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Population health measures to support evidence-based health policy in Estonia

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To my family and friends
who have been so patient and supportive over the years.

CONTENTS

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on following original publications referred to in the text by their Roman numerals:

I Lai T, Habicht J, Kiivet RA (2009). Measuring burden of disease in Estonia to support public health policy. *Eur J Public Health,* 19(5):541–547.

II Lai T, Habicht J. Lives saved in Estonia: reduction of amenable mortality from 2000 to 2009. (Submitted for publication in *Health Policy Plan*)

III Lai T, Habicht J, Reinap M, Chisholm D, Baltussen R (2007). Costs, health effects and cost-effectiveness of alcohol and tobacco control strategies in Estonia. *Health Policy,* 84(1):75–88.

IV Lai T, Habicht J (2011). Decline in alcohol consumption in Estonia: combined effects of strengthened alcohol policy and economic downturn. *Alcohol Alcohol*, 46(2):200–203.

Contribution of Taavi Lai to the original publications:

Papers I, II, III, IV: design of the study, preparation of datasets, data analysis, interpretation of results, coordinating contributions by other authors, writing the final paper.

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ABBREVIATIONS

CBA	cost-benefit analysis
CEA	cost-effectiveness analysis
CUA	cost-utility analysis
DALY	disability adjusted life year
EC	European Commission
EHIF	Estonian Health Insurance Fund
EU	European Union
EU-15	the 15-nation European Union before the enlargement in May 2004
GBD	Global Burden of Disease
GDP	gross domestic product
ICD-10	International Classification of Diseases, 10th revision
OECD	Organisation for Economic Cooperation and Development
QALY	quality adjusted life year
SRD	standradised mortality rate difference
WHO	World Health Organization
WHO-HFA	HFA health statistics database of WHO-Europe
YLD	years lived with disability
YLL	years of life lost

INTRODUCTION

All health systems aim to provide the best possible health outcomes for individuals and population as a whole (WHO, 2000; Roberts et al., 2008). While additional goals have been proposed for health systems, health outcome remains the primary target. Our understanding of concepts like health, population health and health system has developed and broadened remarkably during last sixty years (Evans and Stoddart, 1990). The definition of the health system now includes health care, health promotion, prevention, all the services and resources but also policies and wider contexts that help to improve health (WHO Regional Office for Europe 2008). These developments have brought our understanding of health systems closer to the original 1948 World Health Organization (WHO) definition, which states that "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948).

However, health systems vary in their performance and in how much impact they have on health improvement. This challenges health systems to constant development, which is most effective if based on evidence-based decisions (Frenk et al., 2003). Information needs change with policy development: initial stages require descriptive information of health status, while information on causes of and solutions to identified health problems are needed later (Roberts et al., 2008).

Measuring the health outcomes of a population, their levels and distribution over sex, age, region and other categories is a starting point to ensure continuous improvement of health system performance. Such descriptive information also provides information on best and worst-performing areas so that interventions could be targeted for greatest impact on population health (Morrato et al., 2007).

There are a great many population health measures that could be used to inform health policy. The classical approach is to measure mortality or morbidity, but with the increase of life expectancies and growing importance of quality of life, new population health measures have emerged (Etches et al., 2006). Summary measures of population health combine mortality, morbidity, quality of life and often also our vision of ideal health status into one measure (Murray et al., 2002). Summary measures of population health include examples like quality adjusted life years (QALYs), disability adjusted life years (DALYs), health-adjusted life expectancy (HALE) and many others (Gold et al., 2002).

The selection of priority areas for action calls for knowledge on how much health could be gained in any particular one. One of the measures that helps to pin down such disease areas is amenable mortality, a measure of the number of unnecessary and untimely deaths that could be avoided with perfectly performing health care (Nolte and McKee, 2003). Likewise, it is crucial to know which interventions are the most effective and cost-effective for reducing health

losses in a population. This is especially important as health systems function in a constant situation of resource scarcity and maximum health returns are to be sought from every resource allocation (Drummond et al., 2007).

The Estonian health system has been reformed extensively since the re-establishment of independence in 1991, and the health of the Estonian population has improved considerably as well (Koppel et al., 2008). Reforms of the Estonian health system have included continuous development of health information systems to provide a strategic opportunity for routine and extensive use of summary and other measures of population health in support of health policy during every step of policy development.

Current study provides overview of health of Estonian population using the measures of population health and amenable mortality. Moreover, current study provides information on cost-effectiveness of interventions against hazardous alcohol consumption which is one of the most important behavioural health risks in Estonia and reviews changes of national alcohol policy since 2005. All the above is presented in a manner that easily lends itself for use by policy makers and thus supports evidence based health policy in Estonia.

REVIEW OF THE LITERATURE

1. Health, the health system and population health

Health and the health system

The classical definition of health is provided in the Preamble to the WHO Constitution of 1948: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). The WHO Constitution adds that the highest standard of health – physical, mental, and social – is a fundamental right of all people (WHO, 2006). This definition of health is the most comprehensive and most popular definition worldwide (Larson, 1999), while other definitions have been proposed as well (Kindig, 2007). In accord with the holistic nature of the definition, medicine has treated individuals as social beings whose health is affected by social behaviour and interactions, while the social health of a society also refers to the distribution of economic wealth and to other socioeconomic factors (Larson, 1999). Adoption of definition drew attention to the social determinants of health and invited nations to expand the conceptual framework of their health systems beyond the traditional boundaries set by the physical condition of individuals and their diseases (Jadad and O'Grady, 2008).

Additionally, WHO's 1986 Ottawa Charter For Health Promotion stated that to reach a state of complete physical, mental and social well-being, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living.

Health systems are thus designed for achieving the highest possible levels of health and their conceptual frameworks have health as their ultimate goal, regardless of other differences (WHO, 2000; Atun et al., 2006; Roberts et al., 2008; de Savigny and Adam, 2009). Currently, 53 members of WHO European Region have adopted the Tallinn Charter, Health Systems for Health and Wealth, where health system is defined as:

The ensemble of all public and private organizations, institutions and resources mandated to improve, maintain or restore health. Health systems encompass both personal and population services, as well as activities to influence the policies and actions of other sectors to address the social, environmental and economic determinants of health. (WHO Regional Office for Europe 2008)

Other universal goals of health systems include provision of protection against financial risks of ill health and patient satisfaction, which come under the social and mental health aspects of the definition (WHO, 2000; Atun et al., 2006; Roberts et al., 2008). While the WHO definition of health does not state the subject of health, other definitions mentioned above indicate that it can be an individual, population group or population as a whole. Moreover, the

definition of a health system specifies that both individuals and populations should benefit from improved health through action on different levels of a health system.

Population health

The term "population health" was originally used to mean the health of a population, but since the early 1990s, this literal meaning has taken on the connotation of a "conceptual framework for thinking about why some populations are healthier than others as well as the policy development, research agenda, and resource allocation that flow from this framework" (Young, 2005). The beginning of a divergence of population health as a separate field from individual and prevention-focused public health can be placed in post-World War II era or even in 18th century, but arguably the resurgence in the 1990s was provoked by dissatisfaction with limitations of individual-based methodological approaches (Szreter, 2003).

Probably one of the most influential papers instigating the change in the 1990s was one by Evans and colleagues (Evans et al., 1994) which does not give a concise definition of population health but states the underlying concept as "the common focus on trying to understand the determinants of health of populations". Based on these developments, Kindig and Stoddart (2003) propose three general approaches, according to which population health is: a) only concerned with independent variables (determinants of health), b) only concerned with dependent variables (health outcomes), or c) concerned with both the definition and measurement of health outcomes and the role of determinants. While they state that conceptually all three approaches are valid, they favour the last as being more in line with the overall health definition and enabling consideration of health inequalities, distribution over population groups, interactions among health outcomes and determinants, since a health system is a multilevel, multifaceted system. Based on this, Kindig and Stoddart (2003) conceptualise population health as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group". These population groups can be defined by geopolitical regions, gender, age group or any other characteristics, while a variety of health outcome measures should be used as appropriate to the specific question at hand. The population health measures should be focused on outcomes (as opposed to inputs, processes and products) and should span from simple to complex and from health status to cost-effectiveness. Such variation is especially important as improvement in population health requires the attention and action of multiple actors (e.g. legislators, managers, providers and individuals) who all need different information during the planning and implementation of policy actions.

2. Evidence-based health policy

2.1. Development of health policy and population health outcome measures

Development of health policy

Even though health improvement is the main target of health systems, their performance varies widely with respect to how much impact they have on health improvement and areas for development can be identified (WHO, 2000; Westert et al., 2010; WHO Regional Office for Europe, 2010). Some of the challenges for health systems arise from the current arrangement, while many are caused by population changes (e.g. aging and increase of chronic diseases) (Vogeli et al., 2007; Doyle et al., 2009; Magnusson, 2010) or developments in medical technology (e.g. advances in personalised medicine and e-health) (Glaser et al., 2008; Downing, 2009). These challenges and the need for performance improvement call for changes to health systems that in theory should all be evidence-based (Murray and Frenk, 2001; Frenk et al., 2003; Balabanova et al., 2010). Use of the best available evidence to achieve transparency and clear justification of policy decisions has been increasingly emphasised (Dobrow et al., 2004) and evidence-based approaches have become prominent in national and international health policy agendas (Niessen et al., 2000). Brownson et al. (2009), propose a working definition of evidence-based health policy as: "developed through a continuous process that uses the best available quantitative and qualitative evidence". While WHO defines health policy as "an agreement or consensus on the health issues, goals and objectives to be addressed, the priorities among those objectives and the main directions for achieving them" (WHO-Europe, 1999), policy development needs to be specific as only then can actions address identified problems (Collins, 2005).

Many authors suggest that ideally, there would be a policy development cycle of formulation, implementation and assessment, even though the level of detail and thus the exact number of steps in the cycle varies (Niessen et al., 2000; Collins, 2005; Roberts et al., 2008). According to Roberts et al. (2008), a policy decision should include six main steps: problem definition, diagnosis of underlying causes, policy development, political decision, implementation of policy change and evaluation of the impact of policy change (Figure 1). All the steps in the policy cycle call for information on the health status of the population. Problem definition is informed by population health outcome measures, while diagnosis of the problem calls for a combination of population health outcome measures with information on health system processes, risk factors and the social determinants of health. Policy development, on the other hand, uses ex-ante evaluation of changes in population health that could be expected to be caused by the policy choices at hand. The health effects of all possible policy actions are often assessed in connection to the resources needed to implementation them. Evaluation of policy changes after implementation

requires appropriate population health measurement mechanisms (Morrato et al., 2007).

Brownson et al. (2009) add that data used in the policy cycle needs to be in a form that: a) shows public health burden, b) demonstrates priority of an issue over many others, c) shows relevance at the local level, d) shows the benefits of an intervention, e) personalises an issue by telling a compelling story of how peoples' lives are affected, and f) estimates the cost of the intervention. Moreover, the data should be usable for quick dissemination, based on existing tools and sources while coming from variety of routine surveillance sources.

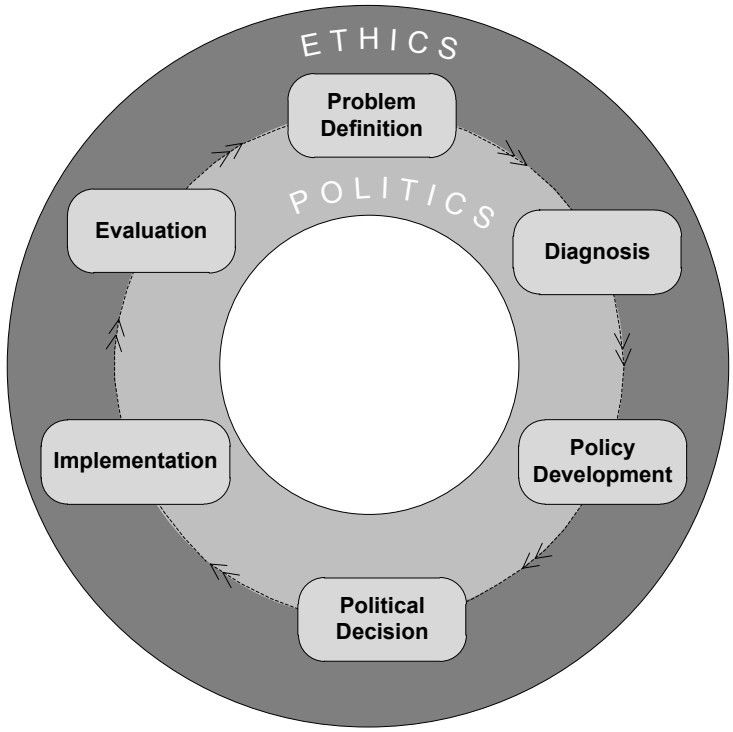


Figure 1. The policy cycle

Source: Roberts et al., 2008

Classifications of population health outcome measures

The number of possible population health outcome measures is almost infinite but an ideal measure should reflect a population's dynamic state of physical, mental and social well-being (Parrish, 2010). However, there seems to be no uniform classification of population health outcome measures, especially if one wants such classification to cover all aspects of population health as defined by Kindig and Stoddart (McDowell et al., 2004). The simplest classification of population health measures divides them into those that measure both direct

(morbidity, mortality, use of services) and indirect (social development, education and poverty indicators) health phenomena. These two categories are also referred to as proximal and distal indicators, respectively (Larson and Mercer, 2004).

Based on the level of aggregation and type of data, Morgenstern (1995) distinguishes between aggregate, environmental and global population health measures. Aggregate measures combine data from individuals, summarising variables of interest to produce measures like rates of disease or mortality. Environmental measures cover factors external to the individual like exposure levels of environmental factors or other health risks. Global indicators, on the other hand, measure contextual variables like policies and similar factors that do not have individual-level analogues.

Parrish (2010) argues that there are three possible approaches to measuring population health outcomes: a) aggregating health outcome measurements made on people into summary statistics, such as population averages or medians, b) assessing the distribution of individual health outcome measures in a population and among specific population groups and c) measuring the function and well-being of the population or society itself, as opposed to individual members. This approach is very similar to the one proposed by Morgenstern, but instead of stemming from studies of environmental health, it is fully rooted in the population health context, as defined earlier. Parrish continues to define three types of basic underlying outcome metrics for population health: a) measures of mortality, life expectancy and premature death, b) measures of health, function and subjective well-being, and c) summary measures of population health.

McDowell et al. (2004), propose a classification of population health measures based on their area of use, as descriptive, predictive, explanatory and evaluative. Descriptive measures are used to give overview of the current health of the population, for example mortality and morbidity. The predictive measures are used to anticipate future health status and are essentially extensions of descriptive measures. The explanatory measures are descriptive in nature as well but comprise a more detailed investigation with additional explanatory variables are included for stratification of population-level data, for example social determinants of health such as income inequalities, social cohesion, geographical location or even sex and age. Evaluative measures also describe health status of a population, but they record outcomes of interventions and monitor the impact of programmes and policies at the societal level. It is also worth noting that even though the starting point for the classification by McDowell et al. is the definition of population health, they propose roughly the same types of population health outcome measures as Roberts et al. (2008) and Morrato et al. (2007).

Following from above, there seem to be two main strands for classifying population health measures, namely those based on the source and type of data, and those based on the intended use of the data. Regardless of the classification, use of health indicators should contribute to overall population health improve-

ment by supporting health advocacy, accountability, system management, quality improvement and research (Etches et al., 2006). With respect to the overall improvement of population health, the framework for selection of health indicators should help to point to the significant dimensions of population health and lead to more balanced discussions about targets for interventions in order to achieve best possible impact on population health (Etches et al., 2006).

2.2. Summary measures of population health

Evolution of summary measures of population health

Description and exploration of population health are the first steps in identifying the population health concerns that call for priority intervention. Historically, the first indicators used in this task were crude mortality reports which in the Nineteenth Century were developed into mortality rates and life expectancies. Later improvements included calculation of age-standardised mortality rates, while since the beginning of the Twentieth Century prevalence of diseases and data on health service use were included in routine monitoring of population health. Prevalence of risk behaviours, quality of life, health expectancies and health gap measures came into use after 1950. Since 1990 summary measures of population health that combine different qualitative and quantitative indicators have become widely used worldwide (Etches et al., 2006). These developments have resulted at least partly from declining death rates and lengthening lifespans leading to emphasis on prevention of disability, improved functioning and relieving pain and physical and emotional distress. Thus, policymakers have needed additional population health measures to help them make decisions and establish priorities to improve population health as mortality measures provide incomplete and insensitive information for decision-making (Field and Gold, 1998; van der Maas, 2003). Field and Gold define a summary measure of population health as a measure that "combines both mortality and morbidity data to represent overall population health in a single number" and give health-adjusted life year and health-adjusted life expectancy as examples (Field and Gold, 1998).

Efforts to develop summary measures of population health have a long history and a wide range of summary measures have been proposed (Sanders, 1964; Sullivan, 1971; Goldsmith, 1972; Chiang, 1976; Murray et al., 2002; Kaltenthaler et al., 2004). According to Murray et al., these can be divided into two broad categories: health expectancies and health gaps (Murray et al., 2000b). In essence, health expectancies are life expectancies where years lived in less than full health are taken into account using lower weights corresponding to the severity of the health state. Examples of health expectancy measures include active life expectancy (ALE) (Katz et al., 1983), disability-free life expectancy (DFLE) (Crimmins et al., 2009), disability-adjusted life expectancy (DALE)

(Murray and Lopez, 1997a), years of healthy life (YHL) (Diehr et al., 1998), quality-adjusted life expectancy (QALE) (Lubetkin and Jia, 2009) and others.

In contrast to a health expectancy, the health gap quantifies the difference between the actual health of a population and a given population health norm or goal (Murray et al., 2002). The implied norm or goal is for all members of a population to live in ideal health throughout their lives, which would be optimally long. The latter can be based either on some type of measured life expectancy or an arbitrarily set ideal goal. Summary measures of population health using the health gap approach thus extend the approach of years of life lost from premature mortality (mortality gap) to health and account for health gaps caused by time lived in states less than ideal (Murray et al., 2002). The two main types of health gap type measures are QALYs and DALYs (Gold et al., 2002). The original purpose for creating QALYs in late 1960s was for use in cost-effectiveness analysis by economists. DALYs were developed in the early 1990s to quantify the burden of disease and disability in populations and to set priorities for resource allocation (Gold et al., 2002).

The 1993 World Development Report, published by the World Bank in collaboration with WHO, presented the first results of DALYs in an attempt to quantify the global burden of premature mortality and morbidity to make recommendations for health improvement, particularly in developing nations. This initial study was followed by the Global Burden of Disease (GBD) study that had three major objectives: a) to facilitate the inclusion of non-fatal health outcomes in debates on international health policy, b) to decouple epidemiological assessment from advocacy and c) to quantify burden of disease using a measure that could be used for cost-effectiveness analysis (Murray and Lopez, 1994, 1996).

Thus, while the concept of conventional QALYs is grounded specifically in decision science (Weinstein et al., 2009) the design goals of DALYs were wider (Murray and Acharya, 1997). However, both measures still assume that health or health improvement can be measured or valued based on amounts of time spent in various health states, whether in terms of quality or disability. Thus, QALYs' weighting results in the benefit to be maximised and DALYs' weighting results in life years that need to be averted to reach ideal health (Murray and Acharya, 1997; Weinstein et al., 2009).

Disability adjusted life years

Since the GBD study, the DALY methodology has been widely used to assess disease burden and health trends as well as to set priorities for health-related research and policies throughout the world (Bradshaw and Schneider, 1998; Mooney and Wiseman, 2000; Kapiriri et al., 2003; Mathers and Loncar, 2006; Michaud et al., 2006; Jankovic et al., 2007;). Currently, there is also an ongoing effort to update the global comparative estimates of burden of disease (Murray et al., 2007).

The GBD study provided summary of global burden of disease estimates for all regions and countries of the world from a viewpoint of global average (Murray and Lopez, 1996). The problems of detailed data availability, large reliance on estimation to fill data gaps and hence complicated calculation procedures can hamper the use of standard burden of disease methodology on a country level (Morrow and Bryant, 1995; Melse et al., 2000). All this can limit the use of burden of disease estimates because even though the international data comparisons provide ample basis for policy discussion, policy-makers often require assurance that these estimates are applicable to the local situation. This is especially important as countries vary enormously in geography, politics, economics, culture and the organisation of their health systems. Hence, health policy in all countries mirrors local political, economic and social pressures, as well as national values and priorities (Collins, 2005).

Taking country specifics into account is a viable option for making local adoption of the burden estimates more desirable (Mathers et al., 2001). Ideally, contextualised results take into account both local mortality and morbidity profiles (e.g. by using a localised burden of disease classification) and use local disability weights that convey disease severity assessments specific to the particular population. Use of population-based routine data is also one of the factors improving uptake of results for policy decisions as in many circumstances policy-makers do not have the time for specialised surveys (Morrato et al., 2007), while the context of decision-making may be at least as important as level of evidence itself (Dobrow et al., 2004).

2.3. Avoidable mortality and potential for health improvement

Development of the avoidable mortality approach

The previous section described how changing needs led to the development of summary measures of population health. The same factors have led to continuous development of mortality-based population health measures as well. Since Dempsey (1947) published a paper in 1947 conceptualising mortality gap measures and the method of potential years of life lost (PYLL) which has been extensively used as a population health indicator (Murray et al., 2000b) and to establishing public health priorities (Lalonde, 1974; Perloff et al., 1984; Doessel et al., 2009). Also, as indicated before, health gap based summary measures of population health used this approach and extended it to include health valuations. Thus, the mortality gap forms an integral part of all summary measures of population health of the health gap variety (Murray et al., 2002).

Mortality gap approaches assume that some deaths are premature. Although many authors have emphasised the importance of the concept of premature mortality, the consensus on the best threshold is still elusive. Most commonly, deaths before age 65 are considered premature, while other thresholds might be

considered for specific populations or population groups with specific diseases (e.g. AIDS) (Centers for Disease Control and Prevention, 1986; Wise et al., 1988).

Rutstein et al. (1976), developed the concept of premature mortality further and introduced a concept of avoidable mortality, a subset of premature mortality. According to this, avoidable deaths are "unnecessary and untimely" deaths that health system interventions could avoid. Rutstein also suggested that avoidable mortality could be used to measure quality of health care, since excess of avoidable deaths indicates shortcomings in the system that warrant further investigation. On the other hand, categorisation of deaths into avoidable and unavoidable is not meant to imply that every death in the first group could in fact been avoided but, that the potential exists (Tobias and Jackson, 2001). Three factors must be present to include premature deaths from a specific condition into a measurement of avoidable mortality: an identifiable disease, a known effective intervention and a system to deliver the intervention (Piers et al., 2007).

Thus, last 25 years have brought a variety of specific solutions for measuring avoidable mortality in different locations and in other largely varying contexts (Westerling et al., 1996; Westerling and Rosen, 2002; Andreev et al., 2003; Logminiene et al., 2004; Newey et al., 2004; Korda and Butler, 2006; Weisz et al., 2008). The specific approaches developed differ in health system definitions and scope, lists of avoidable causes of death and age limits after which deaths from any cause cannot be considered avoidable (Nolte and McKee, 2004). All these choices are to some extent arbitrary, as on one hand death from any cause is a final event in a longer causal chain and on the other hand what is considered avoidable changes across time, populations and health care systems (Nolte and McKee, 2003).

One of the more recent and prominent approaches of avoidable mortality is provided by Nolte and McKee (2003, 2008), who distinguish amenable and preventable mortality, a distinction first proposed by Albert et al. (1996). Amenable mortality is avoidable through health care action, while preventable mortality is avoidable by public health action and intersectoral policies. Understandably, linking specific causes of death to public health action or intersectortal policy is difficult and further methodological development is called for in this area. For this reason, amenable mortality or avoidable mortality as originally proposed by Rutstein et al. (1976), is a more commonly used measure. Moreover, amenable mortality is often proposed as a measure for specifically assessing the effectiveness and quality of health care (Kamarudeen 2010).

Avoidable mortality, performance of health care and potential for health improvement

Several studies have shown that mortality from avoidable causes of death decreased faster than total mortality (Simonato et al., 1998; Niti and Ng, 2001;

Treurniet et al., 2004), which is considered evidence that avoidable mortality is an indicator of health care effectiveness (Mackenbach et al., 1990). Page et al. (2006) point out about avoidable mortality in Australia and New Zealand that decreases in mortality from avoidable causes are unlikely to simply be the result of a general decrease in mortality rates and medical interventions are likely to have contributed positively to reductions in avoidable mortality, as are public health initiatives, though perhaps to a lesser extent.

For many avoidable causes of death, mortality has also been shown to decline faster after the introduction of new technologies such as primary care programmes for hypertension management and cervical cancer screening (McKee, 1999; Westerling, 2001).

Another often used approach to assessing health care effectiveness using avoidable mortality is to calculate the proportion of avoidable mortality out of total mortality (Logminiene et al., 2004; Chau et al., 2010). A step further is to calculate the ratio of the difference in amenable mortality to the difference in all-cause mortality over the observation period. According to such calculation, health care in New Zealand contributed approximately one third to the improvement in the population health status between 1981 and 2004 (Tobias and Yeh, 2009). However, others point out that amenable mortality should not be mistaken as definitive evidence of health care effectiveness but rather as an indicator of the potential weaknesses for in-depth investigation (Rutstein et al., 1976; Nolte and McKee, 2008).

As avoidable mortality has been constructed to measure the theoretical scope for further population health gain (Tobias and Jackson, 2001), it is only natural to use the number of avoidable deaths to calculate potential gains in life expectancy (Malcolm, 1994; Benavides et al., 1992). Interestingly, amenable mortality did on average account for about one third of the life expectancy difference between eastern and western Europe in 1990 (Velkova et al., 1997). Similarly, education-related inequalities in avoidable mortality in Europe in 2000 were highest in the Baltic countries and eastern Europe in general while avoidable mortality contributed 11–24% of the life expectancy differences between the highest and lowest educated population groups in the European countries (Stirbu et al., 2010). Gains in life expectancy from reduced avoidable mortality can be further broken into separate causes of death, age groups or any other stratification variable (Nusselder and Looman, 2004; Lin and Johnson, 2006; Wang and Li, 2009).

Avoidable mortality as a measure is easily available, inexpensive and quick to use (Gaizauskiene and Gurevicius, 1995). These features make it especially appealing to health planners who need to know how much health loss can be avoided and at what cost (Stevens and Mathers, 2010; Tobias and Yeh, 2009).

Finally, Tobias and Jackson suggest that avoidable mortality should be used as a tool for identification of areas of population health in a two-stage process where the second stage is a cost-effectiveness analysis of interventions for achieving identified health gains (Tobias and Jackson, 2001).

2.4. Intervention selection and cost-effectiveness analysis

Economic evaluation for health policy

Improving the health of a population was once thought to be a relatively simple matter: increase health services, build more hospitals, train more doctors, and so on (Young, 2005). However, health systems face the common problem of insufficient resources, while decisions about what services to provide, to whom, where and when, usually have resource implications (Brazier et al., 2007). In 1978, the WHO Alma-Ata Declaration stated that health care services should be made available "at a cost that the community and country can afford to maintain" (WHO, 1978). This is a direct call for economic evaluation of health interventions, because improvement of population health has to be achieved in an economically viable manner. Thus, economic evaluation can be defined as "comparative analysis of alternative courses of action in terms of both their costs and consequences". The overall aim of economic evaluation is thus facilitate efficient and equitable decisions by comparing the costs and benefits of health interventions (Brazier et al., 2007; Drummond et al., 2007).

The main methods of economic evaluation are cost-effectiveness analysis (CEA), cost-benefit analysis (CBA) and cost-utility analysis (CUA) (Brazier et al., 2007; Young, 2005). CBA compares costs to health consequences that are converted into economic benefits or units of currency that can be directly compared to units of cost. CEA compares cost to health effects in units of mortality, morbidity, or some form of summary measure of population health. CUA measures health consequences in terms of health utility (preference or desirability of a specific outcome) (Young, 2005; Drummond et al., 2007). The primary use of CBA is in situations requiring comparison of interventions from different sectors or with very disparate health outcomes or allocations among sectors. CEA and CUA, on the other hand, are best used in situations requiring identification of the best way to achieve outcomes for which resources have already been committed (Brazier et al., 2007).

While Drummond et al. distinguish between CEA and CUA, many authors do not (particularly in the United States) and the latter is often classified as a subtype of the former (Gold et al., 1996; Macones et al., 1999; Brazier et al., 2007; Drummond et al., 2007). The distinction in the case of Drummond et al. lies in whether or not the loss of life years averted by the intervention is weighted using quality of life, disability or other similar values (utilities). The most common summary measure of population health used in CEA (CUA) is the QALY, as such studies date back to the 1970s in North America (Torrance et al., 1972; Weinstein and Stason, 1977) and 1980s in the United Kingdom (Williams, 1985). As described earlier, QALYs were specifically designed for use in economic evaluations with the basic construct that decision-makers seek to maximise health across the population in a situation of resource constraints (Weinstein et al., 2009). QALYs and other summary measures of population health that use utilities have been proposed for economic evaluation of health

interventions (Mehrez and Gafni, 1993; Fox-Rushby and Hanson, 2001) because of three main advantages over classical "natural" health outcome measures: First, interventions with more than one kind of health outcome can be compared since the preference-based measure will reduce the multidimensional change in health to a single number. Second, interventions for the same condition with different outcomes can be compared against each other. Third, interventions for different kinds of health outcomes can be compared (Brazier et al., 2007).

Economic evaluations have been performed extensively to inform health policy decisions – more in health care than in public health – but even in countries like the United Kingdom and the United States, this tool has not been used to its full potential (Banta and de Wit, 2008; Buxton, 2006; Grosse et al., 2007). The situation is even more problematic in developing countries and central and eastern Europe (particularly the Baltic countries), where transfer of research findings from other settings could be a viable strategy for informing health policy decisions. Thus, more research, development of research methodology and resource centres and improved transfer of research findings into policy process are called for (Buxton, 2006; Williams et al., 2008).

Transferability of economic evidence

Issues relating to the lack of generalisability and transferability of economic data have been widely discussed by health economists (Drummond et al., 1992, 2009; O'Brien, 1997; Goeree et al., 2007). Generalisability can be defined as "the degree to which the results of an observation hold true in other settings". Results of a study are thus transferable if their applicability to another setting can be assessed and the results can be applied in that setting (Spath et al., 1999). Drummond and McGuire (2001) list five main areas of input data that are crucial for the transferability of results of economic evaluations over populations and jurisdictions:

- basic demography and epidemiology of disease
- availability of health care resources and variations in clinical practice
- incentives to health care professionals and institutions
- relative prices or costs
- population values.

For example, disease screening programmes are likely to be more cost-effective in a country with high incidence of the disease in question, while high relative price, low value placed on the condition and similar factors may still render the intervention cost-ineffective in that particular context. These questions of transferability of the results of specific studies have resulted in several assessment frameworks and checklists (Welte et al., 2004; Boulenger et al., 2005) while one of the main strategies for improving transferability is economic

modelling based on a combination of information from meta-analyses and multinational and local studies (Drummond and McGuire, 2001).

In addition to limited transferability of results of economic evaluations Hutubessy et al. (2003), also mention methodological inconsistencies, unavailability of data and limited technical capacity as causes of low uptake of the results by decision-makers. As a part of a solution to this, Baltussen et al. (2005) call for more systematic use of CEA, arguing that there is a need for national cost-effectiveness compendia where all interventions are evaluated jointly in a single exercise to avoid methodological inconsistencies and neglect of interventions between diseases and/or interventions. A similarly comprehensive approach was proposed by Weintein and Stason (1977), and later called sectoral CEA; it forms a partial starting point for Baltussen et al. (2005).

Currently, examples of large-intervention compendia like those suggested by Baltussen and others (Weinstein and Stason, 1977; Baltussen et al., 2005) are presented in the World Bank Health Sector Priorities Review (Jamison et al., 2006) and the WHO CHOICE (Choosing Interventions that are Cost Effective) project (WHO 2011b). The latter aims to provide information on costs, health effects and cost-effectiveness for a large set of interventions for different disease areas in epidemiologically different sub-regions of the world in a comprehensive, sound and transferable manner (Murray et al., 2000a; Evans et al., 2005). Additionally, guidance and tools are provided to contextualise results on the country level for improved transferability, which is especially beneficial for countries with low capacity to perform country-specific economic evaluations (Hutubessy et al., 2002; Tan Torres-Edejer et al., 2003; WHO, 2011b).

Although the role of evidence-based health policy has been increasing, decisions are still made in the context of incomplete empirical evidence of intervention effectiveness (Anderson et al., 2005) especially as decision-makers take multiple criteria into account simultaneously (Baltussen and Niessen, 2006; Goddard et al., 2006), including wider ethical, political, institutional and environmental factors that should be understood and researched using tools from multi-criteria decision analysis, political economy, etc. in the interest of more effective policy development (Peacock et al., 2009; Baltussen et al., 2010).

3. The Estonian context

3.1. The country context in general

Estonia has been a member of the European Union (EU) and Organisation for Economic Cooperation and Development (OECD) since 2004 and 2010, respectively. Along with other Baltic countries it shares a post-Soviet background and in 1994 saw the worst mortality peak of the last 20 years in all of Europe (WHO-Europe, 2011). Since regaining independence in 1991, the Estonian

political environment has been stable and economic development rapid. The latter is illustrated among other things by 8% average increase of GDP per capita in real terms from 1996–2006 (Statistics Estonia, 2011c). However, in 2008 the Estonian economy saw a 14% reduction in real terms (Bank of Estonia, 2010) accompanied by an increase of unemployment to 13.8% (Statistics Estonia, 2010a). Estimates from mid-2010 predicted a return of economic growth (2%) in 2010 (Ministry of Finance, 2010).

While the best known reforms since 1991 have been economic in nature, some of the most systematic, extensive and rapid ones took place in the health system. Some examples of health system reforms include the introduction of mandatory social health insurance, modern primary health care and a fully restructured hospital network, as various programmes were launched in public health as well. All the above-mentioned reforms have had a strong focus on increased effectiveness throughout the health system and a drive toward evidence-based decision-making. Hence, all these changes in the health system were made hand-in-hand with the generation of electronic patient registries and databases containing information on every health, welfare and mortality event in the country (Atun et al., 2006; Habicht et al., 2006; Bankauskaite and O'Connor, 2008; Habicht and Habicht, 2008; Koppel et al., 2008; O'Connor and Bankauskaite, 2008). Moreover, health system development has continued until now through gradual reforms after the first extensive changes (Habicht and van Ginneken, 2010).

Administratively, Estonia has two functioning levels, national and municipal. The national level also includes 15 counties that implement national policies in the regions. There are more than 200 municipalities on the second level with large size variations. Health policy issues are mostly covered at the national level while municipalities have only a limited role in public health policy through local Health In All Policies action and implementation of selected national public health programmes.

3.2. Population health and main health risks

Population health research

In Estonia there is a wealth of information on mortality and life expectancy of the population (Leinsalu and Rahu, 1993; Leinsalu, 1995; Podar et al., 1996; Innos and Rahu, 2000; Kaasik et al., 2007), on morbidity (Kalits and Podar, 1990; Taba and Asser, 2002; Õun et al., 2003; Uusküla et al., 2008;Vendt et al., 2007) and to lesser extent on health-related quality of life (Lai et al., 2001; Krikmann et al., 2008; Rüütel et al., 2009; Braschinsky et al., 2010). While some information on avoidable mortality in Estonia is available from international overviews (Jozan and Prhokhorskas, 1997; Velkova et al., 1997; Newey et al., 2004; Stirbu et al., 2010), summary measures of health and especially health gap measures have been almost completely absent (Lai et al., 2003, 2004).

Population health in general

Population health in Estonia has improved fast – life expectancy increased from 66.5 years in 1994 to 75.0 in 2009 (Statistics Estonia, 2010b). The increase in average life expectancy during the past decade has reduced the gap but it is still below EU (79.4 in 2008) and OECD (79.2 in 2008) averages (OECD, 2010; WHO-Europe, 2011). While the life-expectancy increase in Estonia has been remarkable, health inequalities and (alcohol-related) premature mortality have been of major concern(McKee and Shkolnikov, 2001; Kunst et al., 2002; Leinsalu et al., 2003; Habicht and Kunst, 2005; Koupil et al., 2007; Paasma et al., 2007, 2009; Habicht et al., 2009; Rahu et al., 2009; Pärna et al., 2010; WHO-Europe, 2010).

By 2009, the proportion of premature deaths (before age 65) in all deaths had declined to 26%, from 33% in 2000. However, men still accounted for 72% of the premature deaths in 2009, which largely explains sex differences in life expectancy (Statistics Estonia, 2011a). The main causes of death in Estonia are cardiovascular diseases, cancers and external causes (injuries and poisonings), which were respectively responsible for 55%, 22% and 8% of deaths in 2009 (Statistics Estonia, 2011b). Out of these three, cardiovascular diseases and external causes are the main causes of premature mortality in Estonia, but they are also behind 69% of the life expectancy increase from 2000 to 2008 (WHO-Europe, 2010).

Recently Estonia adopted the National Health Plan 2009–2020 which targets 80-year life expectancy at birth by 2020 (75 for men and 84 for women), through focus on social determinants, population health behaviour and improved service provision in both public health and health care (Ministry of Social Affairs, 2008a).

Health system performance and behavioural health risks

Recent assessment of Estonian health system performance identified health protection and health care as the best performing parts, with a high level of immunisation, high population satisfaction with the quality of health care services and low infant mortality provided as indicators. However, overall performance was assessed as moderate, indicated by the low life expectancy ranking compared to the EU levels, and especially because of large inequalities of life expectancy. The lowest assessment was reserved for health prevention, with data on obesity, physical activity, smoking and especially alcohol consumption indicating low performance (WHO-Europe, 2010). As indicated above, even though life expectancy has increased over the years, status and trends of behavioural health risks are not positive even though for some health behaviours some improvement has been seen on average level (WHO-Europe, 2010).

The percentage of obesity and overweight have increased year by year for both men and women and for all age groups since 2004. In 2008, more than 10% of men and women 25–44 years old were obese and more than 50% were either obese or overweight (Tekkel et al., 2005, 2009). Adolescents, especially boys, have become increasingly overweight as well – about 15% of 13-year-old boys were overweight in 2005 (10% in 2001) (Hibell et al., 2004, 2009; Villa et al., 2007). While the trend from normal weight to overweight is clear, the changes in the obese category have not been as clear.

The percentage of the adult population exercising for at least 30 minutes at least twice per week increased from about 30% in 2002–2006 to 35% in 2008. However, there has been a decline in the percentage of 16–24-year-old men who exercise daily: from 15% in 2002 to fewer than 10% in 2008 (Kasmel et al., 2003; Tekkel et al., 2009). Unless this changes, rates of obesity in the adult population are likely to continue to increase.

The percentage of the population 15 years and older who are regular daily smokers increased sharply between 1990 and 1994 (from about 28% to 36%) and after several fluctuations it declined to 28% in 2008 (Helasoja et al., 2001; Kiivet and Harro, 2002; Pärna et al., 2002;Puska et al., 2003; Tekkel et al., 2009). In Estonia, as in many other central and eastern European countries, smoking is much more prevalent among men: in 2008, 39% of men 15 years and older were regular daily smokers compared to 17% of women. However, it is positive that the increase of adult non-smokers is greatest in the 16–24 age group (Tekkel et al., 2009; WHO-Europe, 2011).

Alcohol consumption in Estonia has historically been high, as in other post-Soviet countries (Stickley et al., 2009) while regular intake of strong spirits and binge drinking is still common. Estonia ranked fifth in alcohol consumption per capita among 53 countries of the WHO European Region in 2003, directly after Germany and before Ireland and has had an increasing trend, contrary to most other countries (WHO-Europe, 2011). By 2007, the Estonian population consumed 12.6 litres of pure alcohol per capita, a 7-litre increase since 1997 (Estonian Institute of Economic Research, 2010a). These increases in alcohol consumption were accompanied by corresponding increases in alcohol-related diseases, e.g. cirrhosis of the liver (Pärna and Rahu, 2010). In 2008–2009 there was a slight decrease in per capita alcohol consumption (down to 10.2 litres of pure alcohol). Even though the market share of light mixed alcoholic drinks and beer has increased, strong spirits still account for over 50% of pure alcohol consumed (Estonian Institute of Economic Research, 2010a). The adolescent population shows a higher proportion of hazardous alcohol consumers and higher volumes consumed compared to European averages (Hibell et al., 2009).

Alcohol policy until 2005

Hazardous alcohol consumption has become a global health threat, and calls for worldwide coordinated action have resulted in adoption of a global alcohol

strategy by the 2010 WHO World Health Assembly (WHO, 2010). A strategy to reduce alcohol-related harm in the European Union was adopted already in 2006 (European Commission, 2006). The proportion of the burden of disease attributable to hazardous alcohol consumption is very high in Europe – especially in central and eastern Europe (Mathers et al., 2009), and it is considered the leading behavioural health risk in Estonia (Lai et al., 2004; Ministry of Social Affairs, 2008a; WHO-Europe, 2010).

In the 1980s Estonian alcohol policy saw both widespread introduction of restrictions as part of Gorbachev's perestroika (Wasserman and Värnik, 1998) and restoration of rather loose policies soon afterwards (Nemtsov, 1998). For example, lowering of the minimum age for purchasing alcohol from 21 to 18. By comparison, from 1990–2004 changes in alcohol policy were minor and without clear direction, e.g. while sale to minors was criminalised, the average excise tax on alcoholic beverages was slightly reduced. Simultaneously, the affordability of alcohol increased significantly and by 2008 the average salary could already buy 62 litres of strong spirits compared to 28 in 2000 (Estonian Institute of Economic Research, 2010a). This increase in alcohol affordability was also one of the highest in the European Union (Rabinovich et al., 2009). Measures designed to affect alcohol consumption in Estonia probably also affected alcohol policies and consumption in neighbouring countries like Finland, with Estonia becoming a target for "alcohol tourism" (Mäkelä and Österberg, 2009; Rabinovich et al., 2009)

International research has identified many effective and cost-effective interventions for reducing hazardous alcohol consumption and its negative health outcomes (WHO-Europe, 2009). The Estonian Ministry of Social Affairs commissioned a study in 2004 to find such interventions for strengthening alcohol policy (Lai et al., 2004), and the first major changes since the early 1990s were introduced in 2005.

4. Summary of literature review and rationale for the current study

Health systems are designed to achieve the highest possible levels of health, defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (Roberts et al., 2008; WHO, 1948). However, health system performance varies widely with regard to their impact on the health improvement of individuals or populations as a whole (WHO, 2000). This challenges health systems to constant development, which is most effective if predicated on evidence-based decisions (Frenk et al., 2006) throughout all steps of the policy cycle (Roberts et al., 2008). In the first steps, policy problems and their underlying causes are defined based on information gathered using descriptive measures. Historically, these have usually been simple mortality and morbidity statistics, but with decline of mortality rates,

increasing life expectancy and emphasis on well-being, summary measures of population health have become increasingly important worldwide (Etches et al., 2006; Field and Gold, 1998). Policy options are formulated and courses of action are selected in the next stages of the policy cycle. Evidence for these decisions should ideally include information on areas with highest potential gain for health improvement as well as effectiveness and cost-effectiveness of specific interventions to achieve policy goals (Baltussen et al., 2005; Morrato et al., 2007). In the final step, after the chosen intervention is applied, information is gathered on the changes resulting from the policy so it can be evaluated.

The Estonian economy, health system and population health have improved rapidly since 1991, and development of evidence-based health policy has been supported by simultaneous generation of electronic patient registries and databases containing information on every health, welfare and mortality event in the country (Jesse et al., 2004; Koppel et al., 2008). However, the policy debates over Estonian public health in late 1990s did make it evident that along with reforms and changes in population health behaviour, new indicators of population health were needed. While summary measures of population health had gained high status in global health policy (WHO, 2002) these had not yet penetrated into Estonian health policy processes.

Thus, the rationale of the current study is to introduce novel population health measures to the health policy process, with examples of use throughout the steps of the classical policy cycle. Hazardous alcohol consumption was selected as a focus of the policy development example because previous research identified it as the area of highest impact on population health among behavioural health risks (Lai et al., 2004). Finally, whenever possible, routine sources of data were utilised in order to improve acceptability and uptake of the produced information as suggested by previous international experiences (Mathers et al., 2003; Melse et al., 2000; Shibuya et al., 2005; Morrato et al., 2007).

AIMS OF THE RESEARCH

This thesis is based on four papers about the health of the Estonian population and the possible impact of different interventions to improve population health. The overall aim of the thesis was to apply different population health measures to support Estonian health policy for improved understanding of population health problems, their causes and cost-effective methods of population health improvement. In order to do this, a number of more specific aims were set:

1. to provide a set of national and sub-national burden of disease estimates for Estonia by gender and main causes (Paper I);
2. to provide an overview of amenable mortality in Estonia from 2000–2009 by gender and main causes, and to describe how Estonian healthcare has and can contribute to improvement of population health in the country (Paper II);
3. to assess effectiveness and cost-effectiveness of interventions for reducing health loss associated with hazardous alcohol consumption (Paper III); and
4. to review changes in Estonian alcohol policy from 2005–2010 and provide further directions to reduce alcohol related harm to population health (Paper IV).

MATERIAL AND METHODS

5. Burden of disease

The first paper analyses the burden of disease in the Estonian population in 2002, and has following objectives: to provide a first set of national and sub-national burden of disease estimates; to describe the causes and age/gender distribution of the burden; and to provide preliminary analysis on the association of the burden of disease and selected socioeconomic factors in local municipalities. The number of years lived with disability and the years of life lost due to premature mortality are added by cause, age and gender to reach the total burden of disease expressed as disability adjusted life years for the population under study.

Background of methodological choices

The national burden of disease study was based on the general approach used in the GBD study, which provides summary of global burden of disease estimates for all regions and countries of the world from a viewpoint of global average (Murray and Acharya, 1997; Murray and Lopez, 1997b; Murray and Lopez, 1997c). The problems of detailed data availability, large reliance on estimation to fill data gaps and hence complicated calculation procedures can hamper the use of standard burden of disease methodology on a country level (Morrow and Bryant, 1995; Melse et al., 2000).

All this can limit the use of burden of disease estimates on a local level because even though international data comparisons provide ample basis for policy discussion, policy-makers often require assurance that these estimates are applicable in the local situation. Contextualisation to take country specifics into account is a viable option to make local adoption of the burden estimates more desirable (Mathers et al., 2001). Ideally, contextualised results take into account both local mortality and morbidity profiles (e.g. by using a localised burden of disease classification), use local disability weights that convey disease severity assessments specific to the particular population and employ routinely available data as much as possible. These considerations partially coincide with criticism levelled at the GBD study methodology, particularly concerning the selected ideal life expectancy, discounting and age and disability weights (Barker and Green, 1996; Anand and Hanson, 1997; Arnesen and Nord, 1999; Williams, 1999; Lyttkens, 2003; Arnesen and Kapiriri, 2004).

The GBD study used Japanese life expectancy (82.5 for women and 80 for men) as the standard for YLL calculation. The argument for this choice was an ethical one at heart – it should not be seen as giving more importance to saving lives in a rich country and thus more weight (DALYs) is given to mortality in poor countries (Williams, 1999; Lyttkens, 2003). However, this is not necessary

in a national burden of disease study, and as Williams (1999) suggested for the whole GBD study, actual national life expectancies can be used. Moreover, the standardised life tables were substituted for local ones in the GBD study for estimating intervention impact (e.g. WHO-CHOICE), which lends additional support for the latter (Williams, 1999).

Lyttkens, Anand and others (Anand and Hanson, 1997; Lyttkens, 2003) argue that discounting (3% in the GBD study is irrelevant because in the context of health system as whole, a case of tuberculosis is still a case regardless of whether it happens now or in ten years. Arnesen and Kapiriri (2004) add that discounting also includes an implicit value judgement, as disabilities and deaths in early childhood are affected most by discounting and thus receive a lower value weight compared to other population groups. The original GBD study used age weighting to place lower values on burdens at the beginning and end of life; DALY loss would be the same if 185 newborns, seventeen 6-month-olds, five 2-year-olds, one 25-year-old, two 67-year-olds or three 83-year-olds suffered the same disability for one month (Arnesen and Kapiriri, 2004). Williams (1999) argues that these value judgments should be left to users and calculation of burden of disease should be kept as simple as possible.

Barker and Green (1996) argue that the GDB study's use of standard disability weights for all regions of the world ignores the differential impact of impairment on performance, which varies with social context. Moreover, Arnesen and Kapiriri (2004) performed an alternative valuation of developmental disability due to malnutrition and unipolar major depression, finding that in their particular context, the alternative disability weights produced a significantly lower burden for depression with developmental disability rising from an initial 14% to 90% of the burden of these two conditions. They also comment that while creators of the DALY may be able to disentangle them, most users are not provided with full insight and are probably unable to do the same. Williams (1999) on the other hand, summarises his critique of DALYs by saying that diverting time-consuming and resource-intensive tasks is to be discouraged.

Methods of calculation and data

Based on the considerations above, the current study set out to simplify the calculation of burden of disease as much as possible and introduced the following methodological differences from the standard GBD approach: a) the use of country-specific disease classification, b) the use of disease prevalence data derived from administrative patient databases instead of survey-based disease incidence estimation and c) use of national disability weights according to the contextualised disease classification. The calculation steps are detailed in the next paragraphs along with the descriptions of data sources.

A disease classification to best reflect the most common and relevant conditions in Estonia was developed from the International Classification of

Diseases, version 10 (ICD-10) (WHO, 1992). The data used for disease classification development was provided by Estonian Health Insurance Fund (EHIF). All health care and welfare events in Estonia are recorded in the EHIF databases in detail, i.e. cause of the encounter, care provided, procedures performed, medication prescribed along with personal characteristics of the patients. Individual anonymous data of all medical encounters in Estonia was used, stratified by gender, age, place of residence, ICD-10 code and health care cost of the encounter (latter used only for disease classification development). Data for 2002 was used as most recent, with verified quality and full population coverage at that time.

Development of disease classification began by determining a threshold for a separate disease group in the classification. A separate disease group was considered warranted if the number of people affected by the condition was 0.05% or more out of the total population or if the health care resources allocated to treat a condition were 0.1% or more out of the total health insurance budget in 2002. The remaining conditions in the ICD-10 (8% of the medical encounters and 5% of the health care budget in 2002) were allocated between already available categories in the case of medical proximity or grouped into separate categories case by case. All in all, 168 disease categories in 12 disease groups were identified.

YLD estimates in the burden of disease study are the result of multiplying disease prevalence by a disease-specific duration index and disability weight. Every person in contact with the health system during a year for every ICD-10 3-digit code present in the EHIF databases was counted once to reach prevalence figures. The duration index used in YLD calculation represented a fraction of a year needed for full recovery in case of mild conditions like ordinary influenza, other acute upper respiratory infections, superficial injuries etc. The duration index had the value “1” in case of conditions requiring longer than a year for full recovery or where full recovery is not expected.

National disability weights to match all diseases in the country-specific disease classification come from a separate evaluation event following the examples of the GBD (Murray et al., 2001) and Dutch studies (Essink-Bot et al., 2002). In short, a panel of 25 experts with a medical background weighed 283 health conditions, which were the result of 168 classification items with various severity levels. At the first stage, 26 indicator conditions were valuated in a one-day open session using the person-trade-off (PTO) approach. These valuations were plotted to a visual analogue scale (VAS) and were used as reference points for the direct valuation of the remaining 257 conditions using the VAS scale.

YLL calculations in this study are based on mortality data and on national age/gender-specific life expectancy estimates. The mortality data comes from vital registration and was provided by Statistics Estonia (2011d). The life-expectancy estimates are based on Estonian standard life-tables also published by Statistics Estonia. Thus, the YLL estimate for a condition was reached by

multiplying the number of deaths at any particular age with the life expectancy of that sex/age group.

All calculations were performed in 5-year age/gender groups separately for all 168 disease groups on the national and two sub-national levels. On the first sub-national level (counties) a correlation analysis was performed between regional burden of disease estimates and socioeconomic indicators available from Statistics Estonia. Correlation analysis was not performed on the second sub-national level (municipalities) due to a lack of socioeconomic indicators.

Discounting (Sheldon, 1992) and age-weighting (Tsuchiya, 1999) were not applied to the burden estimates as agreed by a local panel due to data-specific and ethical considerations.

6. Amenable mortality

The second paper analyses amenable mortality in Estonia and has the following objectives: to provide an overview of amenable mortality in Estonia in 2000–2009 by sex and main causes; to describe contribution of health care to the improvement of population health, and to describe potential health care contributions to population health.

Background of methodological choices

As described in the literature review, multiple cause lists for counting avoidable deaths have been used (Nolte and McKee, 2004). Some of the most widely used lists include those by Rutstein (1976), Charlton et al. (1983), Holland (1988) and Nolte (Nolte and McKee 2004). It has been argued that there is no gold standard for analysis of avoidable mortality, and comparative calculations in the United Kingdom using a list by Charlton and Holland have shown major differences in study results (e.g. avoidable mortality constituting 3% versus 22% of total mortality) (French and Jones, 2006).

Selection of methodology for this study was carried largely according to three main criteria: wide international use, incorporation of the latest findings and the possibility of comparison with earlier results on Estonian avoidable mortality. The methodology by Nolte and McKee (2004) fulfilled the first two criteria and most importantly, results 1990 and 2000 results for Estonia were available from Newey et al. (2004) using the same methodology.

Methods of calculation and data

The list of causes of avoidable mortality that could be averted by health care action (amenable mortality) from Nolte and McKee (2004) was used along with the age constraints from the same publication, which include a general upper

limit of 75 years and specific limits for selected diseases such as childhood measles. As in the paper by Nolte and McKee (2003), only 50% of ischaemic heart disease deaths are included in amenable mortality and are excluded from international comparisons, as in Newey et al. (2004), and Nolte and McKee (2008). Mortality data for the calculations was provided by Statistics Estonia (2011d) and originated from vital registration and used ICD-10 coding (WHO, 1992). Mortality calculations were performed for 2000–2009, stratified by sex and 5-year age groups. The calculated mortality rates (per 100 000 population) were standardised using European standard population (Waterhouse et al., 1976). The results of these calculations are presented for 2000–2009 by sex but with age group aggregation.

In addition to calculation of standardised rates of amenable mortality, the proportion of amenable mortality in all-cause mortality by sex for years 2000–2009 was calculated to give an indication of health care improvements during the study period (Nolte and McKee, 2008; Chau et al., 2010). Further, the effect of health care on change of total mortality was estimated following the approach published by Tobias and Yeh (2009). The ratio of the difference in amenable mortality to the difference in total mortality over the observation period (SRD amenable / SRD all-cause) was calculated to achieve this. These results are presented as the percentage of total mortality change that can be attributed to health care. Additionally, amenable mortality was compared to health care expenditure per capita for years 2000–2008 for indirect assessment of effectiveness changes in resource use. Expenditure data for years 2000–2008 was available from National Institute for Health Development (2010) national health accounts database.

Finally, theoretical gains in life expectancy at birth were calculated for a scenario where all amenable mortality was averted. These theoretical gains were further broken into causes of amenable mortality following Pollard's (1988) methodology. Life expectancy at birth was selected over temporal life expectancies for consistency with other available life expectancy measures for better applicability in health policy decision making. Mortality and population data for abridged mortality tables originated from Statistics Estonia (2011d). Results of life expectancy decomposition are presented stratified over causes of amenable mortality for 10 diseases with highest theoretical impact on life expectancy.

All calculations were performed using the Stata 9.2 (StataCorp, 2005) software package, with the exception of life expectancy calculations performed with the EpiDat 3.1 (Service of Epidemiology, 2010) software package.

7. Alcohol interventions and policy

7.1. Cost-effectiveness of alcohol interventions in 2004

The third and fourth papers focus on interventions against hazardous alcohol consumption and alcohol policy in Estonia more generally. The third paper analyses the cost-effectiveness of the main interventions, their combinations and the current mix of interventions against hazardous alcohol consumption in 2004 using the WHO-CHOICE modelling framework. The paper has the following objectives: to contextualise WHO-CHOICE regional analyses to local population specifics, alcohol consumption patterns, current intervention mix and related costs; to assess the effectiveness and cost-effectiveness of the current intervention mix in 2004; and to make policy recommendations for alcohol control. The fourth paper provides a review of changes in alcohol policy from 2005–2010 as a follow up to the third paper.

Background of methodological choices

Findings from previous research had identified alcohol as the main behavioural health risk contributing to burden of disease in Estonia (Lai et al., 2004). Alcohol policy in Estonia is coordinated by Ministry of Social Affairs while on national level majority of interventions are focused on the whole population and almost entirely carried out in jurisdiction of other ministries (e.g. excise taxation in the Ministry of Finance, sales in the Ministry of Economics and Communication, production in the Ministry of Agriculture, etc). Thus, there was a definite need for information on the effectiveness and cost-effectiveness of population-level alcohol interventions. Information was needed both about the intervention mix at the time as well as about possibilities for strengthening the policy. However, there were considerable constraints to the capacity for economic evaluation similar to those described in the case of injury prevention policies throughout central and eastern Europe in late 1990s (McKee et al., 2000b).

While policy-makers were interested in full country-specific economic evaluation of interventions in alcohol policy but the capacity to conduct it was lacking, the WHO-CHOICE (Tan Torres-Edejer et al., 2003) provided a compromise. This framework consists of a compendium of interventions, regional estimates of their cost-effectiveness and tools for taking the local context into account. Moreover, in the case of hazardous alcohol consumption it addressed broad population-level interventions like taxation and advertising bans while also providing an assessment of the intervention mix currently in place (Hutubessy et al., 2003; Chisholm et al., 2004).

Methodological framework

Analysis followed the standard WHO-CHOICE methodology but some important features of WHO-CHOICE are worth stressing. First, all interventions are evaluated against a "do nothing" counterfactual: all interventions are compared to a situation where no interventions exist, which importantly enables the evaluation of current as well as new interventions. The counterfactual is achieved through back-calculation of the current intervention mix and its estimated effectiveness (Tan Torres-Edejer et al., 2003). Second, WHO-CHOICE is a modelling approach where an actual population model is followed-up for 100 years with the intervention applied through the first 10 years of model time (Lauer et al., 2003; Tan Torres-Edejer et al., 2003). Third, intervention effects are expressed in DALYs averted, which in this study were calculated with omitted age-weighting but with a 3% discount rate. Fourth, cost calculations are made using an "ingredients" approach in which the quantities of resource needed to start up and maintain intervention programmes are quantified separately from their respective prices or unit costs. Intervention costs derived in this way were discounted (at a rate of 3%) and are presented in Estonian Krooni (1€ =15.6 EEK).

Data

Data on health behaviour and prevalence of health risks originated from a major postal health survey carried out in the Estonian general adult population (Kasmel et al., 2003; Tekkel et al., 2005). Mortality data (by gender and one-year age groups) were derived from a mortality registry of Statistics Estonia (2011d), while morbidity-related rates (e.g. incidence and prevalence of alcohol-related diseases) were based on a review of the scientific literature (Simpura et al., 1999; McKee et al., 2000a; Kasmel et al., 2003; Puska et al., 2003; Reitan, 2004; Tekkel et al., 2005). Disability weights used for DALY calculations originate in the Estonian burden of disease study (Lai et al., 2003).

All patient-related costs (such as the cost of a hospital outpatient visit) were calculated using data from an EHIF database. Programme costs, i.e. resources needed for administration and enforcement of the intervention, plus training of the personnel or media coverage, were acquired from the Ministry of Social Affairs, the governing body responsible for public health intervention administration and supervision. With the exception of brief physician advice for heavy drinkers, the costs of interventions are solely made up of programme costs. Throughout the analysis the societal perspective was used in cost calculations. Hence, the increased tax revenues and other financial transfers were not taken into account as those resources are still present in the population.

Estimating the impact of interventions

This analysis considers five intervention strategies capable of reducing the burden of heavy alcohol use – together with associated combinations (Ludbrook et al., 2002; Babor et al., 2003; Chisholm et al., 2004): excise tax on alcoholic beverages, reduced access to alcoholic beverage retail outlets, a comprehensive advertising ban (TV, radio and billboards) on alcohol products, roadside breath-testing for blood-alcohol content of motor vehicle drivers and brief interventions involving counselling of at-risk drinkers by a primary care physician. Derivation of effect sizes are only briefly described here (and summarised in Table 1), with a more detailed description provided elsewhere (Chisholm et al., 2004).

Excise taxation on alcoholic beverages primarily affects the incidence of drinking by reducing consumption, with effects measured in terms of price elasticity (estimated to be –0.4 to –0.5 for spirits and beer respectively, and –1.2 for wine) (Ornstein and Levy, 1983; Babor et al., 2003; Estonian Institute of Economic Research, 2004), which relates the change in consumption to the size of the price increase. Both the current rate of excise tax (2004), as well as increases of it (of 25% and 50%) were evaluated and adjusted for the observed or expected level of unrecorded use (WHO 2011a, Estonian Institute of Economic Research) (taken as a close proxy measure for untaxed consumption).

Evidence from Scandinavia (Norström and Skog, 2005), has shown the potential impact of advertising bans and reduced access on the incidence of hazardous drinking and hazardous alcohol-related consequences such as road traffic accidents to be approximately 3%. A lack of local data led to the reliance on prior regional estimates (see Table 1). Counselling in primary care, on the other hand, is intended to reduce disability and, principally, reduce the time spent with the condition. Evidence from trials indicates that brief interventions improve the rate of recovery by 15–20% (Babor et al., 2003; Chisholm et al., 2004) for the covered population. However, after taking into account real-world effect modifiers, including treatment adherence (70%) and target coverage in the population (25% of hazardous drinkers), population-level remission was estimated to be 2.4% better than untreated natural rates.

Drink-driving laws and reinforcement influence fatal and non-fatal traffic injuries, both among hazardous alcohol users and other sub-groups of the population (passengers, pedestrians). Enforcement via random breath testing (RBT) is estimated to reduce fatalities by 18% and non-fatal injuries by 15% if fully implemented (Peek-Asa, 1999).

Additional data on the modelling framework, intervention impact and cost estimation is available from Annex 1.

Table 1. Population-level effectiveness of interventions for reducing hazardous alcohol consumption (change in % compared to null-situation)[a]

Intervention	General population (%)	Heavy alcohol users (%)			
	Residual mortality[b]	Incidence[c]	Remission	Case-fatality[d]	Disability
Current scenario	–1.1	–7.1		–0.9	
Current taxation		–7.1			
Increased taxation (25%)		–7.9			
Increased taxation (50%)		-8.9			
Roadside breath-testing	–1.9			–1.7	
Reduced access to retail outlets	–0.2	–2.5		–0.1	
Advertising ban		–3.0			
Brief counselling in primary care			2.4		–0.8

[a] Primary targets of interventions are depicted. Both primary and secondary effectiveness (e.g. changes of remission, case fatality and disability) are followed up using population model for 100 years of which the intervention is applied for the first 10 years.
[b] Residual (or background) mortality is the general rate of mortality minus the cause-specific rate of mortality.
[c] Incidence of heavy alcohol use – number of new alcohol users with heavy consumption.
[d] Case fatality is the rate of death among people who already have a condition.

7.2. Changes of alcohol policy, 2005–2010

The results of the modelling of interventions against hazardous alcohol consumption generated a lively debate in Estonia. A large majority of the population was in favour of strengthening alcohol policy at the time (Estonian Institute of Economic Research, 2005, 2006). On the other hand, it was also argued that an increase in excise taxes may induce inflation, and should therefore not be implemented as conflicting with Estonian monetary policy to introduce the euro (scheduled for and adopted in 2011).

Discussions on alcohol policy continued in 2006 in an interministerial committee that was tasked with producing a comprehensive alcohol policy for Estonia. While the lifespan of that committee was short, it did provide the basis of an alcohol policy that was prepared in 2008 and reached government hearing in 2009 (Ministry of Social Affairs, 2008b) but was not adopted. All of this illustrates the conflicting nature of national policies in setting priorities that could be involved in the implementation of public health interventions.

A literature search was performed for the review of changes in Estonian alcohol policy, but the documentation of policy discussions and decisions is scarce and the current review mainly resorts to legislative ones available from public databases (Ministry of Justice, 2011). Additionally, data on alcohol consumption and availability as well as alcohol related morbidity and mortality is provided.

RESULTS

8. Burden of disease

Loss of life years from premature mortality

In 2002, 8973 female and 9297 male deaths resulted in 267 139 life years lost (196 per 1000 population). Most often death was caused by cardiovascular disease, cancer or external causes. These three categories have the highest numbers of YLL. Ischaemic heart disease and stroke rank highest among individual conditions both for men and women. These two conditions account for 47% of the total deaths in Estonia but only for 33% of total YLL (Table 2). The other most important sources of YLL for men are external causes like suicide, poisoning and traffic injuries while somatic diseases like cancers are more important for women. On the population level, lung cancer and liver cirrhosis also rank high, coinciding with the country's high level of smoking and hazardous alcohol consumption.

After stratification by both gender and age, the importance of accidents and injuries as a major target for public health interventions is even more pronounced than cardiovascular conditions. A half of YLL for men under age 40 are caused by external factors, compared to only 3% by cardiovascular diseases. At the same time, about 70% of YLL from lethal injuries come from people under age 50, and 80% from men. The total loss from external causes for men is more than three times higher than that for women. Thus, the number of YLL is one third larger for men than for women. The main cause for this lies in high injury and cardiovascular mortality in early ages, while after age 65 both genders have roughly the same level of YLL.

Loss of life years from morbidity

In 2002, Estonian population lost 179 222 life years (131 per 1000 population) due to medical conditions and injuries affecting quality of life. The leading category is cardiovascular, accounting for 32% of total YLD, followed by musculoskeletal diseases and cancer with 12% and 9.5% respectively. The female population contributed 62% to the YLD. Gender difference in total YLD is the result of differences in the prevalence of cardiovascular and musculoskeletal diseases. The latter also represents the largest gender gap among disease groups. Gender difference dominates in ages over 40 where, female loss from musculoskeletal diseases outnumbers the male equivalent up to fourfold.

Table 2. Top ten diseases, ranked according to years of life lost (YLLs) and years lived with disability (YLD) with corresponding shares of burden by gender in Estonia in 2002

YLL rank	Male			Female			Total		
	Conditions	YLL	Total YLLs (%)	Conditions	YLL	Total YLLs (%)	Conditions	YLL	Total YLLs (%)
1	Ischaemic heart disease	30 562	20	Ischaemic heart disease	28 704	25	Ischaemic heart disease	59 266	22
2	Stroke	11 512	8	Stroke	18 098	16	Stroke	29 610	11
3	Suicide	8 371	5	Breast cancer	4 738	4	Suicide	10 359	4
4	Poisonings	7 979	5	Colorectal cancer	3 202	3	Poisoning	9 821	4
5	Lung cancer	7 617	5	Liver cirrhosis	3 201	3	Lung cancer	9 629	4
6	Traffic injuries	6 272	4	Hypertension	2 978	3	Traffic injuries	8 496	3
7	Cardiomyopathy	5 147	3	Stomach cancer	2 478	2	Liver cirrhosis	7 428	3
8	Pneumonia	4 881	3	Traffic injuries	2 224	2	Cardiomyopathy	7 281	3
9	Liver cirrhosis	4 227	3	Cardiomyopathy	2 134	2	Pneumonia	6 307	2
10	Homicide	3 510	2	Lung cancer	2 011	2	Hypertension	5 393	2
	YLL top 10 total	90 078	59	YLL top 10 total	69 769	61	Top 10 total	153 590	57
	YLL total	152 252		YLL total	114 888		Total	267 140	

Table 2 (*continued*). Top ten diseases, ranked according to years of life lost (YLLs) and years lived with disability (YLD) with corresponding shares of burden by gender in Estonia in 2002

YLD rank	Male			Female			Total		
	Conditions	YLD	Total YLDs (%)	Conditions	YLD	Total YLDs (%)	Conditions	YLD	Total YLDs (%)
1	Ischaemic heart disease	7 162	10	Stroke	9 826	9	Ischaemic heart disease	16 290	9
2	Stroke	5 637	8	Hypertension	9 808	9	Stroke	15 464	9
3	Hypertension	4 448	6	Ischaemic heart disease	9 129	8	Hypertension	14 255	8
4	COPD	3 407	5	Osteoarthritis	7 141	6	Osteoarthritis	9 618	5
5	Osteoarthritis	2 477	4	Cardiac insufficiency	3 812	3	COPD	7 149	4
6	Cardiac insufficiency	1 881	3	COPD	3 743	3	Cardiac insufficiency	5 693	3
7	Epilepsy	1 685	2	Cataract	3 247	3	Cataract	4 443	2
8	Paraplegia	1 656	2	Renal failure	2 542	2	Renal failure	3 263	2
9	Fractures	1 320	2	Leiomyoma	2 126	2	Paraplegia	3 144	2
10	Prostate hyperplasia	1 304	2	Rheumatoid arthritis	1 984	2	Epilepsy	2 948	2
	YLD top 10 total	30 977	45	YLD top 10 total	53 358	48	Top 10 total	82 269	46
	YLD total	68 597		YLD total	110 625		Total	179 222	

Total loss of life years

In 2002, the Estonian population lost 446 361 years of perfect health (327 per 1000 population) due either to premature death or time lived with a health condition that reduces health related quality of life. Cardiovascular diseases, cancers and external causes (e.g. injuries and suicides) are responsible for 2/3 of the total burden of disease (Figure 2). The total number of DALYs for both genders was approximately the same, but for men the main source of DALYs was premature mortality while morbidity was the leader for wome. Losses in the working-age years (16–65) account for 60% of the gender total for men and 43% for women. Relative accumulation of DALYs in younger age groups (especially for men) is further illustrated by the fact that 50% of the total DALYs are from the under 55 population.

Conditions causing the highest overall burden in Estonia are ischaemic heart disease and stroke, which are responsible for 17% and 10% of DALYs respectively. In general, the diseases with higher YLL count tend to rank high in overall rankings as well. This is explained by the fact that majority (60%) of DALYs are mortality-related that is also less evenly distributed among causes compared to the morbidity-related burden.

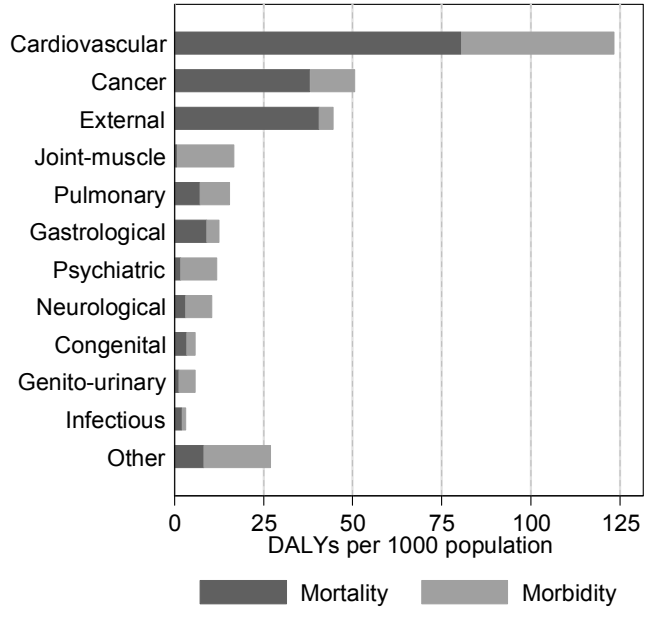


Figure 2. Disability adjusted life years (DALYs) per 1000 population for 12 disease groups in Estonia in 2002 by source (i.e. from premature mortality or lifetime disability).

Sub-national estimates of burden of disease

Burden of disease calculations were performed on two subnational levels – for 15 counties and 227 local municipalities. While the national average was 327 DALYs per 1000 population, the regional calculations revealed considerable variations between counties (from 298 to 414) and municipalities (from 114 to 725) as detailed in Figure 3. Both YLL and YLD followed largely the same pattern of regional distribution as DALYs. The most well off are Estonian central and western counties while the least well off are the southeast, island and northeast regions. Ida-Viru county in that last region causes almost half of the overall variation between counties.

Correlation analysis showed that lower DALY levels per 1000 population had a positive correlation to higher employment rate (r=0.58), number of working hours (r=0.69), hourly wages (r=0.65) and negative correlation of the same strength to higher proportion of households under poverty line and similar indicators. Regions with higher DALY count also have higher share of YLL in the total burden.

In addition, sources of burden-like injuries, alcohol and other largely lifestyle-related conditions tend to rank higher in the counties with higher burden levels. However, it is not possible to ascertain direct correlations, since the health behaviour data is not available on the county level.

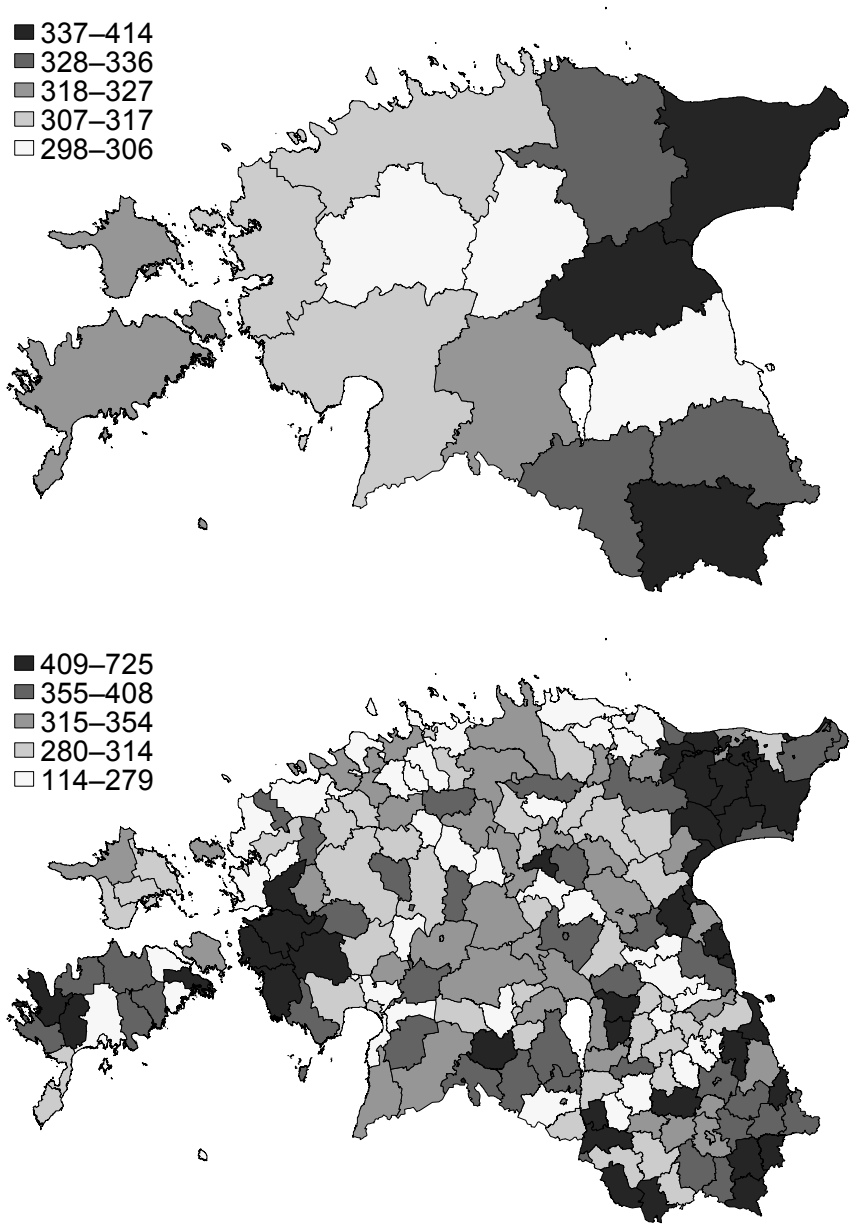


Figure 3. Quintiles of disability adjusted life years (DALYs) per 1000 population in Estonian counties (top) and local municipalities (bottom) in 2002, quintile boundaries shown in legend.

9. Amenable mortality

Changes over time and impact of health care

The amenable mortality rate per 100 000 was 244 in 2000 and declined steadily to 157 in 2009 (Figure 4). The rate of all-cause mortality among the 0–74 age group declined simultaneously, from an initial rate of 690 to 492 in 2009. Thus, amenable mortality declined faster (36% reduction) than all-cause mortality (29% reduction) between 2000 and 2009.

Large gender differences in amenable and all-cause mortality are visible in Table 3. The rate of amenable mortality in 2000 was 336 for men compared to 179 for women, an almost twofold difference. By 2009 rates of amenable mortality for men and women were reduced to 203 (decline of 133) and 105 (decline of 74), respectively. However, the relative decline was still faster for women (41%, compared to 31% for men) and by 2009 gender differences were more than twofold. It is noteworthy is that men in 2009 were still worse-off than women had been in 2000.

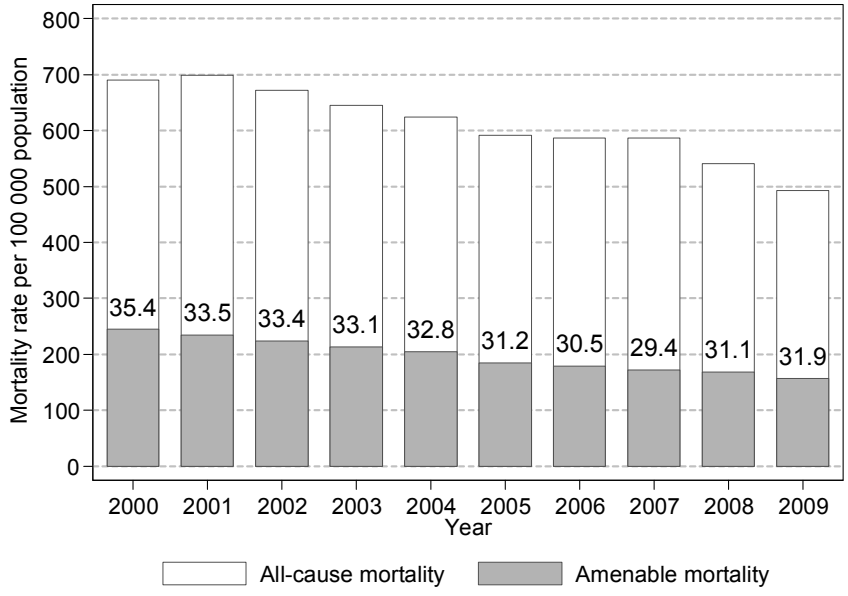


Figure 4. Amenable mortality and all-cause mortality of 0–74 age-group in Estonia in 2000–2009 presented as standardised mortality rates per 100 000 population with with proportion of amenable mortality from all-cause mortality shown on bars.

The main causes of amenable mortality in Estonia are ischaemic heart disease, hypertensive disease and cerebrovascular disease (Table 3). These three cardiovascular diseases accounted for two thirds of all Estonian amenable mortality in 2009 with cancers the second largest disease group. Rates of amenable mortality declined for most of causes but increased for hypertension by almost 70% in comparison of 2000 and 2009. The two cancers with highest amenable mortality rate in 2009 were colorectal and breast cancer. While the rate of amenable breast cancer declined 34% between 2000 and 2009, colorectal cancer showed only a 5% reduction. Moreover, the rate of amenable mortality for colorectal cancer did increase for men (by 10%) while decreasing for women (by 21%). Changes for leading causes of amenable mortality other than for colorectal cancer were consistent between sexes.

The proportion of amenable mortality from all-cause mortality of age-group 0–74 declined from 35% in 2000 to 32% in 2009 (Figure 4). However, this proportion was lowest in 2007 when it reached 31%. Differences between sexes existed in this regard as well, in 2009 amenable mortality constituted respectively 39% and 29% of all-cause mortality for men and women under age 75.

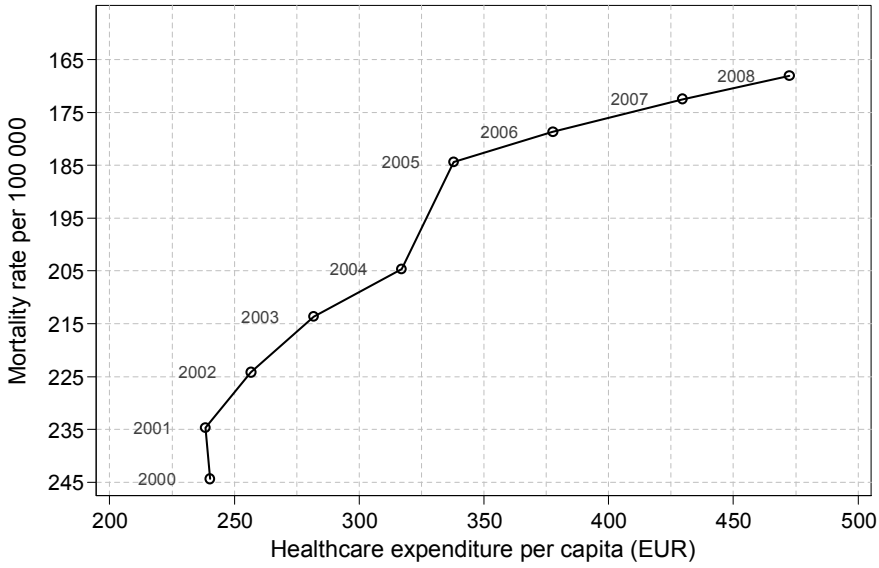
As shown previously, the decrease of amenable mortality was faster than the decrease of all-cause mortality in Estonia. Hence, approximately 44% of the reduction in all-cause mortality (and 34% of all-cause mortality of the total population) from 2000–2009 can be attributed to reduction of amenable mortality and can thus be attributable to health care action. The role of health care in the reduction of all-cause mortality among people aged 0–74 was larger for women (53%) than it was for men (34%).

When contrasting amenable mortality against health care expenditure per capita, two distinct periods emerge (Figure 5). The first period encompasses 2000–2005 when the annual reduction of amenable mortality (and thus increase of health care effectiveness) exceeds expenditure increases. The second period spans 2006–2008, when the increase in health care expenditure corresponds to a fourfold lesser reduction in amenable mortality than in the first period.

Table 3. All-cause and amenable mortality rates per 100 000 population in Estonia in 2000 and 2009 for age group 0–74 by sex along with change of amenable mortality (%) in comparison of these two years.

	Male			Female			Total		
	2000	**2009**	**Change (%)**	**2000**	**2009**	**Change (%)**	**2000**	**2009**	**Change (%)**
All-cause mortality	**1063**	**794**	**–25**	**409**	**270**	**–34**	**690**	**492**	**–29**
Amenable mortality[a]	**336**	**232**	**–31**	**179**	**105**	**–41**	**244**	**157**	**–36**
Septicaemia	120	69	–42	43	17	–60	74	38	–48
Misadventures to patients during surgical and medical care	16	56	72	8	24	64	11	37	69
Influenza	105	44	–58	54	19	–65	75	29	–61
Hodgkin's disease	16	18	10	11	9	–21	13	13	–5
Malignant neoplasm of skin			0	27	18	–34	15	10	–33
Malignant neoplasm of testis	28	13	–54	6	2	–65	16	7	–57
Cholelithiasis and cholecystitis	7	8	12	1	1	19	4	4	11
Intestinal infections	8	3	–60	5	3	–46	7	3	–55
Diseases of the thyroid	7	5	–25	1	1	–30	4	3	–25
Abdominal hernia			0	6	5	–15	3	3	–14
All respiratory diseases (excluding pneumonia)	29	15	–49	17	7	–57	22	11	–52

[a] 50% of deaths from ischaemic heart disease included



* Standardised using European standard population

Figure 5. Amenable mortality compared to total healthcare expenditure per capita in real term Euros in Estonia, 2000–2008.

Potential population health gain

Based on number and distribution of deaths classified as amenable in Estonia in 2000, life expectancy at birth if all these were averted would have exceeded life expectancy at that time by 3.8 years. The 2009 potential for life expectancy increase from averting amenable deaths was 2.7 years. Three leading causes of amenable mortality (ischaemic heart disease, hypertensive disease and cerebrovascular disease) amounted to 59% of the theoretical life expectancy increase in 2009 (Figure 6). The contribution of the remaining conditions is relatively low compared to the aforementioned cardiovascular diseases while amenable cancers had the second highest potential impact on life expectancy in Estonia in 2009. While potential life expectancy gain has diminished over the years as amenable deaths are increasingly averted, hypertensive disease stands out as the one for which rate of amenable mortality and potential life expectancy gain have increased. This has lead to a situation where hypertensive disease has become the disease with the highest potential of life expectancy improvement (0.57 years) if controlled. On the other hand, a majority of the difference of potential life expectancy gains between 2000 and 2009 comes from reduced levels of ischaemic heart disease and cerebrovascular disease as their combined potential for life expectancy increase had fallen by nearly a factor of two.

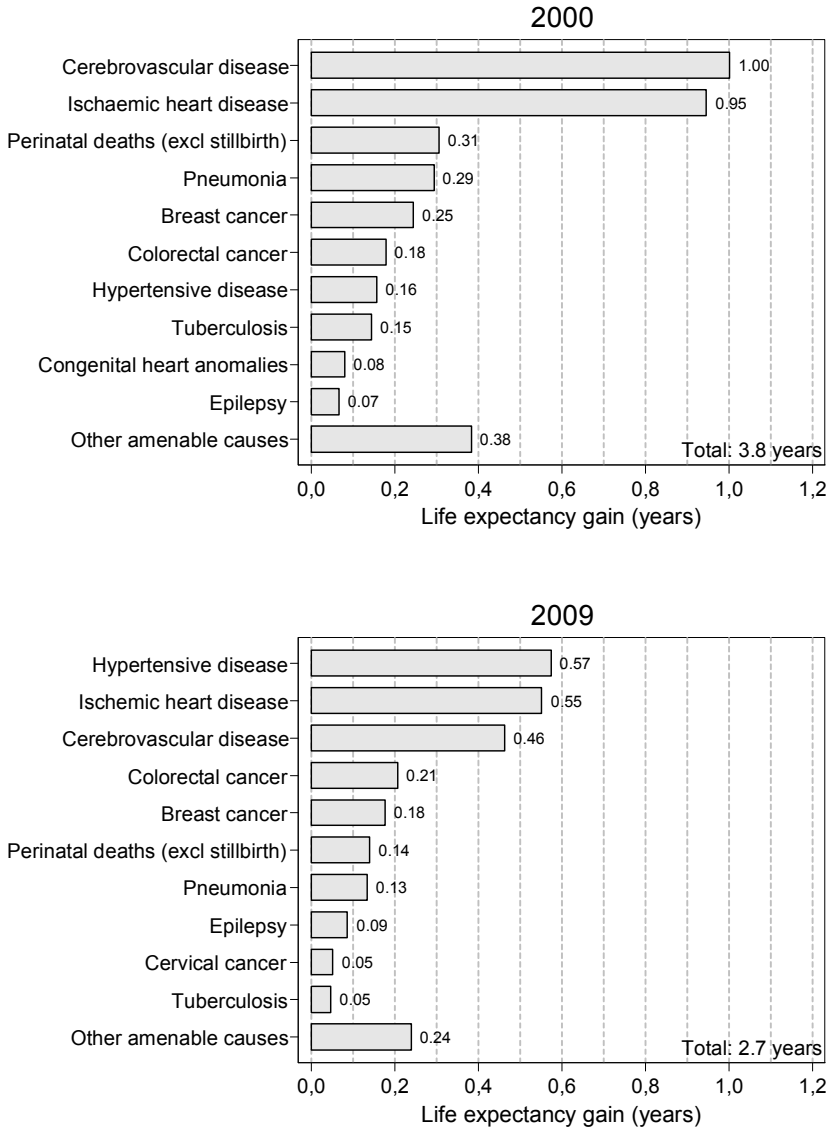


Figure 6. Theoretical gains in life expectancy at birth (in years) if all amenable mortality could have been avoided in 2000 and 2009 in Estonia.

10. Cost-effectiveness of alcohol interventions in 2004

Interventions targeting hazardous alcohol consumption can annually avert 1000 to 3000 DALYs when implemented individually, and almost 7500 DALYs when implemented in combination (Table 4). The least costly interventions were all legislative, including taxation and an advertising ban. The annual costs of implementing these legislative interventions ranged from 1.5 to 2.3 million, EEK and are thereby significantly cheaper than personal intervention strategies such as brief intervention in primary care (12 million EEK) which involves additional resources at the patient level.

Costs, health effects and cost-effectiveness ratios of all evaluated interventions for hazardous alcohol consumption are shown in Table 4. The most cost-effective intervention is a 50% increase in taxation (759 EEK per additional DALY averted). Adding an advertising ban to this tax increase would be the next most efficient choice (an incremental cost-effectiveness ratio of 1 331 EEK per DALY averted). A full combination of increased taxation, advertising ban, brief counselling, reduced access to retail sales and road-side breath testing was estimated to have an incremental cost-effectiveness ratio of 7 152 EEK per DALY averted. Figure 7 plots the total costs and effects of each single and combined intervention. The lower right boundary of this plot represents the

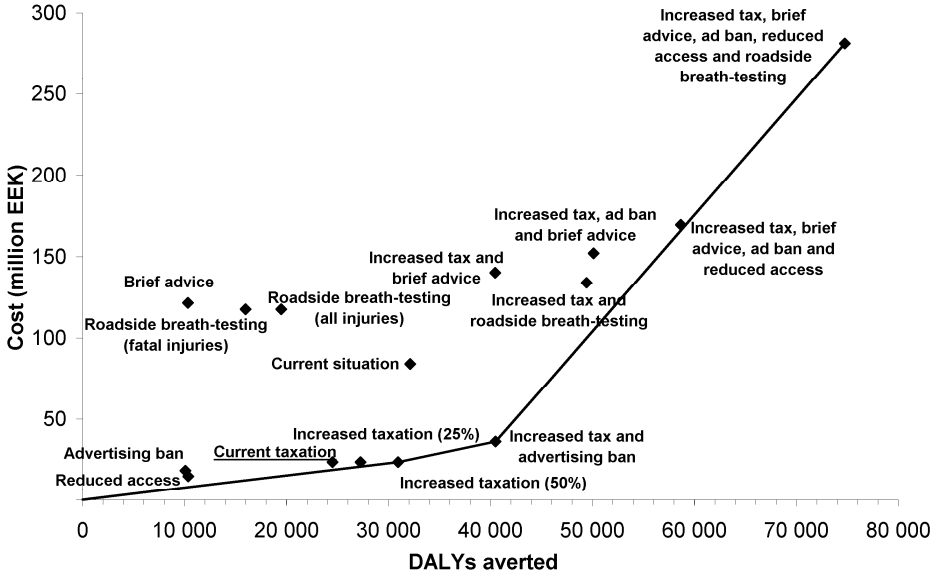


Figure 7. Cost-effectiveness of alcohol interventions and selection order according to the incremental cost-effectiveness ratio (ICER) based on 2004 alcohol policy and population situation in Estonia.

Table 4. Costs, effectiveness and cost-effectiveness of alcohol control strategies using alcohol policy in Estonia in 2004 as baseline.

No.	Intervention	Cost per year (EEK, millions)	DALYs averted per year	ACER[a] (EEK per DALY saved)	ICER[b] (EEK per DALY saved)
1	Current situation (beginning of 2005)	8.4	3 214	2 621	Dominated
2	Current taxation (beginning of 2005)	2.3	2 452	958	Dominated
3	Increased taxation (current + 25%)	2.3	2 727	861	Dominated
4	Increased taxation (current + 50%)	2.3	3 096	759	759
5	Reduced access to retail outlets	1.8	1 009	1 810	Dominated
6	Comprehensive advertising ban	1.5	1 036	1 408	Dominated
7	Brief counselling in primary care	12.1	1 035	11 739	Dominated
8	Roadside breath-testing (fatal injuries)	11.8	1 599	7 359	Dominated
9	Roadside breath-testing (including non-fatal injuries)	11.8	1 950	6 034	Dominated
10	Increased tax and roadside breath-testing	13.4	4 944	2 711	Dominated
11	Increased tax and ad ban	3.6	4 049	893	1 331
12	Increased tax and brief counselling	14.0	4 048	3 464	Dominated
13	Increased tax, ad ban and Brief counselling	15.2	5 011	3 035	Dominated
14	Increased tax, ad ban, brief counselling and reduced access	16.9	5 866	2 888	Dominated
15	Increased tax, ad ban, brief counselling, reduced access and roadside breath-testing	28.1	7 475	3 762	7 152

[a] ACER – Average cost-effectiveness ratio
[b] ICER – Incremental cost-effectiveness ratio i.e. ratio of additional cost per additional life year saved when next intervention is added to a mix

increasing incremental cost of saving one additional DALY and indicates the most efficient way of combining different strategies. Interventions to the north-west of this cost-effectiveness frontier or expansion path are 'dominated', i.e. they are less effective and/or more costly than (a combination of) other interventions.

The uncertainty analysis of results of alcohol interventions showed a 56–60% difference between best- and worst-case scenarios while two-thirds of the difference incurred from the latter, thus indicating possibility of higher than average cost per unit of outcome.

11. Changes in alcohol policy, 2005–2010

There was no comprehensive alcohol policy document to coordinate action against hazardous alcohol consumption in Estonia in 2010. Nevertheless, action was taken to strengthen alcohol policy even though in some cases the primary argumentation was related to national fiscal policy objectives or EU agreements, and only secondarily to public health concerns. Still, the latter were taken into account, indicating a positive cross-sector influence of work done by the Ministry of Social Affairs, institutions under its supervision and public organisations. As part of the cross-sector work the Ministry of Social Affairs established a special taskforce in 2006, consisting of specialists from various ministries, external specialists and representatives of NGOs active in the field. This resulted in a position paper for a comprehensive alcohol policy that was presented in a government hearing in 2009 (Ministry of Social Affairs, 2008b).

Excise tax on alcohol has been increased on four occasions since 2005 for all alcoholic beverages except wine (did not increase on the first occasion). Compared to the 2004 level, excise tax increased 45% by the beginning of 2010. As indicated before, previous research suggested an even higher taxation increase from 2004 levels. The highest tax increases (30% altogether) came 2008 when the economic crisis started to affect the Estonian economy. This was the first occasion when affordability of alcoholic beverages decreased after many years as exemplified by beer in Figure 8 (Estonian Institute of Economic Research, 2010a). Changes in alcohol taxation had mainly fiscal and tax policy objectives arising from the economic crisis and a general preference of consumption taxation over income taxation. Nevertheless, expected positive influences of these taxation effects on health behaviour were also considered.

In 2009 value added tax (VAT) was increased from 18 to 20%, also for budgetary reasons. It would be expected that because these tax types appear to be regressive (Võrk et al., 2008), low-income groups would be most affected. We cannot know this for certain because although there is information collected about beverage preferences and frequencies in different income groups (2008 currently the latest), information on amounts that individuals consume is not recorded. Wine, because wine is favoured by higher income groups, might not

be expected to be much affected. It is likely that the effects of taxation increases were strengthened by the economic downturn in its own right as both income and employment decreased at the time further reducing affordability of alcoholic beverages. Unfortunately, there are not yet enough data to distinguish between the roles of taxation changes and the economic downturn in the reduction of alcohol consumption.

A nationwide restriction on time of off-premise sales of alcoholic beverages was introduced in the summer of 2008. Before 2008, application of such restrictions was wholly in the jurisdiction of local municipalities. There are more than 200 municipalities, thus it was relatively easy to obtain alcoholic beverages from a nearby municipality without a sales restriction. This rendered the existing municipality-based restrictions ineffective. Currently, off-premise sale of alcoholic beverages is prohibited from 10 pm to 10 am throughout Estonia. On the other hand, there is still wide availability of alcohol sales outlets: there were 195 alcohol retail shops per 100 000 inhabitants in Estonia in 2007 while Sweden had 4.5/100 000 in the same year (Estonian Institute of Economic Research, 2010a).

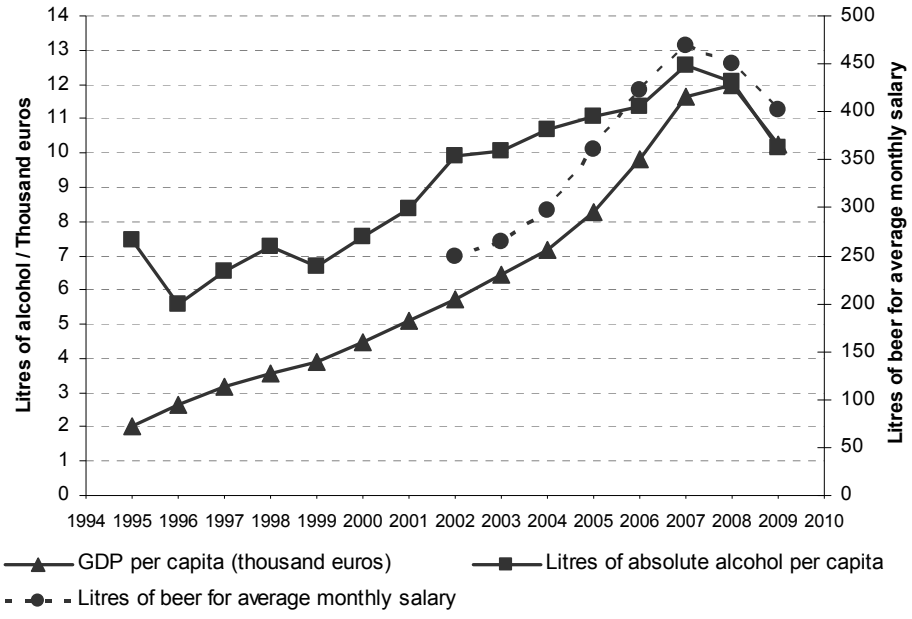


Figure 8. Alcohol consumption (litres of absolute alcohol), GDP (thousands of Euros) per capita (both on left axis) and litres of beer purchasable per average monthly salary in Estonia (right axis), 1995–2009.

Since 2008 advertising of alcoholic beverages on television and radio has been prohibited from 7 am to 9 pm. Before, prohibition ended at 8 pm for alcoholic beverages other than spirits. However, time allocation studies of Estonian adolescents show that at 9 pm 37% of this age group is still watching TV and thus exposed to alcohol advertising while at midnight only 10% of adolescents would be exposed (TNS Emor, 2008). Thus, advertising restrictions could be strengthened and could also extend to print media or even a comprehensive ban on alcohol advertising as suggested by previous research in Estonia (Lai et al., 2004).

Additionally, measures against drunk-driving such as random breath testing on roads are widely applied. The legal blood alcohol concentration limit for motor vehicle drivers in Estonia is 0.02% of blood volume (or 0.1mg/l in breath). These levels were established in 2000 when drunk driving became a criminal offense. However, from the mid-1980s until 2000 the allowed level was zero, but even though the BAC limit is not zero anymore, public discussion, communication of the legislation, etc. still maintain that no (measurable) levels of alcohol are allowed while driving.

Enforcement of alcohol policies has been strengthened in other areas as well, especially in tackling import and production of illegal alcohol and improving tax collection. Public awareness campaigns on inadmissibility of drunk-driving, hazards associated with alcohol, thresholds of hazardous alcohol consumption and other topics have increased both in frequency and volume in recent years. These interventions in combination with other measures described in this paper have been associated with a fall in the proportion of drivers tested who were over the limit from 3.5% in 2002 to 0.8% in 2009. The proportion of automobile injury accidents involving a drunk driver has declined as well – from 22.9% in 2001 to 16.5% in 2009. However, more than 50% of these were under 30 years old in 2009 (Estonian Road Administration, 2010).

Interventions on a personal level, such as alcohol counselling, have had very low priority in Estonia. A new initiative for early identification and counselling of alcohol-related health problems was launched in primary health care in the beginning of 2010 to remedy this situation.

DISCUSSION

12. Population health status

12.1. Burden of Disease

This study clearly showed the extent of the burden of disease in Estonia and its distribution over main causes, sexes, age groups and geographical areas.

In 2002, the Estonian population lost 446 361 years of perfect health. A majority of this loss (60%) was caused by earlier than expected deaths, while diseases and disability during life accounted for 40% of the DALYs. Even though the losses were about evenly distributed between men and women, losses from premature mortality prevailed for men (69% of DALYs) whereas for women they were almost equal to losses from lifetime disability.

Approximately 54% of DALYs in Estonia affect the working-age population (16–64), while men reached 50% of their total DALYs already before age 55. This raises many questions about the productivity of the workforce and overall outlook for the economy if the country's considerable health losses are concentrated in the most productive years of life.

The main disease groups responsible for the DALYs in 2002 were cardiovascular diseases (led by ischaemic heart disease and stroke), external causes (led by suicides and poisonings) and cancers (led by lung and colorectal cancer). These three disease groups are also the main causes of death in Estonia and accounted for 84% of all deaths in 2002 (Statistics Estonia 2011b), so it is not surprising that they also lead in DALY count and losses from premature mortality.

Since 2002, the role of premature mortality in the total burden of disease has slightly declined, reaching 52% by 2006 (Lai and Köhler, 2009). While this may signify improved performance of the health system as premature mortality decreases and life expectancy increases, it also puts further pressure on the health system as people live longer and expect high-quality life and health services through old age (Guralnik et al., 1996; Barondess, 2008; Peel et al., 2005).

The regional burden of disease variation is large, as the number of DALYs per 1000 population differs by a factor of 1.4 in the counties and 6.4 in the municipalities with the best and worst health. Even though the uncertainty margins for regional burden of disease results are very large (due to large population size variations), these differences still warrant consideration, especially since low levels of health are associated with low income, which became an increasingly important health determinant in 2000–2006 (Lai and Köhler, 2009), as financial protection against catastrophic health care expenditures eroded (Habicht et al., 2006). Additionally, longer travel distance from home to county centre has been shown to be associated with higher levels of disease burden as well, even though it is not clear whether it is a factor in its own right

or is mediated through the level of income (Lai and Köhler, 2009). However, previous research has shown that people from rural areas face difficulties in access to health care, particularly specialised care (Habicht and Kunst, 2005; WHO-Europe, 2010).

Burden of disease estimates and Estonian public health policy

Burden of disease estimates have gained an important part in the planning of public health strategies after the first national results were made available. They fuelled debate on public health policy as the magnitude of the impact of poor health became increasingly evident. Burden of disease estimates have been used in planning of all recent national health strategies – the Estonian National Strategy for Prevention of Cardiovascular Diseases 2005–2020 (Ministry of Social Affairs, 2005), the National Cancer Strategy 2007–2015 (Ministry of Social Affairs, 2007) and the National Health Plan 2009–2020 (Ministry of Social Affairs, 2008a). Burden of disease estimates have been also an important instigators for the National Strategy for Injury Prevention, which is currently in preparation. Moreover, the Ministry of Social Affairs has continuously supported further development of the burden of disease methodology (Lai et al., 2003, 2004; Lai, 2006; Lai and Köhler, 2009).

Burden of disease studies have also provided momentum for a more general debate on potential health gains, quality of life and other summary measures of population health like health-adjusted life expectancy. For example, the latter is the main indicator of population health in the overarching National Health Plan 2009–2020 (Ministry of Social Affairs, 2008a). This strategy also sets reduction targets for the burden of disease and health inequalities and increases in health-related quality of life as intermediary health system goals.

12.2. Amenable mortality

Amenable mortality declined considerably (36%) from 2000–2009, and by the end of the period a rate of 157 amenable deaths per 100 000 population had been reached. Moreover, the reduction of amenable mortality was faster than that of all-cause mortality (29%) during the same period. These findings coincide with findings from the burden of disease study, where the role of premature mortality in the total disease burden declined during the last decade.

As in the case of years of life lost in the burden of disease study, there are large gender differences in amenable mortality rates, which are more than two times higher for men. More importantly, health care influenced amenable mortality in men less than it did in women, with respective reductions of 34% and 53% in all-cause mortality reduction in men and women under age 75 from 2000–2009 attributable to health care.

Improving the effectiveness and cost-effectiveness of health care has been an important goal for the Estonian health system since the early reforms after 1991 (Jesse et al., 2004; Koppel et al., 2008). According to a study by Newey et al., (2004) from 1990–1992 the rate of amenable mortality for Estonian men was 221 per 100 000 population and 150 for women, with corresponding shares from all-cause mortality of 20% and 33% (Table 5). There was only a slight decrease in amenable mortality between 1990 and 2000, but the decline has increased significantly since then. Nonetheless, the amenable proportion of all-cause mortality in the 0–74 age-group has remained principally the same regardless of some fluctuations over the years.

Table 5. Amenable mortality and all-cause mortality (both rates per 100 000 population) in Estonia in 1990, 2000 and 2009 along percentage of amenable mortality from total mortality of 0–74 age-group and change in mortality rates in comparison of 1990/2000 and 2000/2009

	Measure	1990[a]	2000	2009	Change (%) 1990 to 2000	Change (%) 2000 to 2009
Male	Amenable mortality[b]	221	216	162	–2.4	–25.0
	All-cause mortality[c]	1128	1063	794	–5.8	–25.3
	Percentage of amenable mortality from total mortality	19.6	20.3	20.4		
Female	Amenable mortality[b]	150	137	88	–8.5	–35.8
	All-cause mortality[c]	454	409	270	–10.0	–34.0
	Percentage of amenable mortality from total mortality	32.9	33.5	32.6		

[a] average for 1990–1991, calculated based on *(Newey et al., 2004)*
[b] excluding ischaemic heart disease
[c] in 0–74 age-group

Recent years have given some indications of a possible additional concern in regard to investment strategies for health improvement. Namely, current data show that from 2006–2008, the reduction of amenable mortality was associated with diminishing returns on health care expenditure. This is at least partly related to the changed investment structure whereby relatively more has been invested in health care personnel salaries (Villsaar, 2009) and working conditions from 2005 onward. This, in connection with other factors like increased investment in medical technology, has raised the average treatment cost per patient without a significant increase in the number of people treated (Villsaar, 2009). However, it should be noted that previous research has shown only weak or no association between amenable mortality and health care expenditure,

while the effects present are believed to be at least partly mediated by socio-economic factors (Mackenbach et al., 1990).

Results from the current study per se do not indicate whether the level of health care performance is good or bad, but a recent publication by Nolte and McKee (2008) provides a basis for an international comparison of current findings. The authors present findings on amenable mortality for 19 OECD countries (including 14 EU members, Canada, New Zealand, Australia, Japan and the United States) for the periods 1997–1998 and 2002–2003. On average, amenable mortality (excluding ischaemic heart disease) accounted for 23% of all-cause mortality for men and 32% for women under 75 in the selected countries in 2002–2003 (Table 6). These results ranged from 15% in France to 27% in the United Kingdom for men and from 25% in France to 36% in Greece and Portugal for women. The average Estonian figures for the same years were 19% for men and 31% for women.

In 2007, Estonian health care was ranked as the most cost-effective in the European Union (Consumer Powerhouse, 2007). However, Estonia did not excel in the report if the numbers and coverage of services where considered on their own, and current results seem to present a similar picture: a relatively high absolute level of amenable mortality in combination with good effectiveness results.

Thus, while amenable mortality levels in Estonia were far below those of OECD countries (women 19% and men 54% below the worst), a relatively low proportion of all-cause mortality was amenable in the country. As mentioned, this can indicate a highly effective health care system but could also indicate higher than average roles of other types of premature deaths. For example, amenable mortality does not cover injuries, which have been an important cause of premature death and lost life years. Such causes of death as motor vehicle accidents, liver cirrhosis and lung cancer have been included as sources of preventable mortality by Nolte and McKee (2004) and Newey et al. (2004). Based on data published by the latter, the average rates of preventable mortality caused by the above-mentioned three causes were approximately 143 and 39 per 100 000 deaths for men and women in 1990–1991. Results from the current study indicate that by 2009 these rates had declined to 89 and 22 respectively. By that time more than half (52%) of these preventable deaths were caused by liver cirrhosis and another 15% were caused by motor vehicle accidents, which are both strongly linked to alcohol consumption (Kaasik et al., 2007; Pärna and Rahu, 2010). While preventable mortality had no clear trend in 2000–2007, there has been a sudden decrease since 2008, coinciding with the global economic downturn reaching Estonia and a considerable decrease in alcohol consumption after years of steady increase (Bank of Estonia, 2010; Estonian Institute of Economic Research, 2010a). Hence, it can be assumed that the economic downturn has helped to reduce preventable mortality by reducing the availability of alcoholic beverages in 2008–2009.

Table 6. Amenable mortality (excluding ischaemic heart disease) in selected OECD countries for period 2002–2003, by gender

Country	Male				Female			
	Amenable mortality		Amenable mortality from total mortality		Amenable mortality		Amenable mortality from total mortality	
	Rate	Rank by rate	Percentage (%)	Rank by percentage	Rate	Rank by rate	Percentage (%)	Rank by percentage
Australia	79	2	23	11	64	4	33	11
Austria	99	10	22	8	71	10	32	10
Canada	86	4	22	7	68	9	29	2
Denmark	105	13	21	4	96	18	29	3
Estonia	**162**	**20**	**19**	**2**	**115**	**20**	**31**	**7**
Finland	120	17	25	15	68	8	32	9
France	73	1	16	1	57	2	28	1
Germany	106	14	23	10	75	12	33	12
Greece	101	11	25	14	68	7	36	19
Ireland	118	16	26	19	89	15	34	18
Italy	83	3	22	6	65	5	34	16
Japan	89	8	25	16	54	1	34	17
Netherlands	88	6	21	5	76	13	30	4
New Zealand	103	12	25	18	89	16	34	15
Norway	89	7	23	9	71	11	31	8
Portugal	125	19	25	13	85	14	36	20
Spain	88	5	21	3	60	3	33	14
Sweden	90	9	25	17	67	6	31	6
United Kingdom	117	15	27	20	90	17	33	13
United States	123	18	24	12	96	19	31	5

Source: *Nolte and McKee, 2008*

Additionally, it is important to note that not only preventable mortality but also amenable mortality is tightly linked to health behaviour. For example, 16% of deaths from the three main causes of amenable mortality (hypertension, ischaemic heart disease and stroke) are attributed to hazardous alcohol consumption (Lai et al., 2004). The links between health behaviour and amenable mortality are even more relevant in a wider health system organisation and financing context, as many interventions traditionally considered part of public health are actually provided in health care settings and funded from health care budgets, as exemplified by the EHIF portfolio (EHIF, 2010).

The results of this study also provide information for policy-makers interested in potential gains achievable by targeting interventions at amenable mortality. Avoiding all amenable deaths in Estonia in 2009 would have given a 2.7-year increase to life expectancy at birth. The latest data show that 2009 life expectancy was 75.0 years, a 4.5-year increase since 2000 (Statistics Estonia, 2010b). About 1.1 years of this increase was associated with a reduction in amenable mortality. By comparison, the potential life expectancy gain from amenable mortality in 2009 corresponds approximately to the improvements in population health over last five years. Moreover, the main health system goal as described in the National Health Plan 2009–2020 (Ministry of Social Affairs, 2008a) is an 80-year life expectancy at birth by 2020, and averted amenable mortality would provide half of this target. The main source of this potential increase lies in reducing cardiovascular and cancer deaths. At the same time, inequalities of avoidable mortality among education groups contribute approximately 24% of their life expectancy differences, one of the worst results in Europe (Stirbu et al., 2010).

14. Alcohol interventions and policy

Cost-effectiveness of alcohol policy in 2004

Cost-effectiveness analysis of interventions against alcohol consumption showed that in 2004 there were several very cost-effective possibilities for reducing the disease burden of hazardous alcohol consumption. The WHO Commission on Macroeconomics and Health (2001) has suggested that all interventions that cost less than per capita GDP can be considered very cost-effective uses of societal resources. For Estonia, this would mean that all interventions that did cost less than 90 454 EEK (€5781) per DALY in 2004 (Statistics Estonia, 2011c) could be considered cost-effective. Thus, all modelled interventions to reduce hazardous alcohol use would have been cost-effective at the time and from a cost-effectiveness point of view, all the interventions analysed were advisable for implementation. Still, it is important to note that cost-effectiveness information is only one input for decisions to improve population health, while there are other political and public interests with legitimate health-system goals

(e.g. reducing health inequalities) and overall economic policies to consider (Baltussen and Niessen, 2006; Goddard et al., 2006).

Notably for 2004 policy discussions, the study results showed that the intervention mix in place did not appear on the expansion path i.e. it was not the most cost-effective combination. Thus, a tax increase, improved coverage of interventions and better enforcement could have saved more DALYs, possibly even within the existing budgetary range, using resource reallocation.

The implementation and effective coverage of alcohol policies or interventions was variable and could have been improved. For example, the implementation of restrictions on access to alcohol was highly variable in 2004, with some municipalities disallowing 24-hour alcohol sales while others bypassed such restrictions. Reaching consensus on policy changes and provision of sufficient resources for intervention enforcement were the two key tasks that had to be addressed for successful expansion of interventions.

Personal interventions like brief counselling in primary health care proved to be cost-effective as well, indicating that an additional scaling-up of them is economically justified. As the whole population of Estonia is covered by a functioning primary health care system (Koppel et al., 2008), it is possible to reach out to all population groups (Habicht and Kunst, 2005) and implement these personal interventions through family doctors and nurses. Training the health care workforce to provide necessary patient support for behavioural change remained an important challenge, since previous research showed that family practitioners saw limited use for this approach in the case of alcohol use, especially compared to primary health care specialists in other European countries (Brotons et al., 2005).

Overall, the study of alcohol interventions cost-effectiveness indicated the superiority of general, impersonal interventions. It also stressed the crucial role of other sectors beyond the health system per se, including instruments of fiscal policy such as excise taxes. In discussions following publication of the results, it was suggested that an increase in alcohol excise taxes might induce inflation, and thus conflict with monetary policy in advance of introducing the euro in coming years. These considerations illustrate the conflicting national policy priorities that come to bear on public health interventions. However, the study provided grounds for policy discussion on health policy and resource allocation with actors within and beyond the health system, e.g. in the debate on the adequacy of excise tax increases.

Alcohol policy since 2005

While studies on alcohol-related harm (Kaasik et al., 2007; Paasma et al., 2007, 2009, 2010; Pärna and Rahu 2010) and its economic impact (Reinap, 2009; Saar, 2009) have been conducted in Estonia in recent years, no other study has approached the cost-effectiveness of alcohol interventions. Thus, the role of the cost-effectiveness study presented in this thesis remains significant to alcohol

policy discussions. The review alcohol policy changes from 2005–2010 showed that most of those proposed had been applied, but not at the levels suggested. Monetary policy was prioritised over public health and the taxation decisions were postponed while alcohol affordability and consumption increased rapidly until 2008. When taxation increased, these changes were still mostly based on national fiscal policy concerns or adaptation of European Union agreements, and public health concerns were addressed only secondarily. While cost-effectiveness analysis indicated that a tax increase would be most effective, other supportive measures were somewhat strengthened as well. For example, television ad-ban intervals were slightly increased when intervention modelling suggested a total ad-ban extending to print media and cultural event sponsorship or the unification of alcohol sales time limits under national jurisdiction.

While alcohol consumption has decreased moderately since 2008, it is currently unclear how much of the decline was caused by policy changes and how much was an effect of the economic downturn, since both affected affordability and presumably reinforced each other. Thus, when economic growth returns there will be a clear need to strengthen alcohol policies to compensate for the lost effect of the economic downturn. It has been shown that affordability is one the most important predictors of alcohol consumption in a population (Booth et al., 2008; Seabrook, 2010).

Currently, no data is available on 2010 alcohol consumption, but preliminary data show a decline in production while price increases seem to be concentrated on high-end product categories, leaving the prices of most common beverages relatively stable (Estonian Institute of Economic Research, 2010b). Hence preventing future decline in the relative price of alcohol and therefore an increase in affordability via excise tax remains a priority option to sustain the consumption reduction of the last two years. However, it is essential to employ a comprehensive alcohol policy where price regulation is used in a systematic and synergistic combination with other effective and cost-effective measures (Lai et al., 2004; WHO-Europe, 2009).

Examples of additional policy actions worth consideration include reducing the density of alcohol outlets, more comprehensive bans spanning all types of advertising (especially those influencing young people), clearer separation of alcoholic beverages from other goods in retail stores and further expansion of the brief alcohol interventions in primary health care initiated in 2010. These need to be supported by improved enforcement of restrictions and public awareness campaigns. And finally, Estonia still lacks a comprehensive alcohol policy that could be used to coordinate action against hazardous consumption.

15. Contextualising methodology and tools

Two studies presented in this thesis included some form of contextualisation for improved correspondence to the national situation. In the burden of disease study, contextualisation included changes in both methodology and input data. In the cost-effectiveness study of alcohol interventions, it was mostly focused on input data. The following sections discuss the effects of contextualisation for both studies.

Burden of disease

The burden of disease concept is very attractive for its power to draw together data from different sources and present this in a systematic and generalised manner. The methodology used in the GBD study is very well suited for comparison of world regions and countries but contextualised results would be more acceptable to policy-makers and the general public on the local level (Mathers et al., 2001; Morrato et al., 2007). Thus, use of disease classification corresponding to local disease profiles and use of routinely collected data for dynamic monitoring of population health would be useful to help the adoption of a measure like burden of disease. Subnational estimates and inclusion of national disease severity assessments in the form of disability weights would increase the appeal of a new measure and its usefulness for the national health policy process even more. Following these considerations, the burden of disease study provided country-specific estimates for national and subnational health policy decision-makers in a manner that enables local comparisons, continuous surveillance and use of routinely collected data.

While contextualisation does improve the national uptake of the results as, indicated previously in relation to Estonian national health strategies and continuous use by Ministry of Social Affairs, the ability to perform direct international comparisons is reduced. This can be described as one of the main weaknesses of the contextualisation even though national burden of disease estimates differing from the traditional approach continue to be published (Essink-Bot et al., 2002; Bradshaw et al., 2003; Yoon et al., 2007). On the other hand, concerns have been raised about the adequacy of GBD methodology (Anand and Hanson, 1997; Arnesen and Nord, 1999; Gold and Muennig, 2002; Brhlikova et al., 2011), lending further support to contextualisation and development of the methodology.

Even though direct comparisons between the Estonian national burden of disease estimates and those provided by WHO (WHO, 2011c) should be made with caution, Table 5 provides a cursory overview of the issue, listing percentages of total burden attributed to the 20 leading causes from WHO estimates in parallel to national findings. The most notable difference from similar lists is in unipolar depression. The different disability weights used cause an

almost twofold divergence of the results – an average national weight for depression is 0.140 compared to 0.275 for the EurC region in the GBD study (Mathers et al., 2004). The disability weights in the GBD study have received much international criticism, especially in the case of unipolar depression, with indications of significant overestimation of the condition (Andrews et al., 1998; Arnesen and Kapiriri, 2004) that support the use of national disability weights.

At the same time, the health service utilisation-based prevalence data does not influence our overall findings greatly in the situation where 60% of DALYs are caused by premature mortality from a relatively small number of causes. As Table 5 indicates, the GBD study did find a 13% share of the total burden for ischaemic heart disease, compared to the current 17%, while the estimates for stroke are even closer (11% vs. 10%). Comparison of disease rankings reveals better representation of different causes of burden in the current study – the top-20 account for 61% of the total burden, compared to 92% in the WHO estimates. That said, a national comparative study using full GBD methodology but national input data to its full extent might help to further our understanding of differential effects of the methodology and data used.

As indicated before, premature mortality accounts for almost 70% of the burden of disease for men but is on par with lifetime losses for women in the current study. These YLL gender differences are even more significant when one takes into account that they were calculated using Estonian gender-specific life expectancies, which are much longer for women (e.g. 11.8 years longer at birth in 2002) (Statistics Estonia, 2010b). The use of actual life expectancies instead of the GBD artificial ones affects the relative valuation of health policy measures, as men and women suffer to different extents from various diseases (Lyttkens, 2003). However, men would have lost many more life years if the comparators had been the EU average gender-specific life expectancies, where the gender gap is smaller, and still more if some ideal life expectancy equal for both genders were used. In the latter eventualities, the currently witnessed overall gender balance of burden of disease would not exist and the number of DALYs lost by men would have been much higher than that for women.

One of the other methodological changes from the GBD standard approach was not to use age weighting. As other authors have indicated, age weights carry a strong value judgement and are best left to policy-makers and wider public discussion (Williams, 1999). Current findings place 54% of the burden of disease in the working-age population. Use of age weighting in the form used in the GBD study would increase this proportion significantly at the expense of children and older population groups. In hindsight, it can also be said that such devaluing of children does not correspond to Estonian public values as presented in the National Health Plan 2009–2020, which places the health of children on the same level as the performance of the whole health care system (Ministry of Social Affairs, 2008a).

Table 5. Comparison of Estonian burden of disease results from the national study (2002) and WHO estimates (2004)

Rank	WHO estimates (for 2004)	Percentageof total DALYs	National estimates (for 2002)	Percentage of total DALYs
1	Ischaemic heart disease	13	Ischaemic heart disease	17
2	Cerebrovascular disease	11	Stroke	10
3	Unipolar depressive disorders	7	Hypertension	4
4	Other unintentional injuries	6	Lung cancer	2
5	Poisonings	5	Suicide	2
6	Alcohol use disorders	5	Poisonings	2
7	Self-inflicted injuries	5	Osteoarthritis	2
8	Hearing loss, adult onset	5	Cardiomyopathy	2
9	Road traffic accidents	5	Liver cirrhosis	2
10	Violence	4	Chronic obstructive pulmonary disease (COPD)	2
11	Osteoarthritis	3	Other injuries	2
12	Inflammatory heart diseases	3	Traffic injuries	2
13	Cirrhosis of the liver	3	Other diseases of heart	2
14	Trachea, bronchus, lung cancers	3	Colorectal cancer	2
15	Lower respiratory infections	3	Pneumonia	2
16	Falls	3	Stomach cancers	1
17	Vision disorders, age-related	2	Cardiac insufficiency	1
18	Alzheimer and other dementias	2	Breast cancer	1
19	Fires	1	Homicide	1
20	Stomach cancer	1	Cataract	1

Altogether, the contextualisation of methodology did allow significant simplification of it. While simplification is not an end in itself , it is still important in a situation were international criticism had called the GBD methodology untransparent and entangled to a degree that only its developers could understand the effects of all the implicit value judgments and data manipulations (Arnesen and Kapiriri, 2004). Moreover, simplification of methodology makes it easier to grasp the implications of the results for policy processes and thus increases chances for actual use and impact, while the main results themselves remain comparable to previous findings at the lower levels of capacity needed for calculation.

Modelling of alcohol interventions

As indicated in the beginning of this section, the cost-effectiveness study of alcohol interventions used data contextualisation, but refrained from methodological changes of the WHO-CHOICE framework (other than not using age weighting). While an extensive dataset was available on the burden of disease related to hazardous alcohol abuse, little was known about the country-specific effectiveness of interventions, and the data on this was retrieved from the international literature. To adjust these estimates more to the Estonian situation, a panel of experts reviewed available information and adjusted the knowledge to local situation.

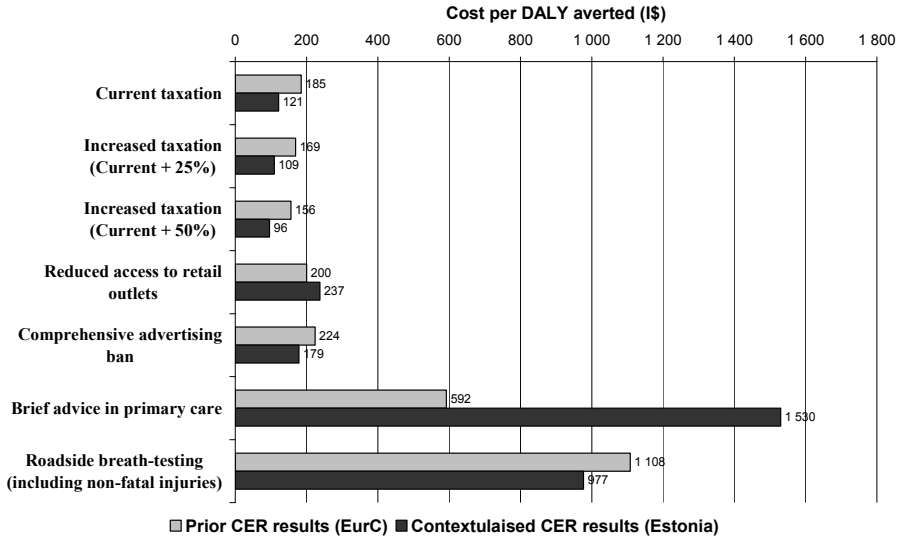


Figure 9. Cost-effectiveness ratios (CER) of selected alcohol interventions before and after contextualisation with costs in international dollars (I$) and effects in disability adjusted life years (DALYs, discounted and age-weighted).

The contextualisation of WHO-CHOICE proved to be a feasible and useful process. Figure 9 shows the difference between the WHO-CHOICE results for the Eastern Europe and those for Estonia. The contextualisation changed the results for alcohol interventions considerably. The order of most cost-effective interventions was changed in two cases – advertising ban and random roadside breath testing among alcohol interventions moved up by one place relegating access restrictions and brief counselling in primary care to the 6th and 9th position, respectively. This was driven by several factors such as differences in epidemiology, administration costs and other input factors. These results again show that contextualisation presumable brings the regional results closer to the national reality and should be applied also in other country-specific exercises.

16. Overall health policy implications

Papers incorporated into the current thesis set out to provide additional information for the evidence base of Estonian population health policy with an ultimate goal of supporting population health improvement. Each of the four papers focused on generating information for different steps of the policy development process, even though some overlaps exist. Moreover, the papers intended to introduce amenable mortality, a measure previously unavailable or underused in the country.

Health problems of the Estonian population

Burden of disease findings show that the Estonian population loses approximately 450 000 life years annually. More accurately, these are additional life years that would result in a case of perfect health. The 179 222 life years lost due to morbidity translate into approximately 48 days lost per person in 2002 because of the diseases and ill conditions suffered in that year. Even though it is beyond the scope of current work, we can readily assume that there are significant productivity opportunities lost in addition to costs associated with treatment of these diseases. While morbidity losses are for one year in this study, life years lost are a projection into the future and have a longstanding effect on the population's contribution to society and the economy. For example, an Estonian study found that a 1.5% per annum reduction in adult mortality rates over 25 years could generate approximately 14% higher per capita GDP at the end of the period compared to the scenario with no adult mortality reduction (WHO-Europe 2006).

In the same year as the first burden of disease estimates in Estonia, there were 18 270 deaths in the country and 4662 (~26%) of these would have been avoidable through timely and effective action in health care and public health. Health care performing at its best could have averted 3617 (~19%) of these

deaths. By 2009, 2515 of deaths out of 16 092 were still amenable. Amenable deaths are by definition premature and thus averting these deaths would have a significant impact in reducing the burden of disease. In actuality, the proportion of the burden of disease caused by premature deaths had declined to 52% by 2006 from 63% in 2002 (Lai and Köhler, 2009). However, the levels of the burden of disease caused by morbidity had increased and the relative importance of chronic diseases increased, and overall levels of the burden of disease did not fall. At the same time, levels of amenable mortality for men are much higher than for women and more than half of burden of disease for men is from working-age population (age group 16–64), which has a 75% share of premature mortality.

Thus, the implication for Estonian health policy is that regardless of some improvement in premature mortality, a strong focus on averting premature deaths is necessary, especially for men of working age. Another implication is that deaths prevented and postponed are likely at the root of increasing morbidity, disabilities and burden of disease. This indicates a constantly increasing need for health care services that at the moment is especially pronounced for women. It is also worth mentioning that the primary target of the recently adopted National Health Plan 2009–2020 is an increase of life expectancy with healthy life expectancy only a secondary consideration and predictably increasing morbidities get scarce attention.

Sources and causes of health problems

Leading sources of burden of disease in Estonia are cardiovascular diseases, cancers and injuries, which are responsible for approximately 60% of the overall burden of disease. Cardiovascular diseases and cancers are also leading sources of amenable mortality and hence it is not surprising that their share of premature mortality is high as well. While injuries are not included in the calculation of amenable mortality, the burden of disease caused by them comes almost entirely from premature deaths, mostly of men.

From 2000–2009, the effectiveness of Estonian health care remained stable or increased slightly as indicated by the share of amenable deaths from all-cause mortality among people under age 75. However, there were large gender differences, as this proportion was 19% for men and 31% for women. This difference implies either that health care is especially effective in the case of men or that non-amenable causes of death are more important for men than for women. Given the high portion of men's burden of disease from premature deaths from injuries, the second explanation seems more plausible.

While direct association between health care expenditure and amenable mortality has not been proven, the link between amenable mortality and socio-economic status has been. It is also likely that effects between health care expenditure and amenable mortality are mediated through variation in socio-economic status and specific details of service provision (Mackenbach et al.,

1990). Results of the current study show that the increase in Estonian health care expenditure has corresponded with diminishing returns in amenable mortality from 2006–2008, when personnel costs and investments in medical inventory had an increasing share of overall health care financing.

At the same time, findings of current studies also indicate that the burden of disease in municipalities is correlated to income levels, and to the distance of the municipality from larger centres where service provision tends to concentrate. This could be confounded by income levels in municipalities, but comparisons over time have shown that low income has become an increasingly important determinant of high burden of disease, especially in more rural areas (Lai and Köhler, 2009). Simultaneously, other research has shown that inequalities in health service use have increased (Habicht and Kunst, 2005; Lai, 2010; WHO-Europe, 2010). Moreover, research has also shown that there are significant differences in life expectancy among education groups, of which 24% are due to inequalities in amenable mortality (Stirbu et al., 2010).

Diseases that are the major causes of the burden of disease and amenable mortality are also strongly linked to the high prevalence of behavioural health risks (Lai et al., 2004; WHO-Europe, 2010), while hazardous alcohol consumption stands out. For example, 70% of men and 44% of women who were killed in motor vehicle accidents in Estonia in 2000–2002 had elevated blood alcohol levels (Kaasik et al., 2007) while a dramatic increase in liver cirrhosis mortality closely followed increases in alcohol consumption (Pärna and Rahu, 2010). In 2007, alcohol consumption in Estonia reached 12.6 litres of absolute alcohol per capita after many years of steady increase (Estonian Institute of Economic Research, 2010a) while 16% of deaths from hypertension, ischaemic heart disease and stroke (the main causes of amenable mortality) were attributable to hazardous alcohol consumption (Lai et al., 2004).

Thus, the implication for Estonian health policy is that while cardiovascular diseases, cancers and deaths from external causes are the main sources of ill-health, more attention should be paid to causes such as hazardous alcohol consumption. Another implication is that in coming years it will be increasingly important to increase health care effectiveness, as more and more of the burden of disease is caused by morbidity. However, it is even more important to improve action outside health care, which is already relatively effective and a very large proportion of premature mortality is not amenable to health care but rather by public health action. And finally, in doing all the above, a reduction of income disparity and regional, educational and other socioeconomic inequalities could contribute significantly to improving population health.

Action to improve population health

Hazardous alcohol consumption causes the highest level of attributable burden of disease in Estonia (Lai et al., 2004). The affordability of alcoholic beverages increased steadily from 1996–2007 to become one of the greatest in Europe,

accompanied by a corresponding increase in alcohol consumption (Rabinovich et al., 2009; Estonian Institute of Economic Research, 2010a). In 2004, alcohol consumption reached 10.7 litres of pure alcohol per capita which corresponds to 14.7 litres of absolute alcohol per adult, placing Estonia second in the WHO European Region after the Czech Republic, according to the WHO Health For All database (WHO-Europe, 2011).

Findings of this study indicate that the intervention mix in place at the time was neither the most effective nor cost-effective in reducing hazardous alcohol consumption or burden of disease associated with it. Among the population level interventions modelled in the study, a 50% increase in the alcohol excise tax was the most cost-effective, even considering the increase of black market alcohol as a side-effect. Interventions like a comprehensive advertising ban and sales restrictions as well as scaled-up random breath testing on roads and brief interventions in primary health care were also cost-effective. The most useful action based on the results of the study would have been a systematic combination of all the single interventions.

Since 2005, the action taken to strengthen alcohol policy has included higher taxation, slight reinforcement of ad-bans and sales restrictions. However, all these actions remain below the levels suggested by the 2004 analysis. Moreover, even though a comprehensive alcohol policy reached a government hearing in 2009, it was not adopted as an official policy document and the changes in alcohol policy are mostly not an effect of coordinated policy. While alcohol consumption decreased during 2008–2009 and is likely to decrease further in 2010, it is currently unclear how much of this is an impact of the global economic downturn and how much is caused by reinforcement of alcohol policy.

Thus, the implication is that there is room for strengthening policies regarding alcohol, which still remains an important contributor to both the burden of disease and amenable mortality.

CONCLUSIONS

1. Current study provided the first national and sub-national burden of disease estimates for Estonia and added a dimension to health measures already available.
   1.1. The study highlighted the combined mortality and morbidity impact of the prevalent diseases on population health in Estonia, where cardiovascular disease, external causes and cancers are the biggest concern while severe disabilities associated with diseases of joints and muscles did raise this disease group into a position not seen in traditional mortality and morbidity statistics.
   1.2. Priority population groups for public health interventions and burden aversion are people in the working age, men under age 35 and persons living in north- and south-east regions of Estonia.
   1.3. Sub-national burden of disease results showed correlation to the socio-economic development of the region, where higher levels of burden were seen in the more distant areas with lower income and employment levels.
2. The progress made in reducing amenable mortality in Estonia from 2000 to 2009 has been considerable while amenable mortality also declined faster than all-cause mortality.
   2.1. However, amenable mortality for Estonian men is more than two times higher than for women and this gender gap is at least partially responsible for Estonia lagging far behind other OECD countries if amenable mortality and life expectancy are considered.
   2.2. Results of amenable mortality indicate that Estonian healthcare is effective but recent years have provided diminishing returns from investments and for further increase of effectiveness new initiatives and resource allocation policies have to be launched.
   2.3 Healthcare action to avert amenable mortality could potentially provide almost half of the life expectancy increase that national health policies target by 2020 while public health efforts to improve population health behaviour play important supportive role in realisation of this potential.
3. Broad implementation of cost-effective alcohol interventions was warranted in 2004 as intervention mix in place was neither the most effective nor cost-effective.
   3.1. The most cost-effective intervention for strengthening alcohol policy in 2004 was an increase in taxation (by 50%), followed by comprehensive advertising bans and reduced access to retail outlets of alcoholic beverages.
   3.2. Population-level interventions were more cost-effective than person-level interventions (counselling in primary health care and random breath testing on roads) while the combination of all interventions was

the most effective in the analysis and also significantly more cost-effective than person-level interventions on their own.

4. Alcohol policy in Estonia was strengthened from 2005 to 2010 but not to the levels suggested by research on 2004 situation.
   4.1. Majority of policy changes affected the affordability of alcoholic beverages as did the economic downturn. There will be a clear need to further strengthen alcohol policies in Estonia to compensate the lost effect of economic downturn when economic growth is regained.
   4.2. Priority action to strengthen alcohol policy in Estonia include the reduction of the number of alcohol outlets, more comprehensive ad bans that span all types of alcohol advertising, clearer separation of alcoholic beverages from other goods in retail stores and full implementation of brief alcohol interventions in primary health care.

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Annex 1. Overview of WHO-CHOICE modelling framework

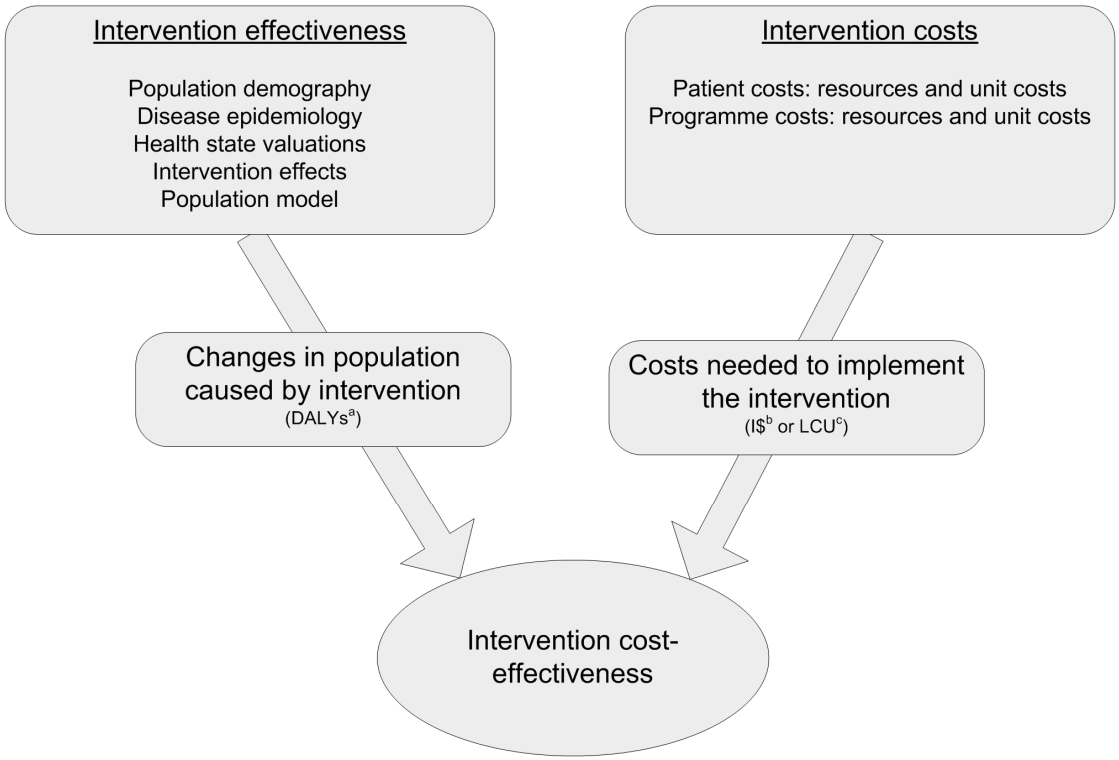

Figure A1.1. Overview of procedure to estimate cost-effectiveness of interventions using WHO-CHOICE modelling framework.

[a] – disability adjusted life years (DALYs); [b] – international dollars (I$); [c] – local currency unit (LCU)

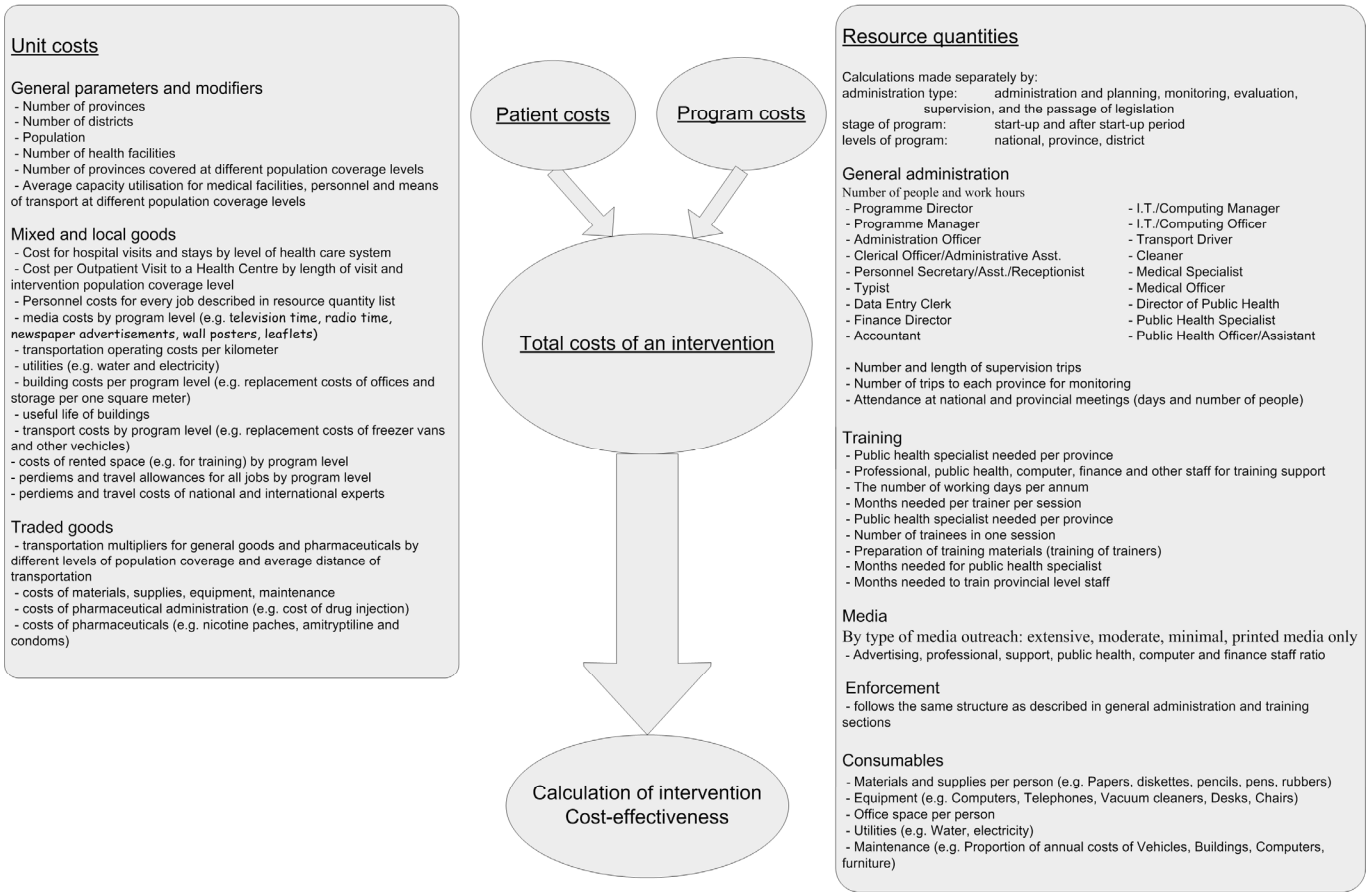

Figure A1.2. Calculation steps and common data for intervention cost estimation in WHO-CHOICE modelling framework.

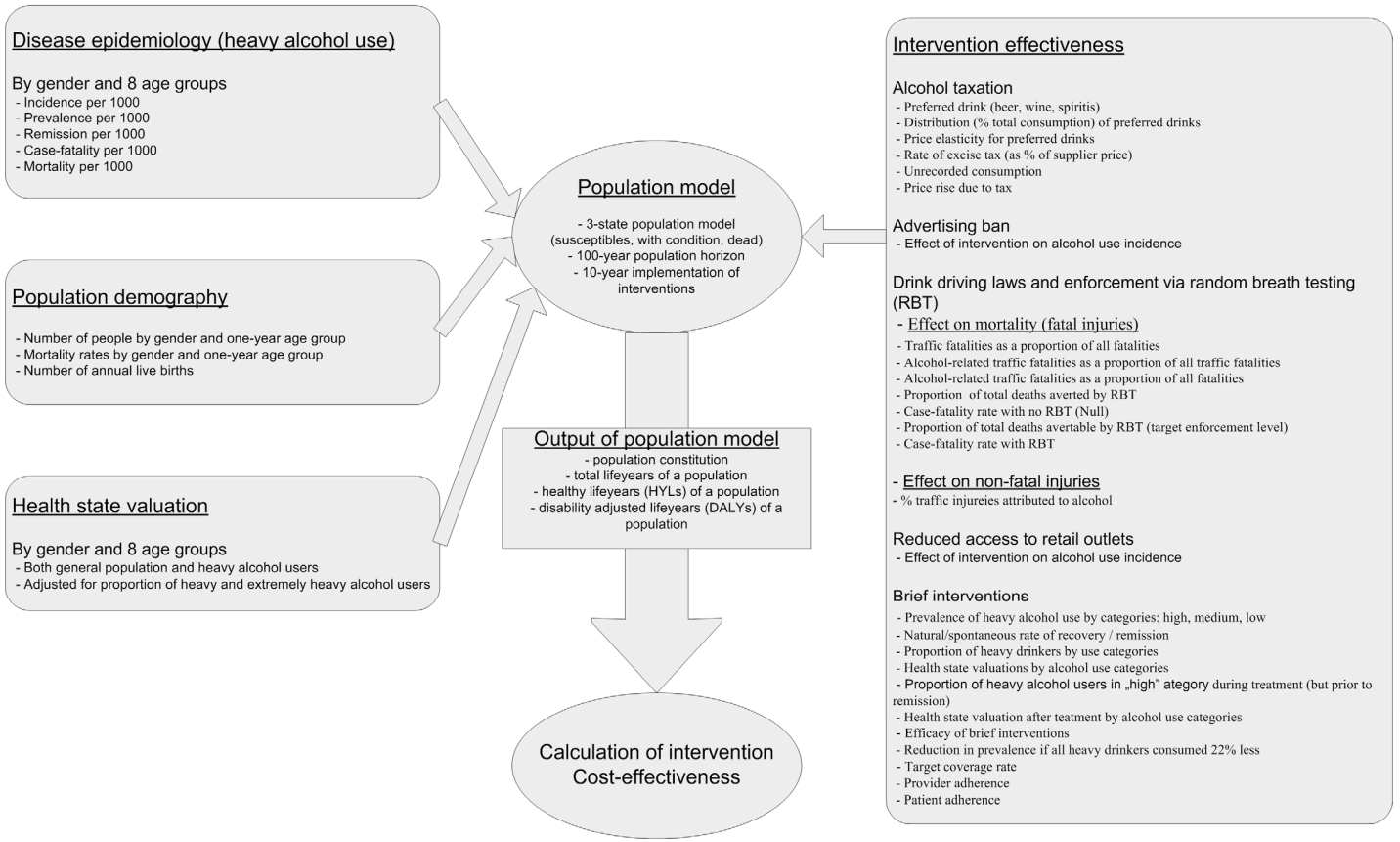

Figure A1.3. Calculation steps and common data for intervention effect and effectiveness estimation in WHO-CHOICE modelling framework.

SUMMARY IN ESTONIAN

Rahvastiku tervise mõõdikud tõenduspõhise tervisepoliitika toetuseks Eestis

Kirjanduse ülevaade

Kõikide tervisesüsteemide eesmärgiks on pakkuda parimat võimalikku tervist rahvastikule ja selle kõigile liikmetele (Roberts jt, 2008; WHO, 2000). Kuigi tervisesüsteemide jaoks on kirjanduses pakutud ka teisi eesmärke, jääb parimate tervisetulemuste saavutamine siiski peamiseks. Meie arusaamad kontseptsioonidest, nagu tervis, rahvastiku tervis ja tervisesüsteem, on viimase 60 aasta jooksul märkimisväärselt arenenud ja laienenud (Evans ja Stoddart, 1990). Näiteks hõlmab tervisesüsteemi definitsioon praegu nii tervishoidu, tervisedendust ja ennetust nagu ka kõiki teisi teenuseid, poliitikaid ja kontekstuaalseid tegureid, mis aitavad kaasa tervise paranemisele (WHO Regional Office for Europe 2008). Need arengud on meid tervisesüsteemi mõistmisel lähemale toonud algsele Maailma Terviseorganisatsiooni (WHO) tervise definitsioonile aastast 1948, mis märgib: "Tervis on täieliku füüsilise, vaimse ja sotsiaalse heaolu seisund, mitte üksnes haiguse või põduruse puudumine " (WHO, 1948).

Siiski varieerub tervisesüsteemide toimivus ja nende võime mõjutada tervise paranemist märkimisväärselt. Selle tulemusena on tervisesüsteemid oma eesmärgi saavutamiseks pidevas muutumises ja arengus ning ideaaljuhul tugineb see täielikult teadmistepõhistele otsustele (Frenk jt, 2003). Teadmistepõhise tervisepoliitika arendamise kõigis etappides on erinevad teabevajadused: poliitika arendamise esimestes etappides on rõhk kirjeldavatel andmetel, hiljem kandub rõhk aga üha enam terviseprobleemide põhjuste ja tervise parandamisele suunatud sekkumisvõimaluste tuvastamisele (Roberts jt, 2008).

Tervisesüsteemi pideva arengu aluseks on rahvastiku tervise taseme ja jaotuse mõõtmine. Teadmine sellest, milline on rahvastiku tervis näiteks soo, vanuse, piirkonna ja teiste kategooriate lõikes, annab meile alguspunkti rahvastiku tervise parandamiseks. Lähtuvalt sellisest kirjeldavast teadmisest on võimalik valida valdkondi ja rahvastikurühmi, kus sekkumistegevused on kõige vajalikumad ning kus on võimalik rahvastiku tervist enim parandada (Morrato jt, 2007).

Erinevaid mõõdikuid rahvastiku tervise hindamiseks ja tervisepoliitika toetamiseks on loodud väga suurel hulgal. Klassikaline lähenemine eeldab suremuse ja haigestumuse mõõtmist, kuid eluea pikenemise ja kõrge elukvaliteedi üha olulisemaks muutumise tingimustes on maailmas üha suuremat populaarsust saavutanud summaarsed rahvastiku tervise mõõdikud (Etches jt, 2006). Need liidavad ühtseks tervikuks suremuse, haigestumuse ja elukvaliteedi andmed ning sageli kombineerivad neid ka meie nägemusega ideaalsest tervisest (Murray jt, 2002). Levinuimate summaarse rahvastiku tervise mõõdikute hulka kuuluvad näiteks tervisele kohandatud eluaastad (*quality adjusted life years* e.

QALY), vaevustele kohandatud eluaastad (*disability adjusted life years* e. DALY), tervisele kohandatud eeldatav eluiga (*health-adjusted life expectancy* e. HALE) (Gold jt, 2002).

Tervise parandamisele suunatud sekkumiste planeerimisel on oluline teada, kui suurt tervise paranemist on teoreetiliselt võimalik saavutada eri seisundite ja rahvastikurühmade puhul. Jõupingutused tuleb suunata sinna, kus võimalik tervise paranemine on suurim. Üks meetod, mille abil saab hinnata võimalikku potentsiaali tervise parandamiseks, on välditav suremus. See mõõdik näitab enneaegsete surmade arvu, mida perfektselt toimiva tervishoiu tingimustes oleks võimalik ära hoida (Nolte ja McKee, 2003). Samuti on oluline teada, millised konkreetsed sekkumised on erinevates olukordades kõige tõhusamad ja kulutõhusamad rahvastiku tervise parandamiseks. Viimane on eriti oluline, sest tervisesüsteemid toimivad pidevate ressursipiirangute tingimustes ja iga investeering peaks seega tootma võimalikult palju tervisetulemit (Drummond jt, 2007).

Eesti tervisesüsteemi reformid on alates 1991. aastast olnud laiaulatuslikud ja põhimõttelised ning rahvastiku tervis on praeguseks oluliselt paranenud (Koppel jt, 2008). Eesti tervisesüsteemi reformid hõlmasid muu kõrval ka erinevate tervise infosüsteemide arendamist, mis tagavad strateegilise võimaluse rahvastiku tervise pidevaks, rutiinseks ja süsteemseks mõõtmiseks kõigil tervisepoliitika arendamise etappidel.

Eesmärgid

Käesolev doktoritöö põhineb neljal teadusartiklil, mis käsitlevad Eesti rahvastiku tervist ning selle parandamise võimalusi. Töö üldeesmärk oli panustada Eesti tervisepoliitika teadmistepõhisusse, kasutades Eesti oludes uudseid rahvastiku tervise mõõdikuid terviseprobleemide, nende põhjuste ja lahendusvõimaluste leidmiseks. Sellest tulenevalt olid käesoleva doktoritöö alaeesmärgid järgmised:

1) analüüsida Eesti rahvastiku tervise olukorda tervisekaotuse metoodika alusel (artikkel I);
2) analüüsida rahvastiku tervise parandamise võimalusi välditava suremuse metoodika alusel (artikkel II);
3) leida kõige tõhusamad ja kulutõhusamad sekkumised tervist kahjustava alkoholitarvitamise ennetamiseks (artikkel III);
4) anda ülevaade Eesti alkoholipoliitika muutustest aastatel 2005–2010 pärast sekkumissoovituste avalikustamist (artikkel IV).

Meetodid ja materjalid

Käesolevas uurimistöös on Eesti rahvastiku tervisekaotuse leidmiseks kasutatud Eesti Statistika suremusandmeid ja andmeid eeldatava eluea kohta soo ning

vanuse järgi aastal 2002. Samuti on kasutatud Eesti Haigekassa kõikseid haigestumusandmeid sama aasta kohta ja ekspertrühma hinnanguid haigusseisundite raskuse kohta (Lai jt, 2003). Tervisekaotus koosneb suremuskaotusest (eeldatava eluea ja tegeliku surma vanuse erinevus) ja haiguskaotusest (haigena veedetud aeg korrutatud haiguse raskusega) ning seda väljendab vaevustele kohandatud eluaastate arv rahvastikus või rahvastikurühmades. Arvutused tehti 5-aastastes soo-vanusrühmades, eraldi kõigi kohalike omavalitsuste, maakondade ja tervisekaotuse põhjuste lõikes.

Välditava suremuse leidmiseks on käesolevas uurimistöös kasutatud Eesti Statistika kõikseid suremusandmeid aastate 2000–2009 kohta. Kasutatud metoodika (Nolte ja McKee, 2004) mõõdab üksnes tervishoiusekkumiste poolt välditavaid surmasid, kuid ei kajasta ennetustegevustega välditavaid surmasid. Välditavate surmapõhjuste loetelu ja välditavuse vanuspiirid pärinevad samast allikast. Üldine vanusepiir surma enneaegsuse määramiseks oli 75 eluaastat, kuid näiteks lapsepõlves põetud haiguste puhul oli välditavuse vanuspiir madalam. Tulenevalt käitumuslike terviseriskide suurest rollist südame isheemiatõve puhul, kaasati sellel põhjusel enne 75 eluaastat toimunud surmadest analüüsi vaid pooled. Surmajuhud standarditi Euroopa standardrahvastikule. Lisaks leiti uuringus välditavate surmade osakaal kõigist 0–74 vanusrühma surmadest ja seda näitajat kasutati tervishoiusüsteemi efektiivsuse hindamiseks (Tobias ja Yeh, 2009; Chau jt, 2010). Lõpuks leiti välditavate surmade ärahoidmise teoreetiline mõju rahvastiku sünnihetke eeldatavale elueale ning dekomponeeriti see välditavate surmapõhjuste lõikes (Pollard, 1988).

Alkoholi liigtarvitamisest tingitud tervisekaotuse vältimiseks kasutatavate sekkumiste kulutõhususe hindamiseks kasutati WHO-CHOICE metodoloogilist raamistikku ja analüüsivahendeid. Lähenemise eripäraks on võimalus hinnata lisaks uutele sekkumistele ka olemasolevate sekkumiste kombinatsiooni, mis põhineb dünaamilise rahvastikumudeli kasutamisel (Tan Torres-Edejer jt, 2003). Analüüsi lähtepunktiks olid regionaalsed (WHO Euroopa regiooni) lähteandmed (Chisholm jt, 2004), mis võimalusel asendati Eesti andmetega. Kuna WHO-CHOICE kasutab komponentlähenemist, siis oli võimalik kontekstualiseerida nii rahvastiku koosseisu, alkoholi tarvitamise leviku, sekkumiste ülesehituse, sekkumiste komponentide ressursikulu ja muid andmeid. Sekkumisi rakendati mudelis nii üksikult kui eri kombinatsioonides 10 mudelaasta jooksul, sekkumiste mõju rahvastikule hinnati kokku 100 mudelaasta jooksul. Kõik tulemused on esitatud võrreldes olukorraga, kus alkoholi liigtarvitamise vastased sekkumised puuduvad (see on vajalik olemasoleva sekkumiste kombinatsiooni mõju ja kulude hindamiseks).

Eesti alkoholipoliitika muudatuste ülevaate aluseks on Riigiteataja andmebaasis esitatud Alkoholi-, tubaka-, kütuse- ja elektriaktsiisi seadus, Alkoholiseadus, Reklaamiseadus ja Käibemaksuseadus ning nende muudatused aastatel 2005–2010. Lisaks on ülevaates kasutatud Eesti Konjunktuuriinstituudi alkoholituru ja -tarvitamise uuringute andmeid ning muid rahvusvahelises teaduskirjanduses ilmunud ülevaateid alkoholi tervisekahjudest Eestis.

Tulemused

Eesti rahvastik kaotas 2002. aastal 446 361 eluaastat, sellest 60% enneaegse suremuse tõttu. Tervisekaotus jaotus meeste ja naiste vahel üsna võrdselt, kuid meestel oli suurem suremuskaotuse ja naistel haiguskaotuse roll. Näiteks moodustas naiste haiguskaotus 62% kogu haiguskaotusest. Tervisekaotusest 54% (60% meestel ja 43% naistel) toimub tööealises rahvastikus ja eriti meestel näitlikustab tervisekaotuse kuhjumist nooremasse ikka tõik, et pool tervisekaotusest pärineb neil alla 55-aastasest rahvastikust. Haigusrühmadest on suurimad tervisekaotuse allikad südame-veresoonkonna haigused (eelkõige südame isheemiatõbi ja insult), kasvajad (eelkõige kopsu- ja kolorektaalsed kasvajad) ning vigastused (eelkõige enesetapud ja mürgistused). Nimetatud kolm haigusrühma moodustavad umbes 2/3 kogu tervisekaotusest ning kõigi nende puhul on oluline roll enneaegsel suremusel, eriti vigastuste puhul. Eesti maakondade ja kohalike omavalitsuste tervisekaotus varieerub suurel määral ja on seotud nende piirkondade sotsiaalmajandusliku olukorra ning kohalike omavalitsuste puhul veel nende kaugusega maakonnakeskusest.

Eesti rahvastiku välditav suremus vähenes 2000–2009 algselt 244-lt kuni 159 välditava surmajuhuni 100 000 inimese kohta. Sealjuures oli 0–74-aastaste välditava suremuse langus kiirem (36% võrra) sama vanuserühma üldise suremuse langusest (29% võrra) samal perioodil. Kuigi välditava suremuse langus oli absoluutarvudes suurem meestel, ei muutunud suhtelised välditava suremuse erinevused meeste ja naiste vahel, samuti ei saavutanud meeste 2009. aasta suremuse tase naiste 2000. aasta välditava suremuse taset. Välditava suremuse peamisteks allikateks on südame isheemiatõbi, kõrgvererõhutõbi ja insult, mis kokku moodustavad ligikaudu 2/3 kogu välditavast suremusest. Oluline on veel, et kui enamiku seisundite välditav suremus langes, siis kõrgvererõhutõve puhul see kasvas. Välditava suremuse osakaal 0–74-aastaste üldsuremusest langes 2000–2009 36%-lt 32%-ni, mis viitab tervishoiu suurenenud efektiivsusele. Siiski oli see tervishoiu efektiivsuse näitaja parim aastal 2007. Lisaks suurenesid 2006–2008 tervishoiukulud varasemast kiiremini ja ressursipaiguse kohta saavutatud välditava suremuse langus vähenes. Lõpuks tuleb lisada, et kogu 2009. aasta välditava suremuse ärahoidmisel pikeneks Eesti rahvastiku eeldatav eluiga 2,7 aasta võrra.

Kõik analüüsitud alkoholi liigtarvitamise vastased sekkumised osutusid kulutõhusateks, kusjuures seadusandlikud ja kogu rahvastikku hõlmavad sekkumised olid soodsama tulude ja kulude suhtega kui isiku tasandil rakendatavad sekkumised. Arvestades Eestis 2004. aastal levinud alkoholi tarvitamise mustreid, osutus kõige kulutõhusamaks sekkumiseks alkoholiaktsiisi suurendamine 50% võrra võrreldes 2004. aasta tasemega ning selle sekkumise puhul oli ühe eluaasta päästmise ligikaudne hind 759 krooni. Alkoholi maksustamisele järgnesid kulutõhususelt selle kombineerimine alkoholireklaami laiaulatusliku piiranguga ja müügikohtade arvu ning müügiaegade vähendamisega. Üksiksekkumistest kõige ebasoodsama tulude ja kulude suhtega oli alkoholi tarvitamise probleemidega inimeste nõustamine esmatasandi tervishoius ning sellest

soodsam kulutõhusus oli ka kõigi sekkumiste kombinatsioonil. Oluline on märkida, et Eestis 2004. aastal rakendatud sekkumiste kombinatsioon ei olnud ei kõige tõhusam ega kulutõhusam ning esines suuri võimalusi alkoholipoliitika tõhustamiseks kulutõhusate sekkumiste abil.

Aastatel 2005–2010 tõusis alkoholiaktsiis Eestis neljal korral, kokku 45% võrra võrreldes 2004. aasta tasemega. Samuti tõusis 2009. aastal käibemaks 2% võrra, mis veelgi vähendas alkohoolsete jookide rahalist kättesaadavust, mis kuni 2008. aastani tõusis pidevalt koos alkoholi tarbimisega. Samas peitus viidatud maksutõusude peamine motivatsioon eelkõige rahanduspoliitikas. Lisaks ei ole teada, kui suurt rolli alkoholi tarvitamise mõningases vähenemises alates 2008. aastast mängis samal ajal alanud globaalsest majandussurutisest tingitud sissetulekute vähenemine ja kui suur oli alkoholi maksupoliitika muutuste mõju. Maksupoliitilisi alkoholipoliitika muudatusi toetasid Eestis 2008. aastal alkoholi jaemüügi ajaliste piirangute ühtlustamine ja samal ajal rakendunud televisioonis näidatava alkoholireklaami piirangute mõningane karmistumine. Lisaks alustati 2009. aastal esmatasandi tervishoius toimuva alkoholi liigtarvitamist käsitleva nõustamise rakendamist.

Järeldused

1. Käesolev uuringu tulemusena on kättesaadavad esimesed rahvuslikud ja piirkondlikud tervisekaotuse andmed ning täienesid võimalused rahvastiku tervise hindamiseks Eestis.
   1.1. Uuring tõi esile Eestis prevaleeruvate haiguste summaarse mõju rahvastiku tervisele, millest suurimat tervisekaotust põhjustavad südame-veresoonkonna haigused, kasvajad ja vigastused, samas kui luu-liiges-haiguste põhjustatud vaevuste raskuse tõttu kerkis see haigusrühm kohale, mida tavapärane suremus- ja haigestumusstatistika ei näita.
   1.2. Prioriteetsed rahvastikurühmad tervist parandavate sekkumiste sihitamiseks ja tervisekaotuse ennetamiseks on tööealine rahvastik, alla 35–aastane meesrahvastik ja Kirde- ning Kagu-Eesti rahvastik.
   1.3. Piirkondlik tervisekaotus on seotud piirkonna sotsiaal-majandusliku olukorraga ning suurem tervisekaotus ilmneb eelkõige raskema sotsiaal-majandusliku olukorraga piirkondades ja kohalikes omavalitsustes.
2. Edusammud välditava suremuse ärahoidmisel Eestis 2000–2009 olid märkimisväärsed ja lisaks vähenes välditav suremus kiiremini kui üldine suremus.
   2.1. Siiski on Eesti meeste välditav suremus enam kui kaks korda suurem naiste välditavast suremusest ja see sooline erinevus on vähemalt osaliselt (võrreldes teiste OECD riikidega) süüdi märkimisväärselt kõrgemas välditava suremuse tasemes ning lühemas elueas.
   2.2. Välditava suremuse andmed näitavad, et Eesti tervishoid on efektiivne. Siiski on viimastel aastatel tervihoidu tehtud investeeringud tootnud varasemast vähem tervisetulemit ja efektiivsuse jätkuvaks suurenda-

miseks tasub kaaluda uute algatuste rakendamist ning muudatusi ressursijaotuses.

2.3 Tervishoiutegevus välditava suremuse ärahoidmisel võiks potentsiaalselt saavutada umbes poole rahvastiku tervise arengukavas seatud eeldatava eluea eesmärgist aastal 2020, samas kui edasised pingutused rahvastiku tervisekäitumise parandamiseks mängivad olulist toetavat rolli selle potentsiaali realiseerimisel.

3. Kulutõhusate alkoholi liigtarvitamist vähendavate sekkumiste laialdane rakendamine oli 2004. aastal soovitatav, sest tollane sekkumiste kombinatsioon ei olnud kõige tõhusam ega kulutõhusam.

3.1. Alkoholipoliitika tugevdamise kõige kulutõhusamad viisid 2004. aastal olid alkoholiaktsiisi tõstmine poole võrra, laiaulatusliku alkoholireklaami piirangu ja jaemüügi kohtade arvu ning müügiaegade piirangu rakendamine.

3.2. Rahvastiku tasandil rakendatavad sekkumised olid kulutõhusamad isikutasandi sekkumistest (nõustamine esmatasandil ja joobekontroll teedel), samas kui kõikide sekkumiste kombinatsioon oli uuritud sekkumistest kõige tõhusam ning ka kulutõhusam eraldiseisvatest isikutasandi sekkumistest.

4. Eesti alkoholipoliitika tugevnes aastatel 2005–2010, kuid muudatused ei jõudnud 2004. aasta kohta tehtud soovituste tasemeni.

4.1. Enamik poliitikamuudatusi vähendas alkohoolsete jookide kättesaadavust, mida mõjutas ka majandussurutis. Alkoholipoliitika jätkuv tugevdamine on Eestis eriti vajalik, et kompenseerida majandussurutise vähenevaid mõjusid, kui majandus uuesti elavneb.

4.2. Prioriteetsed tegevused Eesti alkoholipoliitika tugevdamiseks hõlmavad alkoholi jaemüügikohtade arvu vähendamist, alkoholireklaami piirangute ulatuse suurendamist, kauplustes alkohoolsete jookide eraldamist muudest kaupadest ja alkoholinõustamise võimaluste laiendamist esmatasandi tervishoius.

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PUBLICATIONS

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2006–2007	Health Policy Analyst in PRAXIS Centre for Policy Studies, Estonia
2001–2003	Research Fellow in Estonian Genome Foundation and EGeen Inc, Estonia
2001	Visiting Scientist in International Agency for Research on Cancer in Lyon, France

Scientific work

Main area of research has been population health, where several strands can be identified:

- Health-related quality of life of the general population and special disease groups
- Burden of disease, national burden of disease studies and regional variations of ill health
- Design and analysis of population health surveys and bridging these for secondary analysis

- Disease and population modelling with special regard to HIV/AIDS in Estonia
- Cost-effectiveness of public health interventions (esp. mental health, alcohol, tobacco, HIV)
- Comparison of health policies and health systems in European countries
- Inequalities in population health in Estonia and internationally
- Health system performance assessment.

Since 2001, lecturing at the University of Tartu, Department of Public Health in undergraduate courses related to health systems, performance of health systems, population health, alcohol prevention and medical ethics.

Selected materials published in English in peer reviewed journals (seven articles), co-author of two books, author of four book chapters, and number of reports. In addition, numerous presentations have been made in international and national conferences both for scientific and general audiences, as well written articles to general audiences.

Peer reviewed international articles

1. Lai T, Habicht J (2011). Decline in alcohol consumption in Estonia: combined effects of strengthened alcohol policy and economic downturn. *Alcohol Alcohol*, 46(2):200–203.
2. Orru H, Maasikmets M, Lai T, Tamm T, Kaasik M, Kimmel V, Orru K, Merisalu E, Forsberg B. (2010) Health impacts of particulate matter in five major Estonian towns: main sources of exposure and local differences. *Air Qual Atmos Health* 1–12.
3. Lai T, Habicht J, Kiivet RA (2009). Measuring burden of disease in Estonia to support public health policy. *Eur J Public Health*, 19(5):541–547.
4. Orru H, Teinemaa E, Lai T, Tamm T, Kaasik M, Kimmel V, Kangur K, Merisalu E, Forsberg B (2009). Health impact assessment of particulate pollution in Tallinn using fine spatial resolution and modeling techniques. *Environ Health*, 8:7.
5. Weiser P, Becker T, Losert C, Alptekin K, Berti L, Burti L, Burton A, Dernovsek M, Dragomirecka E, Freidl M, Friedrich F, Genova A, Germanavicius A, Halis U, Henderson J, Hjorth P, Lai T, Larsen JI, Lech K, Lucas R, Marginean R, McDaid D, Mladenova M, Munk-Jorgensen P, Paziuc A, Paziuc P, Priebe S, Prot-Klinger K, Wancata J, Kilian R. (2009) European network for promoting the physical health of residents in psychiatric and social care facilities (HELPS): background, aims and methods. *BMC Public Health*, 9:315.
6. Krikmann U, Taba P, Lai T, Asser T (2008). Validation of an Estonian version of the Parkinson's Disease Questionnaire (PDQ–39). *Health Qual Life Outcomes*, 6:23.
7. Lai T, Habicht J, Reinap M, Chisholm D, Baltussen R (2007). Costs, health effects and cost-effectiveness of alcohol and tobacco control strategies in Estonia. *Health Policy*, 84(1):75–88.

ELULOOKIRJELDUS

Taavi Lai

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Hariduskäik

1990–1993	Pärnu Ühisgümnaasium
1993–2000	Tartu Ülikool, arstiteaduskond, ravi eriala
2000–2001	Internatuur Pärnu Haiglas
2001–2011	Tartu Ülikool, arstiteaduskond, tervishoiu instituut, doktorantuur

Ametikäik

2007–…	vanemanalüütik, terviseinfo ja analüüsi osakond, Sotsiaalministeerium
2001–…	uurija ja konsultant mitmete teadusprojektide meeskonnas, peamiselt Tartu Ülikooli tervishoiu instituudis
2006–2007	tervisepoliitika analüütik, poliitikauuringute keskus PRAXIS
2001–2003	uurija Eesti Geenivaramus ja EGeen Inc Eesti kontoris
2001	külalisteadur Rahvusvahelises Vähiuuringute Keskuses IARC, Lyon, Prantsusmaa

Teadustöö

Peamine uuringuvaldkod on läbi aastate olnud rahvastiku tervis. Selle üldise teema raames on spetsiifilised uurimistegevused hõlmanud järgnevaid teemasid:

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- Tervisekaotus, selle põhjused ning jagunemine soo ja –vanuse järgi ning piirkondlikult. Tervisekaotuse seosed sotsiaalmajanduslike teguritega.
- Rahvastiku (tervise)uuringute kavandamine ja analüüs ning eri (tervise)-uuringute sidumine teiseses analüüsis
- Haiguste ja rahvastiku modelleerimine erilise tähelepanuga HIV/AIDSile
- Rahvastikusekkumiste kulutõhusus ja selle modelleerimine erilise tähelepanuga vaimsele tervisele, alkoholi tarvitamisele, suitsetamisele ja HIV/AIDSile
- Tervisesüsteemide ja -poliitikate võrdlev analüüs Euroopas
- Tervise ebavõrdsuste analüüs Eestis ja rahvusvaheliselt
- Tervisesüsteemide toimivuse analüüs

Alates 2001. aastast lektor Tartu Ülikooli tervishoiu instituudis peamiselt põhiõppe üliõpilastele. Peamised teemad tervisesüsteem ja selle toimimine, rahvastiku tervise mõõtmine, alkoholi liigtarvitamise ennetus ning meditsiinieetika.

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