in other sectors of society (Drummond & Jönsson, 2003). However, clear descriptions of the financial incentives might prompt discussions on measures to increase the incentives for all sectors of society to take socially desirable actions (Weinstein, 1990), such as the structural reform in Denmark. It has also been suggested that a cost-effective diabetes prevention programme, the US DPP, should be made into a "strong business case" to induce cost-sharing, in order to make private health insurers reimburse the programme before beneficiaries reach the age of 65 years and enter Medicare, as most of the benefits fall on Medicare (Ackermann et al, 2006).

A subsector financial analysis was one of the suggested methods to address the challenge termed Intersectoral costs and consequences in the methodology review (Drummond et al, 2008). A "multi-sectoral societal decision-making approach" has also been proposed (Claxton et al, 2007) that employs a similar compensation test as in cost-benefit analyses, i.e. a programme is deemed worthwhile, i.e. increases societal welfare, if the sector of society that is a net beneficiary hypothetically could compensate the sector that is a net payer. However, if the overall societal decision criterion is to maximise welfare, and not minimise costs, the approach requires that non-financial benefits of each sector are monetised and included in the calculation.

If objectives of organisations extend beyond saving costs, there might be other incentives than financial ones for collaborating organisations to participate in public health programmes (Butterfoss et al, 1993; Rosén & Jansson, 2000; Tones & Tilford, 2001, p. 476; Rosén, 2003). Ultimately, the incentives for different sectors of society are determined by the decision-making criteria for the sectors, which should reflect the objectives of each sector. For the health sector, health economists have proposed that the decision-making criterion is the maximisation of health, at times supplemented with equity in health. To my knowledge, no explicit decision-making criterion for the key collaborator in Swedish community-based public health programmes, i.e. the local authorities, or for other sectors of society has been accepted nor proposed.

### 6.2.2 Constraints: Cost-effectiveness analysis and valued outcomes from public health programmes

The constraints encountered during the work are mainly related to the economic evaluation methodology, i.e. if the methods recommended for, and mainly applied to (Neumann et al, 2005a; Carlsson et al, 2006) pharmaceuticals are appropriate for public health programmes. The economic evaluation methods, in turn, affect the methodology of the effect evaluations, i.e. how the outcomes from public health programmes should be measured to fit the economic evaluation methodology (Burrows et al, 1995). There are also a number of valued outcomes, as termed by Nutbeam (1998), from public health programmes that are difficult to capture in the cost-effectiveness methodology, which tends to underestimate the social value of the programmes. The aspect Measuring and valuing outcomes was also one of the challenging areas in the methodology review (Drummond et al, 2008).

*Social diffusion of lifestyles*

As stated above, Markov models appear suitable to estimate future effects from public health programme. However, the individual-level outcomes used in the models is a constraint (Shiell & Hawe, 1996). The models are constructed to estimate the average effects for an individual or a group of individuals, which implies the estimation of effects is derived only from the individuals directly affected. One of the "valued outcomes" from public health programmes, however, is the diffusion of lifestyles to other individuals (Rosén & Lindholm, 1992; Lindholm & Rosén, 2000). Examples relevant for the studies included here could be that spouses and friends also quit smoking and that teenagers do not start smoking when a woman quits (study I), that elderly people bring friends on walks and that these also remove falls hazards at home (study II) and that changing food habits affects the whole family and not only the adult that is responsible for the cooking (study III).

These effects, which can be called spill-over, or contamination (Donner & Klar, 2000) or externalities (Drummond et al, 2005), probably constitute a sizeable part of the effects from public health programmes. On an aggregate level, these changes in lifestyles are often termed secular trends, which should be controlled for in effect evaluations (Bauman & Koepsell, 2006; Luepker et al, 1994) (study II, III), because they are assumed spontaneous and thus should have occurred even in the absence of an implemented programme. However, these spontaneous trends might well be long-term effects from previous programmes, but will remain unaccounted for in effect and economic evaluations. In the area of infectious disease, such as HIV-AIDS, there are examples of transmission models that incorporate negative diffusion (Weinstein, 2006). Accordingly, it might well be possible to also include beneficial social diffusion of lifestyles in cost-effectiveness models.

*Non-disease valued outcomes*

The only non-monetary effects included in the studies (study I, II, III) is QALYs, which allegedly measure health-related quality-of-life (Garber, 2000). However, as used in the cost-effectiveness analyses, it measures absence of specific diseases. Consequently, the analyses do not include most components of what constitute health, defined by the WHO as "…a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (WHO, 1948). Because this concept of health is

the ultimate objective for those active in public health, this is a serious drawback of the methodology. The economic evaluations thus do not incorporate what is deemed important in the public health field. Therefore, the internal validity of the studies is questionable. Furthermore, certain parts of the WHO concept, such as mental and social wellbeing, might be the objectives for other sectors of society, such as the local authorities and the voluntary sector, which might explain why these sectors, presumably not concerned with health issues, are willing to participate in public health programmes. The development of a more general measure of wellbeing, as well as sector-specific measures, was also one of the proposed future research questions in the methodology review (Drummond et al, 2008).

Within public health, not only the long-term outcomes, e.g. health, are deemed valuable (see figure 2 from Nutbeam, 1998). The actual health promotion actions, such as health education and advocacy, and the short-term outcomes in terms of a knowledgeable population and social action are also considered valuable aspects of health promotion programmes. In the three cases reported here none of these aspects is included as benefits; on the contrary the health promotion actions are considered programme costs. If there is a societal value arising from the actions and short-term outcomes, the cost-effectiveness of the three programmes is underestimated (Rosén & Lindholm, 1992; Cohen & Hale, 2002).

At the individual level, avoiding disease is just one, albeit an important component, of overall wellbeing that might be affected by public health programmes. Wellbeing might be derived from the actual participation in the programmes, called process utility (Donaldson & Shackley, 1997; Salkeld, 1998; Salkeld et al, 2004; Drummond et al, 2005, p. 214), which might be both positive and negative. Examples from the cases could be the pleasure, or displeasure, felt by some persons during physical activity (study II, III) or coffee breaks during study courses (study II) or get-togethers (study I). In fact, this time spent by participants is included (when possible) in the programme costs, valued as leisure time forgone, in all studies (study I, II, III). This was heavily questioned in the elderly safety promotion programme (study II) with the argument that the programme arranged very sought-after activities for the elderly.

Positive as well as negative effects on wellbeing might also arise from the programmes' aim to change lifestyles. If a participant does not succeed to change his or her lifestyle, feelings of shame and worry would decrease wellbeing. Public health programmes and campaigns might also lead to social stigma, further distressing those individuals that do not succeed in leading a healthy lifestyle. On the other hand, those individuals that succeed in changing their lifestyle might experience feelings of empowerment, such as mothers that manage to quit smoking and thus create a smoke-free environment for their children (study I), or of freedom and security, such as the elderly that dare to walk outdoors because of a safer street environment and an improved balance from doing qigong (study II). Some of these sources of wellbeing are contained in the utility in anticipation concept (Cohen, 1984), but none are included in the cost-effectiveness analyses.

Nevertheless, two of the three cases (study I, II) resulted cost-saving, so the omission of other valued outcomes would not affect the overall conclusion from these economic evaluations. In the third case (study III), however, the programme might have been cost-

effective in only one of the municipalities. It is possible that the economic evaluation would have shown that the programme constituted good value for money in the other municipalities as well if more valued outcomes had been included.

The underestimated social value of public health programmes when evaluated with standard cost-effectiveness methodology might be aggravated the more complex the programmes, i.e. the more they conform to the contemporary ideal on how to implement public health programmes. The first and second generations of programmes that focussed on individual changes of lifestyles Eriksson (2000), such as the smoking cessation programme (study I), might be more amenable to the methodology used for pharmaceuticals. The methodology might be feasible on the third generation of programmes, the community-based such as the elderly safety promotion programme (study II), although the analyses require a societal perspective. The fourth generation of public health programmes, which emphasises supportive environments for health and policy changes to counteract processes that undermine the population health, as exemplified by the diabetes prevention programme (study III), appears more difficult to accommodate within the standard cost-effectiveness analysis framework. Thus, analyses would tend to seriously underestimate the social value of such programmes.

## *6.3 Implications for future research*

The appropriateness of standard cost-effectiveness methodology for public health programmes is currently under discussion in several institutions, in Sweden and elsewhere. The Swedish government has stated that: "The methodology for economic evaluations of public health measures is not sufficiently developed and needs refinement …"(Swedish government, Skr 2005/06:205 p. 210; author's translation)[5] and "In the future… it is desired that the method is implemented such that the content of the general national public health objective is captured in the performed analyses, so that the choice of measures leads to fulfilment of objectives within the policy area." (ibid)[6]. The discussions are mainly found within the social work field (Swedish National Agency for Education, Swedish National Board of Health and Welfare, Swedish National Public Health Institute, 2004; Swedish National Board of Health and Welfare, 2007; Sefton et al, 2002). There are, however, examples of economic evaluations of Swedish social work (Nilsson, 2000; Jess, 2005; Månsdotter et al, 2007a).

In the UK concerns with the inadequacy of the standard QALY measure to capture important quality-of-life effects from social work as e.g. urban replanning (Fenwick, Lorgelly, Briggs, *unpublished abstract)* as well as the non-health effects from health care interventions has led to discussions on enhancing, or exchanging, the QALYs with more comprehensive indexes as inspired by the Amartya Sen's capabilities approach (Anand & Dolan, 2005; Cookson, 2005; Grewal et al, 2006; Coast et al, 2008a; Coast et al, 2008b). This approach seeks to incorporate more factors that affect wellbeing into the cost-effectiveness methodology. Another possibility is to refrain from summarising

[5] In Swedish: "Metodiken för att genomföra ekonomiska utvärderingar av folkhälsoåtgärder är inte tillräckligt utvecklad och bör förbättras"

[6] In Swedish: "Vid en framtida utveckling ... är det önskvärt att metoden utformas så att innebörden av det övergripande nationella målet för folkhälsoarbetet fångas upp i de analyser som genomförs så att valet av åtgärder verkligen leder till måluppfyllelse inom politikområdet"

the effects into one outcome measure, but present all effects in a cost-consequences analysis, as suggested by Cohen & Hale (2002), McDaid & Needles (2006) and Drummond & co-authors (2008). This would enable decision-makers to choose and value the programme effects that they consider relevant for their objectives.

Yet another option for economic evaluations of public health programmes is the cost-benefit analysis. The analysis is used in several sectors of society as a basis for decisions on resource allocation that affects non-monetary values, such as traffic safety and environmental work, and is firmly grounded in welfare economics. The method was used for early economic evaluations on public health issues, including vaccination (Jönsson, 1975, 1976) and suicide prevention (Rutz et al, 1992). In addition, it was mentioned as a possible alternative to cost-effectiveness analyses for public health programmes by the methodology review of Drummond & co-authors (2008). Cost-benefit analyses have also been used in conjunction with cost-effectiveness analyses on the same programmes (Boyle et al, 1983; Johannesson & Fagerberg, 1992; Lindholm et al, 1994; Lindholm et al, 1996a; Zethraeus et al, 1997). Finally, a number of recent studies have used the approach to evaluate programmes aiming to affect health (van der Pol et al, 2003; Dixon & Shackley, 2003; Sönbö Kristiansen et al, 2006; Johnson et al, 2006; Hjelmgren & Anell, 2007; Borghi & Jan, 2008) or to value health aspects of environmental programmes (Alberini & Chiabai, 2007; Forslund et al, 2007; Pervin et al, 2008).

The major advantage of the method is that it seeks to incorporate the welfare aspects of programmes as perceived by the population affected. When asked about their valuation of programmes, respondents could include elements that are difficult to capture in more explicit measures, such as empowerment, feelings of security and reduced (or increased) anxiety, but which are important components of public health programmes. The major drawback is the monetary valuation of these aspects, which remains controversial and empirically challenging (Olsen & Smith, 2001; Drummond et al, 2005, p. 215, 240; Ryan & Amaya-Amaya, 2005; van Exel et al, 2006).

A limitation of this thesis is that these alternative methods were not employed in any of the cases. An economic evaluation using an alternative methodology, in combination with the cost-effectiveness analysis, would have strengthened the work so the extent of the underestimated valued outcomes could have been discussed. In particular, the diabetes prevention programme (study III) would have benefited from a more elaborate analysis in order to investigate if the conclusion regarding the not cost-effective programme areas would have changed with another methodology. However, that remains a task for future research, which ought to investigate whether, and which, alternative methods are more appropriate for public health programmes.

# 7. Conclusions

The recommended methodology for economic evaluations within health and medicine, i.e. the cost-effectiveness analysis, is feasible for public health programmes, as evidenced by the three cases included in this thesis. The analyses indicate that the smoking cessation programme was cost-saving, that the elderly safety promotion programme imposed zero societal costs, and that the diabetes prevention programme might have been cost-effective in one programme municipality. The thesis has shown that different types of public health programme can be cost-effective and that similar programmes potentially constitute a good way to use societal resources.

Both constraints and opportunities with the cost-effectiveness methodology were revealed during the work. The monetary consequences of the programmes pose no constraints; on the contrary, the societal perspective revealed opportunities to discuss financial incentives and local community participation in community-based programmes. The proportion of total programme costs paid by local collaborators might be used as a measure of local community participation, whereas financial incentives for the collaborators could be assessed in a subsector financial analysis. The constraints were instead found in the programme effects included in the economic evaluations. Several valued outcomes from public health programmes that affects societal welfare and individual wellbeing are not reflected adequately, which lead to underestimates of the societal value of successful public health programmes.

The appropriateness of cost-effectiveness analyses for public health programmes is discussed particularly in the field of social work, in Sweden and internationally. During recent years, the development of public health methods might have distanced public health work from the realm of the health sector and into that of other societal sectors. If that is the case, the decision-making criterion, which determines the incentives, for public health programmes might not be cost-effectiveness, as measured by costs per QALY, but some other criteria that reflect the objectives of each sector. Alternatively, cost-effectiveness analyses could be regarded as just one decision-making basis, that needs to be complemented by other decision-making bases using other criteria to determine whether public health programmes should be a priority among the competing uses of societal resources.

There are alternative methods for economic evaluations which might better reflect the societal value of public health programmes. Alternatives mentioned either remain in the cost-effectiveness framework but seek to include factors important for wellbeing beyond health into a QALY-like measure, or seek to measure wellbeing directly from the population groups affected via monetary willingness-to-pay, in a cost-benefit framework. It remains an important task for future research to investigate whether, and which, alternative methods are more appropriate for public health programmes.

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