The contribution of smoking, obesity and alcohol consumption to country mortality differences and life expectancy in Western Europe.

Student: Marloes Cantrijn
Student number: 2947838

Master programme: Socio-Spatial Planning
Faculty of Spatial Sciences, University of Groningen

Supervisor: Claudia Yamu
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Abstract

Background: In 2012, the World Health Organization implemented the goal to reduce premature mortality from non-communicable disease by 25% by 2025. Non-communicable diseases (NCD) have become the leading causes of death in Europe. Non-communicable diseases can cause long-term healthcare costs, related disabilities and premature death, which all have social and economic consequences and burdens. It is estimated that at least 80% of all heart diseases, strokes and type 2 diabetes, and at least one third of cancer cases are avoidable, because they can be related to lifestyle risk factors. Smoking, alcohol consumption, unhealthy diets and physical inactivity, resulting in obesity, are the main lifestyle risk factors that contribute to increased mortality in Europe. Nevertheless, NCDs are still not part of the development agenda of most countries in Europe.

Data and methods: This research consists of a quantitative analysis, using secondary data from three different databases. This data includes prevalence of smoking, alcohol consumption and obesity, as well as risk factor attributions of numerous causes of death to these three lifestyle risk factors, and the number of deaths due to those causes of death. With this data age-standardized mortality rates and the Potential Gain in Life Expectancy were calculated. The age-standardized lifestyle-related mortality rates were also compared to age-standardized all-cause mortality rates. The Potential Gain in Life Expectancy were added to the life expectancy at birth observed in the Western European countries.

Results: There are differences between men and women in prevalence of smoking and alcohol consumption, and smoking-attributable and alcohol-attributable mortality. For most countries men have higher prevalence and mortality for both risk factors. For obesity the prevalence and mortality is similar for both men and women in all countries, but Ireland. For men smoking-attributable mortality was higher than alcohol-attributable and obesity-attributable mortality, whereas for women it depended on the country, whether smoking-attributable or obesity-attributable mortality was the highest. The Scandinavian countries seem to be healthier than the rest of Western Europe, as they show both low prevalence of smoking and alcohol, as well as low smoking-attributable and alcohol-attributable mortality. But for obesity these countries show higher prevalence and attributable mortality. Denmark and Belgium show the opposite trend where both show high prevalence and mortality of smoking and alcohol, for both men and women, but then show low prevalence and mortality of obesity as well.

Conclusion: A divide between Northwestern and Southwestern Europe can be observed. As for the risk factors smoking and alcohol, the Southern countries show highest mortality for men, but the lowest mortality for women. The Northern countries show the opposite trend, where these countries have the lowest mortality for men, highest mortality for women. The Southern countries also have largest differences between men and women, whereas the Northern countries show the smallest differences between men and women. This divide between North and South is not observed for obesity. But it can be observed in life expectancy as well. For men, the Southern countries gain more years in life expectancy than the Northern countries. For women, the Southern countries gain the most years in life expectancy from obesity-attributable causes of death, whereas the Northern countries gain the most from smoking-attributable causes of death.

Keywords: Lifestyle, Smoking, Alcohol, Obesity, Mortality, Life expectancy, Western Europe

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List of abbreviations

ASMR - Age standardized mortality rate

BMI - Body mass index

CHD - Coronary heart disease

CVD - Cardiovascular diseases

GBD - Global Burden of Disease

ICD - International Classification of Diseases

IHD - Ischemic heart disease

IHME - Institute for Health Metrics and Evaluation

NCD - Non-communicable diseases

PGLE - Potential gain in life expectancy

WHO - World Health Organization

1. Introduction

1.1 Theoretical background

Back in 2012, member states of the World Health Organization implemented the goal to reduce premature mortality from non-communicable diseases by 25% by 2025 (Kotseva et al, 2017). Non-communicable diseases (NCD) have become the leading causes of death worldwide. Among all countries part of the World Health Organization, Europe has the highest burden of non-communicable diseases. The four major non-communicable diseases are cardiovascular diseases, cancer, respiratory diseases and diabetes, and together they account for 77% of the burden of disease and 86% of premature mortality. Non-communicable diseases can cause long-term healthcare costs, related disabilities and premature death, which all have social and economic consequences and burdens (WHO, 2014). Ageing is often associated with an increasing risk of chronic diseases, such as cardiovascular diseases and cancer, which consequently increases the need for social and medical services (de Groot et al, 2004). NCDs can force people into early retirement or to work part-time, which reduces their income. NCDs can cause higher demands for social care and welfare support, and decreased productivity and employee turnover (WHO, 2014). All of these outcomes can potentially be reduced, if the increase in chronic diseases and the related disabilities can be delayed (de Groot et al, 2004). It is estimated that at least 80% of all heart diseases, strokes and type 2 diabetes, and at least one third of cancer cases are avoidable (WHO, 2014). In part, they are avoidable, because they can be related to lifestyle risk factors. Smoking, alcohol consumption, unhealthy diets and physical inactivity, resulting in obesity, are the main lifestyle risk factors that contribute to increased mortality in Europe (WHO, 2009). For example, over 50% of cancers and over 40% of circulatory diseases are estimated to be attributable to lifestyle risk factors (Sanderson et al, 2009). For heart diseases, it is estimated that in western countries about 31% of cases can be attributed to poor diets, about 22% to physical inactivity and another 22% to smoking (WHO, 2002, in Sanderson et al, 2009). Nevertheless, NCDs are still not part of the development agenda of most countries in Europe (WHO, 2014). Since lifestyle risk factors are more prevalent in low socio-economic groups, reducing their prevalence can help reducing inequalities in mortality rates among different socio-economic groups (Kulhánová et al, 2016).

The World Health Organization undertakes a comprehensive study known as the Global Burden of Disease, which measures the impact of morbidity and mortality on populations. Evidence has shown the health effects of behavioral risk factors, such as smoking, alcohol consumption, poor diet and physical inactivity (Ding et al, 2015). In 2017 this study estimated that 91% of all deaths in Europe are the result of non-communicable diseases, of which 61% can be attributed to lifestyle risk factors, including unhealthy diets, physical inactivity, smoking and alcohol consumption (EU Science Hub, 2020). Research has shown that in Europe there has been an increase in obesity, but no change in smoking, and poor blood pressure and lipids control, despite the substantial increase in blood pressure and lipid-lowering drugs (Kotseva et al, 2017). Europe has the highest alcohol intake in the world and a per capita consumption twice as high as the world average. Even though the prevalence of smoking has decreased or stabilized in Europe, the prevalence among women is slightly increasing. Poor diet, overweight and obesity contribute to a large proportion of NCDs, including cardiovascular diseases and cancer, which are the two main causes of death in Europe. Unhealthy diets and physical inactivity mainly cause high blood pressure, high blood cholesterol, overweight and obesity. These factors are also worsened by other factors, such as excess consumption of saturated fat and trans-fat, high intake of sugar and salt and low consumption of fresh vegetables and fruits. Overweight and obesity has become a growing issue in Europe. More than 20% of children and adolescents are overweight, and one third of these cases are obese. The annual rate of increase in the prevalence of obesity has been growing steadily over the last couple of decades (WHO, 2014). Prevalence of diseases in a population are shaped by the physical, social, economic and political contexts in which individuals of a population reside during their lifetime and how individuals interact with those contexts. These contexts differ within and across populations and thus cause health disparities over time. These contexts in which individuals reside, along with their personal lifestyle factors are influential on the ageing process (Clarke & Nieuwenhujsen, 2009). Lifestyle behavior has often been linked to the ageing process. A healthy lifestyle is strongly related to high life expectancy, so improvement of unhealthy lifestyle behaviors and choices are matters of concern (Haveman-Nies et al, 2003). Many diseases that can be caused by unhealthy lifestyle choices, such as cardiovascular diseases can have permanent damages to the human body. The most effective strategy to battle these diseases is prevention. Thus an overall healthy lifestyle is more effective in lowering the risk of diseases, such as cardiovascular diseases that related to unhealthy lifestyle behavior (Chiuve et al, 2008). Differences in lifestyle behavior across population can lead to differences in mortality rates across populations (Mackenbach, 2013).

1.2 Research problem and knowledge gap

Many studies have looked at lifestyle risk factors and related causes of deaths. But often these studies have looked at a specific single lifestyle risk factor, cause of death, age group, social group or country (Kyro et al, 2010; Moraeus et al, 2015; Pérez-Rodrigo et al, 2015). Although risk factor-specific and cause of death specific analyses are also useful for policy, more comprehensive global assessment of burden of disease attributable to risk factors can help strengthen the basis for action to reduce disease burden and promote health (Lim et al, 2012). There has not been much research into how multiple lifestyle risk factors impact both mortality rates and life expectancy across the total population of multiple countries. Many studies are restricted to comparing only two or three countries (Kyro et al, 2010). Usually when studies examine more than three countries in Europe, the focus is on the east-west division in health inequalities in Europe (Vagero, 2010), and on examining the impact of individual's socio-economic status on health inequalities (Alvarez-Galvez, 2016). However within Western Europe, socioeconomic position and employment status seem to have limited impact on life expectancy (Vallin, 1995 in Trias-Llimós, 2018). Thus there are other factors in play. Individual lifestyle behavior and its consequences on the individual's health is a well-established phenomenon, but it is often overlooked how external constraints influence lifestyle choices. Thus the individual lifestyle choices become societal ones, as there are limits in countries on the availability of healthy lifestyle options (Olsen & Dahl, 2007). Country differences in health determinants can provide insights into macro level determinants, which includes structural and policy influences, and thus have the potential to improve population health (Ploubidis et al, 2012). The increasing risk of non-communicable diseases are related to several lifestyle risk factors, and to combat this, substantial attention needs to be given to these lifestyle risk factors collectively in research and public health practice (de Groot et al, 2004). As the combination of two or more lifestyle risk factors is also associated with an even higher increased risk of cardiovascular diseases or cancer, than the risk associated with separate lifestyle risk factors (Schuit et al, 2002). The attribution of disease burden to several risk factors provides a different perspective, compared to an analysis between different diseases (Lim et al, 2012). Furthermore, it is not yet clear how many years can be gained, if smoking-related, alcohol-related and obesity-related causes of death were completely eliminated. This research will show what lifestyle risk factors, in particular smoking, alcohol consumption and obesity have cost the population in terms of mortality rates and life expectancy years. Additionally this research shows which causes of death contribute the most to mortality rates per country, and whether these causes of death differ per country. Studies have looked at specific causes of death that are related to lifestyle risk factors (Islami et al, 2015; Kulhánová et al, 2016), but there is no certainty that these causes of death also contribute the most deaths to the mortality rates of every country in Western Europe. Lifestyle risk factors in wealthy countries are important to research, because the related causes of death and diseases have high healthcare and welfare costs, due to impairments, disabilities and loss of workforce, in an already ageing population with a shrinking workforce.

1.3 Societal relevance

Lifestyle-related diseases have become a major public health concern around the world over recent years, and the growing prevalence around the world is a serious concern for public health authorities (Benmarhnia et al, 2017). Unhealthy lifestyles are also causing increased healthcare costs and put an increased pressure on the already declining working age population (Tamayo et al, 2013). Additionally, declines in birth rates, increases in life expectancy and a growing number of the older population have focused attention on the public health and policy importance of health status, especially in later life (Ploubidis et al, 2012). There is an urgent need for more coordinated, population-based intervention programs aimed at improving health and reducing health-related expenses through, for example increased physical activity, in the entire population, which should be implemented at the national and international level (González-Gross & Mendélez, 2013). In the past many Western European countries have adopted health care systems based on financing through taxes. That means that the tax-paying population of a country indirectly pays for health-related expenses of risky lifestyle behavior.

The European policy for health and wellbeing 'Health 2020' has stated better governance for health as one of its objectives. It also recognizes that governments can be more successful in improving health and wellbeing, but only if they promote more comprehensive action in which they involve both health and non-health sectors, public and private actors, and citizens, and include both governmental and societal approaches. The increase in NCDs can be seen as a global crisis, which prevents development goals, such as poverty reduction, health equity, economic stability and human security. Sustainable social and economic development requires political commitment and investment at high levels in preventing and controlling NCDs (WHO, 2014).

Healthy lifestyle behaviors are not only related to higher chances of survival, but also to slower deterioration of health status, as compared to unhealthy lifestyle behaviors (Haveman-Nies et al, 2003). Unhealthy lifestyles, such as smoking, alcohol consumption, unhealthy diets and physical inactivity have striking impact on the health of the population (Sanderson et al, 2009). For example, it is estimated that for a woman, who maintains a healthy weight and diet, exercises regularly, doesn't smoke and consumes only a moderate amount of alcohol can experience a decrease in heart disease risk of 84% (Stampfer et al, 2000, in Sanderson et al, 2009). Improvement of unhealthy lifestyle behaviors and maintenance of healthy lifestyle behaviors are matters of concern, since lifestyle behaviors are related to survival and health at older ages, and also contribute to the ageing process. Improvements in lifestyle habits can be made at all stages in life and thus can be directed at both the general population and specific age groups. But in general healthy lifestyle changes made early in life and continued during life are most effective for the prevention of diseases and disabilities (Haveman-Nies et al, 2003). But the main problem is that the general public is often unaware of the risks of certain lifestyle choices. There is already a high awareness in Western countries of the link between smoking and lung cancer for example, but for other lifestyle risk factors the level of awareness is significantly lower. If people are unaware of the risks, then they are also far less likely to make changes in their lifestyle behavior (Sanderson et al, 2009). When developing prevention strategies, insights into clustered lifestyle risk factors is important (Schuit et al, 2002).

1.4 Academic relevance

Quantitative data on the vulnerability of the population to cancer risk factors can help in the process of defining and designing appropriate public health policies, for example by estimating the current and future burden of cancer on the population. But it can also be helpful for planning and evaluating prevention activities (Boniol & Autier, 2010) Policies and programs that are designed to combat diseases, are based on proper, current and timely information about the nature and extent of health problems, health determinants, and how the impact of diseases is changing, in regards to how the diseases are distributed and weighted in a population. The data most commonly used are statistics on the number of people who die, by age and sex, and on the causes of those deaths (Mathers et al, 2005). A better understanding of the level of vulnerability to lifestyle risk factors helps to anticipate future changes of the burden of diseases on the population through primary prevention programs (Boniol & Autier, 2010). Change of the burden of diseases on the population can be influenced by changes in the vulnerability of the population to the most common risk factors (Boniol & Autier, 2010). Public health institutions have limited resources and thus accurately measuring the impact of premature deaths from various diseases is important to help allocate the limited resources appropriately to the diseases that are the burden on society (Lai & Hardy, 1999). Understanding the effects of risk factors on disease burdens can also be informative for policy making and resource allocation in the context of primary prevention (Ding et al, 2015).

1.5 Objective

Lifestyle risk factors, such as smoking, alcohol consumption (Ding et al, 2015) and obesity (WHO, 2014) are becoming an increasing problem in Europe. Many studies have looked into the divergence of life expectancy and mortality rates between Western and Eastern Europe. In Western Europe life expectancy and mortality have improved at a higher pace than in Eastern Europe (Meslé & Vallin, 2002). But the differences within Western Europe are being overlooked. Within Western Europe a difference can be observed between the north and the south in the development of non-communicable diseases over the last few decades. As the mortality rates from infectious diseases declined in all of Western Europe during the last century, North-Western Europe experienced a significant increase in mortality rates from non-communicable diseases, whereas South-Western Europe only experience a slight increase in mortality rates from non-communicable diseases. As a result Southern European countries developed some of the lowest adult mortality rates in Europe at the end of the last century (Powles, 1992). Many studies have looked into the differences between Western and Eastern Europe. These regions often differentiate from one another, because of their varied political, economic and social development, due to the Cold War, which influences life expectancy and mortality rates (Mackenbach, 2013). If one were to study Europe as a whole, by definition the results would highlight that distinction between Western and Eastern Europe, while the differences between Western countries would be overshadowed. That is why the aim of this study is to look at the contribution of lifestyle factors; smoking, obesity and alcohol consumption to country mortality differences and life expectancy in Western Europe only. Western Europe consists of countries with similar political, social, economic contexts, which makes it interesting to see how these countries differ in lifestyle risk behavior. These countries will include the following 16 countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1.6 Research questions

The primary research question is stated as follows:

To what extent are there differences between Western European countries in life expectancy and mortality due to smoking, alcohol and obesity?

This primary research question will be answered through several sub-questions:

1. How does the prevalence of smoking, alcohol and obesity relate to mortality and life expectancy in Western European countries?
2. How can certain causes of death be attributed to either smoking, alcohol or obesity?
3. What are the differences in smoking-attributable, alcohol-attributable, obesity-attributable mortality rates between Western European countries and how do they contribute to the all-cause mortality rates
4. How is life expectancy in Western European countries affected by smoking, obesity and alcohol?

2. Theoretical Framework

2.1 Epidemiologic transition theory

Over the last century there has been a shift in Western countries from the prevalence of infectious diseases towards the prevalence of lifestyle-related diseases (Brownson et al, 2006, in Benmarhnia et al, 2017). The theory of epidemiologic transition has focused on the complex changes in patterns of health and diseases, but also on the interactions between these patterns and their demographic, economic and sociologic causes and outcomes (Caselli et al, 2002). The theory uses five propositions to describe the changes in population patterns. The first proposition states that mortality plays a dominant role in population dynamics (Santosa et al, 2014). During pre-modern periods human populations faced cycles of variating fertility and mortality rates (Omran, 2005). Even in times of high fertility, population sizes would still be limited due to epidemics, wars and famines, which happened repeatedly and caused a high increase in mortality rates. Populations relied on relative few and one-sided food sources, leaving them highly vulnerable to food shortages (Powles, 1992). These pre-modern societies were characterized by frequent and harsh variations in mortality patterns and an overall high level of mortality in general. High mortality rates and occasional epidemics, famines and wars resulted in low life expectancy rates. The high and variating mortality rates are the main cause of the slow rate of world population growth before about 1650 A.D (Barrett et al, 1998). After 1650, population growth started to become more exponential rather than cyclic. Even though mortality rates remained high up until the middle of the eighteenth century, population growth started to become more sustained, mainly because, even though the mortality rates were still high, variations in mortality became less frequent and less drastic (Omran, 2005). This marks the near end of the first stage of the epidemiologic transition. The first stage is the age of pestilence and famine. In this stage the mortality rates are high and variating which limits the potential of sustained population growth. Also in this stage the average life expectancy at birth is low and variable, usually between 20 and 40 years (Santosa et al, 2013). The second stage is the age of receding pandemics. In this stage mortality rates are declining and mortality peaks become less frequent and severe. Life expectancy then increases and population growth becomes more sustained and exponential (Omran, 2005). In Europe, the second stage began somewhere between 1850 and 1920, depending on which part of Europe you're looking at, and lasted until about 1950-1970 (Mackenbach, 2013). The persistent growth in world population was a result from several factors including steady rises in life expectancy, declining mortality rates and more stable and predictable mortality patterns (Vallin & Meslé, 2004). Thus as variations in mortality become less severe and mortality peaks less frequent, populations can begin to grow exponentially. As the second proposition states that during the transition, a long-term shift occurs in mortality and disease patterns, whereby pandemics of infectious diseases are gradually displaced by degenerative and man-made diseases, as the leading causes of death (Santosa et al, 2014). Somewhat halfway through the 20th century begins the third stage, which is called the age of degenerative and man-made diseases. In this stage mortality continues to decline and eventually stabilizes at a low level. The average life expectancy at birth continues to rise gradually (Omran, 2005). This stage is characterized by a decline in infectious diseases and an increase in degenerative diseases, such as cardiovascular diseases and various types of cancers (Mackenbach, 2013).

The causal factors of the transition from infectious diseases to degenerative diseases are not easily identified. But there are three major categories of disease causal factors. First, eco-biologic causal factors indicate the complex balance between disease agents, the level of hostility in the environment and the resistance of the host (Hewa, 2015). The link between recessions of plague and other pandemics has never been fully understood, but these causal factors have determined that the recession of plague and other pandemics in Europe were not related to the progress made in medical science (Omran, 2005). Second, socio-economic, political and cultural causal factors include standards of living, health habits, hygiene and nutrition. These causal factors were caused by social changes in Europe (Wilkinson, 1994). Third, medical and public health causal factors are specific preventative and curative measures used to combat disease. These measures often include improved public sanitation, immunization and the development of decisive therapies. Even though these factors were introduced later in the Western transition, they have an influence early on in the accelerated and contemporary transitions. The eco-biologic and socio-economic factors played a large role in the reduction of mortality in Europe during the nineteenth century, whereas the medical factors came into play later around the start of the twentieth century (Omran, 2005). Historically females in the adolescent and reproductive age periods and children of both sexes have shown increased survival rates during the recession of pandemics, because of their relative high susceptibility rate. As the third proposition states that children and young women experience the most impacts of the epidemiological transition, which results in declining infant and maternal mortality and reducing fertility rates (Santosa et al, 2014). Specifically childhood survival seems to improve significantly when pandemics recede in response to better living standards, advancements made in nutrition and sanitation measures. This was even further enhanced with the introduction of modern public health measures. After their reproductive age period, females seem to have, at all life expectancy levels, a lower risk of dying compared to males. High fertility rates offer an explanation for higher relative risks for females. As the third proposition states that during the epidemiologic transition, the most profound changes in health and disease patterns can be obtained among children and young women (Omran, 2005).

The increased survival rate among females in the adolescent and reproductive years and children have different impacts on fertility rates. On the one hand, increased health and life expectancy for females tend to increase their fertility rates, but on the other hand decreased risks of children mortality tend to lengthen birth intervals through prolonged lactation and improved faith in childhood survival. Female survival rates tend to improve earlier in the epidemiologic transition than children survival rates. Thus fertility is likely to rise in the early stage of the epidemiologic transition. The likelihood of increasing children survival rates to decrease fertility in subsequent stages of the transition can be attributed to several factors. First bio-physiologic factors, which show that increasing survival rates among infants and children will result in prolonged lactation, which in turn acts as a natural protection against conception and thus it lengthens birth intervals and overall this will decrease fertility rates (Omran, 2005). Second socio-economic factors, since improved nutrition and sanitation is linked to socio-economic conditions (Wilkinson, 1994). Also changes in socio-economic conditions can change children’s positions in social and economic systems, when children are no longer seen as an economic asset, but rather as an economic liability. Third psychologic factors, as children survival rates are improved and parents gain more certainty that their children, especially sons, will in all likelihood survive them, parents are more likely to limit their family expansion (Omran, 2005). This is related to changes in lifestyles within domestic households, as changes in attitudes and practices changed the way children were viewed within the household (Powles, 1992).

Shifts in health and disease patterns, that characterize the epidemiologic transition are closely related with the demographic and socio-economic transitions linked to modernization (Mackenbach, 1994). As the fourth proposition states that there is a link between long-term population changes in health and disease patterns, and demographic, economic and social determinants and mortality changes (Santosa et al, 2014). A decline in mortality rates that is happening during the epidemiologic transition shows a demographic gap between birth rates and death rates, and thus affects demographic change by increasing population growth. Mortality transition indirectly affect demographic movements, because of its impact on fertility and population composition. During the course of the epidemiologic transition successive changes occur in the age and sex structure and the dependency ratios of populations. In the age of pestilence and famine, infectious diseases and chronic malnutrition take a particularly high toll on children and females in their adolescent and reproductive years. During this stage only a small proportion of the population actually survives the high mortality rates among youth. Thus the young dependency ratio is relatively high, and this continues in the following stage, which is the age of receding pandemics. During both stages the population comprises about the same proportions of males and females. During the age of receding pandemics, when infectious diseases starts to recede, more children will survive childhood and the dependency ratios become more balanced. It is not until the age of degenerative and man-made diseases that the survival rates of all age groups improves significantly. But at the same time the dependency ratios for the older population increases, and the male to female ratio for that age group also becomes less balanced, since females tend to have higher life expectancy at older ages (Omran, 2005).

Within the epidemiologic transition variations in patterns, pace, causal factors and outcomes can be observed and three models of the epidemiologic transition can be differentiated. As the fifth and final proposition states that the three variants of the epidemiological transition are functions of interesting variations in the pattern, the pace, the determinants and the consequences of population change (Santosa et al, 2014). First the classical model of epidemiologic transition, which can mostly be applied to Western European societies. This model demonstrates high mortality rates and high fertility rates in the early stage of the transition. Mortality slowly, but gradually declines during the age of pestilence and famine, with the most significant decline around the start of the twentieth century, by which fertility has also started to decline (Omran, 2005). In this model socio-economic factors are the primary causal factors for the transition (Mackenbach, 1994). It was public health measures, such as safe drinking water and proper sewerage and improvements in diet that made the largest contribution to mortality decline. Professionally applied medical measures, such as antibiotics and vaccines were introduced too late to make a similar major contribution (Powles, 1992). These were complemented by improved sanitation, medical and public health knowledge. Decreasing mortality rates were accompanied by exponential population growth and sustained economic development. The last stage of the transition, which is the age of degenerative and man-made diseases, started somewhere around the second and third decades of the twentieth century, and of course in this stage the degenerative and man-made diseases became the leading causes of mortality and morbidity. The second model is the accelerated epidemiologic transition model, which mostly describes the transition that occurred in Japan. The main difference between this model and the classical model is that the period in which mortality is declining is much shorter in the accelerated model. Also the shift towards the age of degenerative and man-made diseases occurred much faster compared to the classical model. Though in the accelerated model this shift showed a selective improvement in survival rates among children and females. In this model societies experienced a slow process of modernization before the huge decline in mortality in the twentieth century, which was determined by improvements in sanitation and medical knowledge as well as general social improvements. These societies also favored to control population growth and to lower fertility in a relatively short period of time. The third model is the contemporary epidemiologic transition model, which describes the most recent and sometimes in-completed transitions of most developing countries. These countries mostly started to experience mortality decline only after the Second World War, while fertility rates have remained high. Public health measures through internationally donated medical packages have played a dominant role in the increase in population growth. Now population control has become a major issue for these countries (Omran, 2005).

2.2 Health status

A person's health status is closely related to the ageing process. Genetics and environmental influences are reflected in the biological process of ageing. Within this process both progressive and irreversible biological changes can be observed, which can result in growing risk of chronic diseases, cognitive impairments, impairment of functions and an increased probability of dying. As people grow older, they do not just endure physical and mental illnesses and ailments, but their entire perception of health changes. As people grow older, they start to focus less on the physical aspects of their health, but rather they start to value the qualitative aspects higher (Haveman-Nies et al, 2003). Both individual and societal characteristics can influence health. At the individual level, certain demographic and socio-economic characteristics, such as age, gender, income, education and occupational status are thought to be predictors of health. At the society or country level, social and political institutions have shown to influence health inequalities (Olsen & Dahl, 2007). Healthy ageing can be described as the ideal situation in which people survive to an advanced age, while keeping their vigour and functional independence and experiencing morbidity and disability not until a relatively short period of time before death. This process can then be distinguished into two stages. The first stage contains a relatively long period of a few decades, in which the health status only slowly deteriorates due to the normal ageing process. In following second stage the health status deteriorates quickly in a relatively short period of a few years as a consequence of illness or an accident (Campion, 1998, in Haveman-Nies et al, 2003). Ageing is a complex process that can be influenced by both personal lifestyle and environmental factors. Both personal lifestyles and environmental factors can also be used to explain variations in lifestyle risk factors. For example pedestrian-oriented designs and access to recreational facilities have been shown to be positively associated with physical activity and negatively related to obesity (Clarke & Nieuwenhuijsen, 2009). Inactivity has been associated with dysfunction, and even morbidity, as lack of movement can produce progressive atrophy and physical weakness in the whole body. Modern technology and the further development of motorized transport systems and machines have taken over tasks and activities, formerly taken care of through man-power. This has resulted in a decrease in physical activity in people's daily routines, both at home, in the workplace and while commuting. This also causes people to spend most of their days sitting down. The term 'sedentary' has been often used to describe people, who spend most of their days sitting down (Gonzélez-Gross & Mendélez, 2013). Sedentary behavior has been associated with several health concerns, independent of physical activity, including weight gain, metabolic syndrome, diabetes and heart diseases (Kerr et al, 2012). The protective effect of physical activity has been studied before, and these studies have shown that people, who participate in more sedentary work are more likely to be at risk of health issues, especially cardiovascular diseases (Dietz, 1996). Shorter sitting time and physical activity are independently protective against all-cause mortality, not just for healthy individuals, but also for those individuals suffering from cardiovascular diseases, diabetes, overweight or obesity (Gonzales-Gross & Mendélez, 2013). A person is considered obese when their body-mass index (BMI) is higher than 30, which is considered a high level of body fat. The prevalence of obesity has increased across all age groups in developed countries (Gallus et al, 2015). Physical activity has shown to have a positive effect on health in general, regardless of body composition, meaning that also people suffering obesity experience benefits from physical activity. Studies have shown that physical activity can produce a sufficient mechanical stimulation of the tissues in order that stem cells are turned preferably into fat-free cells. Thus in the other way around, in the absence of physical activity or through excessive food intake stem cells can turn into fat mass cells (González-Gross & Mendélez, 2013).

Health promotions, like health screenings, fitness centers, and behavior change courses and policies, have become increasingly common over the last 30 years. This is because a person's health behavior has been linked with healthcare costs. More important, if health behaviors can be improved, healthcare costs can be reduced (O'Donnell et al, 2015). So national healthcare costs could be reduced by promoting healthy lifestyles, and subsequently decreasing the need for medical services (Leigh et al, 2005). But, besides reducing healthcare costs, effective health programs can also improve life expectancy and quality of life (Goldsmith et al, 2004, in Benmarhnia et al, 2017). However, even though lifestyle-related diseases have been recognized as a health and economic burden, the funding for public health programs is still only a fraction of the total health spending of countries (Brownson et al, 2006, in Benmarhnia, 2017). Studies have shown that structured and multidisciplinary programs achieve healthier lifestyles and more effective risk factor control than usual care does. However despite the evidence for cost-effectiveness of such programs, research has shown that such high-quality services are limited in most of Europe, because of either lack of funding, lack of professional guidelines or lack of a strong health service infrastructure (Kotseva et al, 2017).

2.3 Country differences in lifestyle behavior

Lifestyle-related diseases have become a major public health concern, because of its growing prevalence around the world (Geneau et al, 2010, in Benmarhnia et al, 2017). Lifestyle risk factors are related to a number of diseases, including obesity and diabetes (Mozaffarian et al, 2009) and cardiovascular diseases (CVD) (Kotseva et al, 2017), such as ischaemic heart diseases or coronary heart diseases among others (Kulhánová et al, 2016). Several elements of modern lifestyles, like activity level, diet composition and drug use, such as cigarette smoking and alcohol intake, are said to be predictive of increased risk of non-communicable diseases (NCD) (Powles, 1992). Cardiovascular diseases (CVD) account for a majority of non-communicable disease mortality and are preventable (Kotseva et al, 2017). Most of the risk factors can be changed and reduced, which makes these diseases preventable (Mozaffarian et al, 2009). In determining health both individual and societal characteristics are important. On the individual level, characteristics such as age, gender, socioeconomic status, and living conditions play a part. On the level of the country, several societal factors can be used to explain country differences in health, such as characteristics of the welfare state, socioeconomic development, income inequalities, social capital and external lifestyle constraints (Olsen & Dahl, 2007). Differences in socioeconomic development, income inequalities and GDP per capita are thought to be linked with population health, where wealthier countries generally have better population health, but above a certain threshold of national income, this link becomes much weaker (Bloom & Canning, 2007). Social benefits, social services and other institutional arrangements are often associated to better population health (Ploubidis et al, 2012). However the relationship between public expenditure and health is weak. In Western Europe, there is a tradition of the active citizen that is well developed. Collectively, social capital has the potential to enforce healthy norms through social pressure and influence. Society-level constraints on the availability of healthy lifestyle options can influence population health, through individuals' unhealthy lifestyle choices, as they become societal ones (Olsen & Dahl, 2007). The different societal factors that could explain country differences in health are not mutually exclusive and could be interrelated. For example, characteristics of the welfare state can reflect certain policies that were introduced to induce socioeconomic development, reduce income inequalities, increase social capital or influence lifestyle behavior (Ploubidis et al, 2012). Differences in societal factors allow for diversity in lifestyle factors in European countries, and subsequently differences in population health as well (de Groot et al, 2004). Overall, poorer health outcomes are expected in Southern Europe, compared to Northern Europe. Specifically the Scandinavian countries, along with Germany, the Netherlands and Switzerland are expected to have better population health, than Spain and Italy (Ploubidis et al, 2012).

2.3.1 Smoking

Smoking became increasingly popular in the early twentieth century. It was seen as a socially learned habit and a personal choice of many (Jarvis, 2004). In Europe, the smoking habit started in the Northwestern European countries, and after approximately 25 years, it started to appear in Southwestern European countries as well. Women, in general, also started smoking roughly two decades later than men (Janssen, 2020). In the early days it was rather a men's habit to smoke and it was considered not suited for women. During the 1920s and 1930s this changed for women. Prior to World War 1 the attitude towards women smoking was rather negative. After World War 1, many traditions concerning gender and sex roles were put under strain. By 1940s smoking was seen as an attractive feature of women, by men. Women started using smoking as a visual sign of their independence of and equality to men, and thus the popularity and prevalence of smoking amongst women increased (Tinkler, 2001). But by the time women started smoking, the negative effects of smoking were starting to become public knowledge, and this has generally prevented the prevalence of smoking among women from reaching the same levels as men. But because women started smoking later, it is believed that for Northwestern European countries that the smoking-attributable mortality for women could reach similar heights, as to the smoking-attributable mortality of men (Janssen, 2020). Smoking has remained a sign of rebellion for young teenagers, but typically young teenagers that come from backgrounds that favor smoking, are more likely to start smoking themselves. Smoking has also been associated to lack of success, as perceived by the individual or their surroundings, low self-esteem, lower psychological wellbeing, overweight and poor achievements at school (Jarvis, 2004).

Most smokers start smoking between the ages of 15 and 18 years old. The prevalence of smoking among young adults in Europe remained high until the 1970s (Marcon et al, 2018). Since then the role of nicotine in sustaining smoking behavior has become common knowledge, but this doesn't mean that other factors, such as social, economic, personal or political factors, aren't of influence in determining patterns of smoking prevalence and cessation. For example social influences, such as cultural and professional disapproval of smoking, and smoke-free policies in workplaces and public spaces, can help with smoking cessation (Jarvis, 2004). During the 1970s many countries adopted tobacco control policies, such as increases of prices, restrictions on smoking in public spaces and banning advertisements on smoking, and started to inform the public of the harmful consequences of smoking (Mackenbach et al, 2013). The Scandinavian countries were among the first in Europe to adopt tobacco controlling policies (Marcon et al, 2018). Sweden for example has had successive governments that have taken action to reduce the prevalence of smoking. Countries such as Ireland, the United Kingdom, France, Italy and Spain all have adopted tobacco controlling policies since (Mackenbach et al, 2013). However smoking initiation is still high in Southern European countries, compared to Northern Europe, and the declining trend of smoking has stagnated in Southern European countries after the 1990s (Marcon et al, 2018). But the smoking trend never reached the same level as in Northwestern European countries, due to the lower economic development in

Southern European countries, thus smoking prevalence and mortality has remained lower here, especially for women (Janssen, 2020). Some Northwestern European countries have been slower in adopting tobacco controlling policies. Countries such as Germany and Austria, where there is a tight link between the tobacco industry and politics, tobacco controlling policies have been adopted slowly and even the measures that have been taken, are being only partial or poorly enforced by authorities and the public. Another example is Denmark, where the tobacco industry has successfully promoted smoking as an expression of personal freedom (Mackenbach et al, 2013). Denmark has a broad acceptance of smoking among women as a social activity, as Danish women have historically started smoking earlier, than women in other European countries, and thus have a historically higher prevalence of smoking, compared to other European countries. Additionally in Denmark, it is a common strategy for smoking to be used as a coping method for stress (Janssen, 2020).

2.3.2 Alcohol

Overall, in contrast to smoking, there has been barely any development in alcohol control over the last few decades. Even though several countries have implemented alcohol control policies, such as restrictions on marketing and availability, and tax increases, they have made little impact. In many Western European countries alcohol consumption has even increased, although not in Southern Europe (Mackenbach et al, 2013). In Southern Europe, the level of alcohol consumption has actually been extremely high in the 1970s, but declined after mid-1970s and onwards (Gual & Colom, 2006). The main issue is that alcohol consumption is ingrained into European culture (Mackenbach et al, 2013). In recent years there has been more research about the consequences of alcohol consumption to a person's health. Apparently moderate alcohol drinkers live longer than both non-drinkers and heavy alcohol drinkers. Moderate drinkers, with a consumption rate of about 10g of alcohol per day, are at a 15% lower mortality risk than non-drinkers. It also appears to be more healthy to consume alcohol in moderation and regularly, possibly during meals, but avoiding binge and heavy drinking. Even though moderate alcohol drinking appears to have health benefits, non-drinkers shouldn't be encouraged to start drinking for health reasons alone, because alcohol consumption can still lead to excessive use and addiction, which then become harmful to health. Excessive alcohol consumption increases the risk of certain cancers and liver diseases. A moderate alcohol consumption habit is part of the Mediterranean diet, which could explain its favorable health effects in those countries. However there is still much debate about, whether or not the assumed health benefits of moderate alcohol consumption are biased (Costanzo et al, 2019).

There can be differences between countries, in terms of what type of beverage is consumed the most. Several countries, such as the Netherlands, the United Kingdom, Germany, Sweden and Finland are traditionally beer-drinking countries, whereas countries, such as France and Italy are traditionally wine-drinking countries. Thus there is a divide between Northwestern Europe and Southwestern Europe, where Northern countries consume more beer and Southern countries consume more wine. Another difference between the North and South is the drinking pattern. Northwestern European countries, such as the Netherlands, the United Kingdom, Sweden and Finland drink mostly on weekends and outside of the context of meals (Allamani et al, 2000). Whereas in Southwestern European countries, such as France and Italy mostly consume alcohol daily and during meals, usually at dinner (Trias-Llimos et al, 2018). Also in France and Italy, children often are allowed to have their first alcoholic beverage at a much younger age than in other European countries. The drinking habit also remains constant over life course, whereas in Northwestern European countries, such as the Netherlands and the United Kingdom, alcohol consumption tends to be high only in the age group of young adults. Thus overall the total alcohol consumption rate is higher in Southwestern Europe than in Northwestern Europe (Allamani et al, 2000). But the alcohol consumption in Southwestern Europe is done more responsibly, as drunkenness is not accepted, even at parties, festivities or celebrations. Additionally there is little social pressure to drink, compared to other parts of Europe (Engs, 1995).

Though in the last few decades, France has been successful in reducing alcohol consumption, at the very least reduced its consequences. During the 1970s France had one of the highest death rates in Western Europe from chronic liver disease and cirrhosis. To combat this, France implemented several policies, including restrictions on availability and marketing, and increases of prices, which reduced the high-risk consumption of alcohol. As a result France has seen decrease of two thirds in deaths from cirrhosis. This is in contrast to the United Kingdom, which has sought to deregulate alcohol consumption, and thus eased regulations on alcohol availability and access. As a result deaths from cirrhosis have increased since 1970. Another country where policies have failed is Finland. During the turn of the century when Finland joined the European Union, it also deregulated its state monopoly on alcohol amongst other strict alcohol controlling policies. In addition, neighboring country Estonia also joined the European Union in 2004 and introduced lower alcohol prices on the market, to which Finland responded by decreasing taxes on alcohol significantly. Death rates from alcohol-attributable causes of death, including cirrhosis, have increased significantly, since then until 2008, when tax increases were introduced (Mackenback et al, 2013).

2.3.3 Obesity

Obesity has become one of the leading causes of preventable morbidity and mortality from cardiovascular diseases, diabetes, cancer and other chronic diseases. The prevalence of obesity in the world has almost doubled over the last three decades. Almost half of the European population is overweight or obese (Gallus et al, 2015). Overweight and obesity is measured by the body mass index. It is an index that looks at weight and height and is mostly used to classify overweight and obesity. The index is defined as a person's weight in kilograms divided by the square of his height in meters, thus kg/m^2 (WHO, 2020). A body mass index of 25 kg/m^2 to 30 kg/m^2 is considered overweight and from 30 kg/m^2 onwards is considered obese (Tamayo et al, 2013). The concept of the nutrition transition focuses on major shifts in diet and activity patterns, mostly their structure and composition. Changes in diet and activity are reflected in people's body and stature composition. Additionally changes in diet and activity patterns coincide with major changes in health status and demographic and socioeconomic changes (Popkin, 2006). Yet these changes do not occur simultaneously in every population or country, as there are significant contextual differences between populations or countries (Vidra, 2019). There are also factors that influence the demand for food and the usage of food. In particular cultural and knowledge factors that are associated with making food choices, disease patterns and sociologic considerations, such as the role of women and the family structure (Popkin, 2006). Diets play an important role in the prevalence of overweight and obesity. Diets consisting of high amounts of fruits, vegetables and fish, and low amounts of meat, milk, sugar and soft drinks, reduce the risk of overweight and obesity (Gallus et al, 2015). The consumption of processed and convenience foods, such as processed meat and snacks, chocolates and desserts has increased in Europe (Gracia & Albisu, 2001). The prevalence of overweight and obesity is also influenced by socio-economic factors, as the prevalence of overweight and obesity tend to be higher amongst lower income and lower educated populations. Overweight and obesity is connected to smoking cessation as well, as smokers who are trying to quit, experience withdrawal symptoms. Among those symptoms is food cravings, thus during the cessation period, soon-to-be exsmokers tend to gain weight (Gallus et al, 2015). Overweight and obesity has often been linked to physical activity. Physically inactivity significantly increases the risk of obesity. The onset of obesity then by itself creates a vicious cycle of less activity, low energy expenditure and increasing adiposity (Pietiläinen et al, 2008). In most European countries women still bear most of the responsibilities in household duties and childcare, while men bear most of the responsibilities for generating income. This affects how men and women shape their individual and household lifestyles, where men are more likely to have leisure time, once they come home from work, women tend to lose their leisure time due to household duties and childcare (Van Tuyckom et al, 2012).

Northern European countries tend to show relatively high rates of obesity, whereas Southern European countries tend to show relatively low rates of obesity (Gallus, 2015). For Southern European countries it is speculated that the Mediterranean diet, which consists of high amounts of fresh fruits, vegetables and olive oil, has been a factor in the relatively low rates of ischemic heart disease in Southern Europe. But globalization has influenced food consumption throughout Western Europe, as the European common market influenced food production, marketing and trading, and governments started to intervene in the food industry, by providing subsidies to the agricultural industry, regardless of the effects on health (Mackenbach et al, 2013). Thus it has been suggested that diets have converged between the countries, and that diet composition and consumption patterns have become increasingly similar in Europe. However even though different food products have become widely available through Europe, people tend to have preferences for products that they are used to, regardless of whether these products are considered unhealthy (Gracia & Albisu, 2001). Historically the United Kingdom, Finland and Germany have had the highest obesity prevalence in Europe. The United Kingdom has also experienced a strong cohort effect, compared to other European countries, where more recent birth cohorts in the UK have developed greater probabilities of overweight or obesity at younger ages (Vidra, 2019). Some countries have started to try to influence food consumption and nutrition on the basis of its health effects. Finland, Denmark and France have taken actions on the consumption of trans fats, sweetened soft drinks and salt (Mackenbach et al, 2013).

2.4 Conceptual model

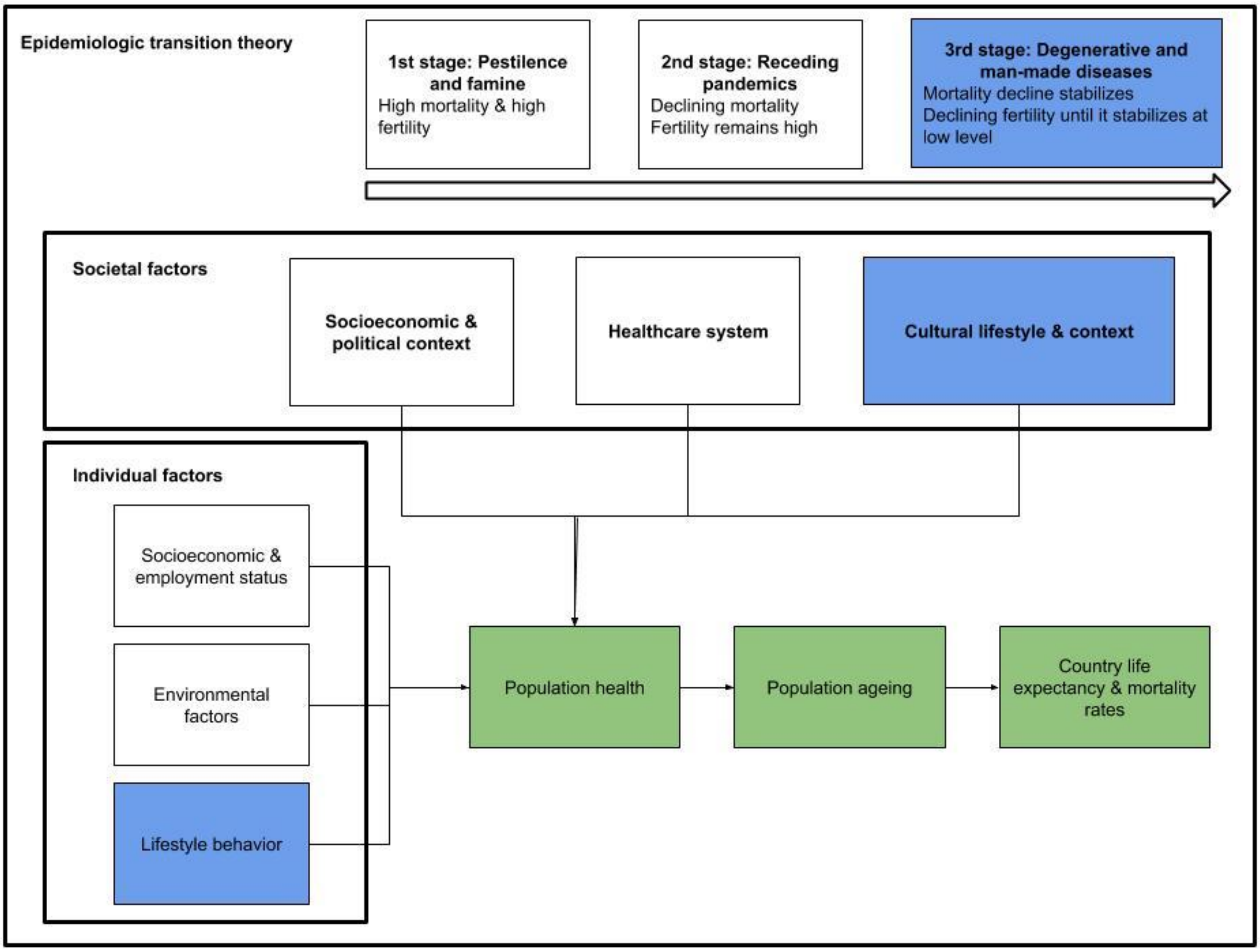

Figure 2.1: Conceptual model.

Figure 2.1 shows the conceptual model, which combine the previous discussed concepts of the epidemiologic transition theory, health status and country differences in lifestyle behavior. Currently Western Europe is in the third stage of the epidemiologic transition theory, which is characterized by the rise of degenerative and man-made diseases (Omran, 2005). These type of diseases are influenced by lifestyle behavior and are thus preventable (Mozaffarian et al, 2009). Both individual and societal characteristics can influence health. Besides lifestyle behavior, at the individual level, certain demographic and socio-economic characteristics (Olsen & Dahl, 2007) and environmental factors (Haveman-Nies et al, 2003), influence health. At the society or country level, social and political institutions have shown to influence health inequalities (Olsen & Dahl, 2007). Differences in societal factors allow for diversity in lifestyle factors in European countries, and subsequently differences in population health as well (de Groot et al, 2004). Lifestyle behavior is an important factor in determining a person's health status, which is closely related to the ageing process. On the level of the total population how healthy people age has impact on the life expectancy and mortality rates of that population.

2.5 Hypotheses

Characteristics of the welfare state such as social benefits and services in Nordic countries help to create a buffer against structural pressure on health inequalities (Olsen, 2007). Overall, poorer health outcomes are expected in Southern Europe, compared to Northern Europe. Specifically the Scandinavian countries, along with Germany, the Netherlands and Switzerland are expected to have better population health, than Spain and Italy (Ploubidis et al, 2012).

The smoking habit started in Northwestern Europe, and approximately 25 years later in Southwestern Europe, according to Janssen (2020). Janssen (2020) explains that lower economic development limited the rise of the smoking epidemic in Southwestern Europe. The Scandinavian European countries have historically proceeded better and earlier in adopting tobacco controlling policies, compared to the rest of Europe according to Marcon et al (2018). Germany, Austria and Denmark are the countries with the worst tobacco controlling policies according to Mackenbach et al (2013). Based on these studies the following hypothesis can be formulated:

1. The highest smoking prevalence and mortality will be found in Germany, Austria and Denmark, whereas the lowest smoking prevalence and mortality will be found in the Scandinavian countries, and the Southern European countries will be in the middle.

According to Janssen (2020), because women started smoking later than men, they have not yet reached their peak in smoking-attributable mortality, whereas for men, the smoking-attributable mortality is expected to decline. Northwestern European countries are thus expected to have smoking-attributable mortality rates for women that are similar to those of men. In contrast to this, Southwestern European countries are likely to show greater differences between men and women:

2. The highest smoking prevalence and mortality for women will be found in Northwestern Europe, whereas the lowest smoking prevalence and mortality for women will be found in Southwestern Europe.

Historically Southwestern Europe had higher alcohol intake than Northwestern Europe, as alcohol was part of daily meals, and this leads to a higher alcohol intake over life course, whereas in Northwestern Europe, drinking usually happens on the weekends, according to Allamani et al, 2000. Although it is yet unclear whether moderate alcohol consumption is healthier than zero alcohol consumption (Costanzo et al, 2019). But in the last few decades France has been successful in reducing alcohol consumption, whereas the United Kingdom and Finland have failed (Mackenbach et al, 2013). Still the following hypothesis can be formulated:

3. The highest alcohol consumption and mortality is expected in Southwestern Europe, whereas the lowest alcohol consumption is expected in Northwestern Europe.

Northern European countries tend to show relatively high rates of obesity, whereas Southern European countries tend to show relatively low rates of obesity (Gallus, 2015). For Southern European countries it is speculated that the Mediterranean diet, which consists of high amounts of fresh fruits, vegetables and olive oil, has been a factor in the relatively low rates of ischaemic heart disease in Southern Europe (Mackenbach et al, 2013). Historically the United Kingdom, Finland and Germany have had the highest obesity prevalence in Europe. The United Kingdom has also experienced a strong cohort effect, compared to other European countries, where more recent birth cohorts in the UK have developed greater probabilities of overweight or obesity at younger ages (Vidra, 2019). Based on these studies, the following hypothesis can be formulated:

4. The highest obesity prevalence and mortality is expected in Northwestern Europe, specifically the UK, Finland and Germany, whereas the lowest obesity prevalence and mortality is expected in Southwestern Europe.

3. Methodology

3.1 Study design

To determine the contribution of lifestyle risk factors; smoking, obesity and alcohol consumption to country mortality differences and life expectancy in Western Europe, this research will be using secondary data. This research will thus consist of a quantitative analysis. Quantitative research answers questions, such as ‘how many’ or ‘how much’ (McCusker & Gunaydin, 2014). Quantitative research is often used to explain certain phenomena through the collection of numerical data and the analysis of this data using mathematically based methods (Aliaga and Gunderson, 2002, in Muijs, 2004). This is what differs quantitative research from qualitative research, as qualitative data does not necessarily have to be numerical and thus can also be analyzed by other methods than statistics (Sukamolson, 2007). This does not necessarily mean that quantitative data is more limited, as lots of data that are not naturally quantitative, can still be collected in a quantitative way. This can be done through designing research instruments that are aimed at converting certain phenomena that are not naturally quantitative into quantitative data, which can then be analyzed statistically (Muijs, 2004). Quantitative research can best be used to find answers to research questions that either demand a quantitative answer, or that look at numerical change, or that look at causal factors or that aim at testing certain hypotheses (Tuli, 2010). Quantitative research can be designed as either experimental or non-experimental. An experimental research design can be defined as a test under controlled conditions that is made to demonstrate a known truth or examine the validity of a hypothesis (Sherman & Strang, 2004). For this research the former is the case. Control is most important in this research design. This means that the environment in which the research is done is controlled as much as possible and the focus is only on the chosen variables that need to be studied. Control can also include a certain degree of manipulation by the researcher of the predictor variable, which is the variable that is supposed to affect the outcome of the experiment (Muijs, 2004).

The underlying epistemology of quantitative research can be described as realism. Realism makes the assumption that research uncovers the truth and the existing reality. This means that researchers need to use objective research methods to maximize the level of objectivity in their research and minimize their own involvement (Sukamolson, 2007). Quantitative research can thus be seen as neutral and not biased. Quantitative research methods can be repeated over different sized samples and different time periods allowing comparisons to be made and creating a representative rendition of reality (McCusker & Gunaydin, 2014). Quantitative research also takes a pragmatist approach to research, meaning that different methods will be used depending on the research question that needs answering (Muijs, 2004).

This research can also be described as a cross-sectional study. Cross-sectional studies are carried out at a specific time point or over a short time period (Sedgwick, 2014). They are typically used to estimate the prevalence of a specific aspect for a given population and their purpose can be important for public health planning. Thus a cross-sectional study can be beneficial when the purpose of the study is descriptive and the main goal is to find the prevalence of a specific aspect for a given population within a specific time frame or for a specific time point (Omari, 2015). Cross-sectional studies help indicate associations that may exist between exposure to risk factors and the outcome of interest, and are thus useful in generating hypotheses for future research (Levin, 2006).

3.2 Data

This research uses secondary data. Three different databases will be used to collect the data from. First is the mortality database from the World Health Organization. This database will provide data on specific cause of death and all-cause mortality for each Western European country plus the population size for each Western European country. The second database is Eurostat. This database will provide data on the prevalence of smoking, obesity and alcohol and data on life expectancy per Western European country. The third database is the Global Burden of Disease (GBD). The GBD is an institution that researches mortality and disability rates from all kinds of diseases, injuries and risk factors. This database will provide information on which causes of death are caused by smoking, alcohol or obesity. It is important that all data used comes from the same year, but is also the most recent data available. Since for both the Eurostat database and the mortality database from the WHO the year 2014 was the most recent year from which data could be collected, this year will be examined in this research.

The World Health Organization (2005a) provides insight into how data is reported in countries. For the Western European countries it is reported that deaths are first reported at a civil registry, local health authority or a national board of health and welfare. The responsibility of finalizing the data at the national level lies at either a central statistics office, the ministry of health or some other public health institute. All countries include the causes of deaths as part of the information collected in their respective compulsory national death registration system, except for Germany and Switzerland for which there was no information available (WHO, 2005a). All countries are reported to have a national estimated completeness of overall registered deaths of at least 90%, except for Belgium, Germany and Switzerland for which there was no information available (WHO, 2005b). This is important for the representativeness of the data. If causes of deaths are underreported or misreported, the results of an analysis of this data will become biased (Mathers et al, 2005). Registering of deaths can happen at the hands of different professionals, thus an objective centralized coding procedure on how to categorize a cause of death is important. All Western European countries are reported to have some form of centralized coding procedure. Only for Belgium, Ireland, Luxembourg, Norway, Spain, Germany and Switzerland, this coding system is not entirely based on the International Classification of Diseases, created by the World Health Organization (WHO, 2005c). The International Classification of Diseases (ICD), which is a globally used diagnostic tool for classifying diseases, created and updated by the World Health Organization and available for all member states. With the help of the ICD, causes of deaths are more likely to be reported objectively and similarly regardless of who and in which country the death is reported. This means that the data on causes of death in countries are comparable.

The data used from the Eurostat database was originally gathered by Eurostat through surveys. These surveys are distributed among European countries and cover the population from 15 years and over of the respective countries. Eurostat aims a minimum output quality, by providing standardized models and allowing countries to adjust the models to fit their national needs, methods of data collection and, methods of data registration. This way each participating country can optimize their survey responses. Eurostat provides this flexibility, whilst also checking on consistency and integrity to make sure the data remains representative and comparable between different countries. But data collected through large-scale surveys might contain missing data, as respondents tend to underreport or misreport their health status. It can therefore be assumed that the prevalence of lifestyle risk factors are higher than the data shows (Jakob et al, 2017).

The Global Burden of Disease looks at over 300 different types of causes of death in more than 100 countries in the world. To gather the data on all the different causes of death, the GBD works with multiple databases from each country. The different data sources include censuses, disease registrations, surveys and scientific literature (IHME, 2018). The GBD study looks at both the prevalence of a given risk factor and the relative harm it causes. It shows which diseases can be caused by the given risk factor and what proportion of those diseases can be attributed to lifestyle risk factors. The GBD provides a so-called risk factor attribution, which estimates what proportion of a given cause of death can be attributed to the given risk factor. This will be used to determine what proportion of the number of deaths by a given cause of death can be attributed to a given risk factor. This is done, because for example lung cancer is not always caused by smoking, since people can develop lung cancer, while having never smoked in their entire life, while someone who has smoked all their life can perish from a disease unrelated to their smoking habit. Figure 3.1 shows the causes of death related to either smoking, alcohol consumption or a high body mass index and shows the risk factor attribution for men and women of Western Europe as a whole to give an indication of how much each cause of death can be attributed to the lifestyle factors. For the calculation of the age standardized mortality rates of each country, country-specific, age group-specific and gender-specific risk factor attributions will be used. The risk factors provided are available for the age groups 15 to 49, 50 to 69 and 70+, thus these will be the age groups used in the calculation.

Smoking	**Risk factor attribution**	
Causes of death	**Men**	**Women**
Tracheal, bronchus and lung cancer	76,59	61,29
Chronic obstructive pulmonary disease	56,41	33,68
Ischemic heart disease	20,16	9,15
Stroke	13,73	6,49
Liver cancer	25,25	12,74
Stomach cancer	24,68	11,91
Colo and rectum cancer	19,07	9,85
Leukemia	34,57	20,23
Breast cancer		5,66
Esophageal cancer	46,33	29,43
Pancreatic cancer	26,72	24,76
Cervical cancer		27,28
Prostate cancer	6,27	
Bladder cancer	35,93	20,37
Kidney cancer	24,77	13,44
Larynx cancer	74,77	56,26
Other pharynx cancer	62,57	48,27
Nasopharynx cancer	37,32	22,18
Atrial fibrillation and flutter	6,54	2,12
Aortic aneurysm	39,74	18,25
Peripheral artery disease	34,72	12,63
Lip and oral cavity cancer	46,31	28,1
Alzheimer's disease and other dementias	23,44	8,1
Diabetes	10,16	3,38
Asthma	21,33	9,5
Multiple sclerosis	19,38	12,42
Upper digestive system diseases	25,44	11,45
Gallbladder and biliary diseases	7,69	2,61
Lower respiratory infections	21,6	9,05
Tuberculosis	22,56	9,12

Alcohol use	**Risk factor attribution**	
Causes of death	**Men**	**Women**
Stroke	21,24	0,16
Liver cancer	41,39	19,5
Colon and rectum cancer	27,67	12,36
Esophageal cancer	52,56	30,68
Hypertensive heart disease	35,33	18,39
Cardiomyopathy and myocarditis	26,24	4,31
Atrial fibrillation and flutter	23,04	9,53
Lip and oral cavity cancer	71,12	42,23
Larynx cancer	50,32	25,06
Other pharynx cancer	73,66	51,71
Nasopharynx cancer	69,75	49,09
Cirrhosis and other chronic liver disease	47,98	31,49
Diabetes mellitus	7,31	
Epilepsy	47,44	25,63
Pancreatitis	53,37	18,99

High body mass index	**Risk factor attribution**	
Causes of death	**Men**	**Women**
Ischemic heart disease	19,66	15,4
Stroke	15,83	10,97
Liver cancer	20,14	12,54
Colon and rectum cancer	14,14	4,9
Esophageal cancer	27,97	25,57
Breast cancer		5,99
Leukemia	7,05	10,35
Pancreas cancer	6,17	7,61
Ovarian cancer		3,34
Gallbladder and biliary tract cancer	12,25	25,22
Non-Hodgkin lymphoma	7,47	5,66
Kidney cancer	18,67	23,94
Multiple myeloma	7,42	7,59
Uterine cancer		41,18
Thyroid cancer	17,14	11,02
Hypertensive heart disease	41	41,62
Atrial fibrillation and flutter	23,16	24,18
Alzheimer's disease and other dementias	15,2	15,55
Asthma	28,07	28,54
Diabetes	34,02	31,02
Chronic kidney disease	29,31	29,33
Gallbladder and biliary diseases	29,86	44,75

Figure 3.1: Causes of death related to either smoking, alcohol use or a high body mass index, alongside the risk factor attribution for men and women. Source: IHME, 2014. Accessed through https://vizhub.healthdata.org/gbd-compare/.

3.3 Methods

To answer the sub-questions on the prevalence of smoking, alcohol and obesity in Western European countries and the life expectancy and all-cause mortality rates in Western European countries, descriptive statistics will be used.

For the analysis of the mortality rates of the lifestyle-related diseases, age-standardization is the most appropriate technique. The mortality rates of lifestyle risk factors in a population are age-dependent, meaning that the risks increase with age. Since not all populations have the same age composition, comparisons of crude age-specific rates between populations can be misleading (Ahmad et al, 2001). Age standardization is a technique to compare populations with different age structures. So the composition of the populations is statistically transformed to a reference population (Naing, 2000), which in this research is the total population of Western European countries. Age standardization is done because this gives the different populations the same age distribution structure, so that the calculated results will be more comparable. It is also a favourable technique, when the characteristic that is being research varies with age (Statistics Canada, 2017).

To calculate the age standardized mortality rate (ASMR), several steps are taken. First the age-specific mortality rates for each group is calculated by dividing the number of deaths by the respective population, and then multiplying the resulting number by 100,000. Each age-specific mortality rate is then multiplied by the proportion of the standard population belonging to the particular age group. This proportion is called the standard population weight. Finally the age-standardized rates are calculated by adding the resulting numbers (Statistics Canada, 2017).

The effect of smoking, obesity and alcohol on life expectancy can be calculated using a PGLE analysis. PGLE stands for Potential Gain of Life Expectancy. It is the added years of life expectancy for the population if the death from one or multiple causes of death were removed or eliminated as a competing risk of death (Wong et al, 2006). So it shows how many years of life expectancy a population were to gain if certain causes of death were removed from the equation (Wong et al, 2002). The PGLE can be calculated using observed life expectancy rates at birth and cause specific mortality data by age cohorts. It can be used to show the effect of one or multiple causes of death on the life expectancy of a specific population (Lai & Hardy, 1999).

There are no ethical considerations to be made, as the data is secondary and the anonymity of the participants of the original survey was guaranteed, due to the data already being displayed anonymously by the Global Burden of Disease. The only ethical consideration, while handling the data, is that any researcher using this data, is not allowed to share the data. Thus all the data used is available for download at the website of the Global Burden of Disease.

4. Results

4.1 Lifestyle-attributable mortality rates

4.1.1 Smoking-attributable mortality rates

Prevalence of smoking is estimated to be related to higher smoking-attributable mortality. Figure 4.1 shows the prevalence of smoking in Western European countries for men and women in 2014. Switzerland is excluded from this figure, because there was no data available on this topic for this country. The percentage of current smokers includes both daily and occasional smokers. France has the highest prevalence of smoking for men with 31.8 percent, followed by Austria with 31.1 percent. Both countries have the highest prevalence of smoking for women with 25 percent. Sweden has the lowest prevalence of smoking for both men and women, with 16.6 percent for men and 13.1 percent for women. Clearly there are differences between men and women in the prevalence of smoking. Less women smoke than men in Western European countries.

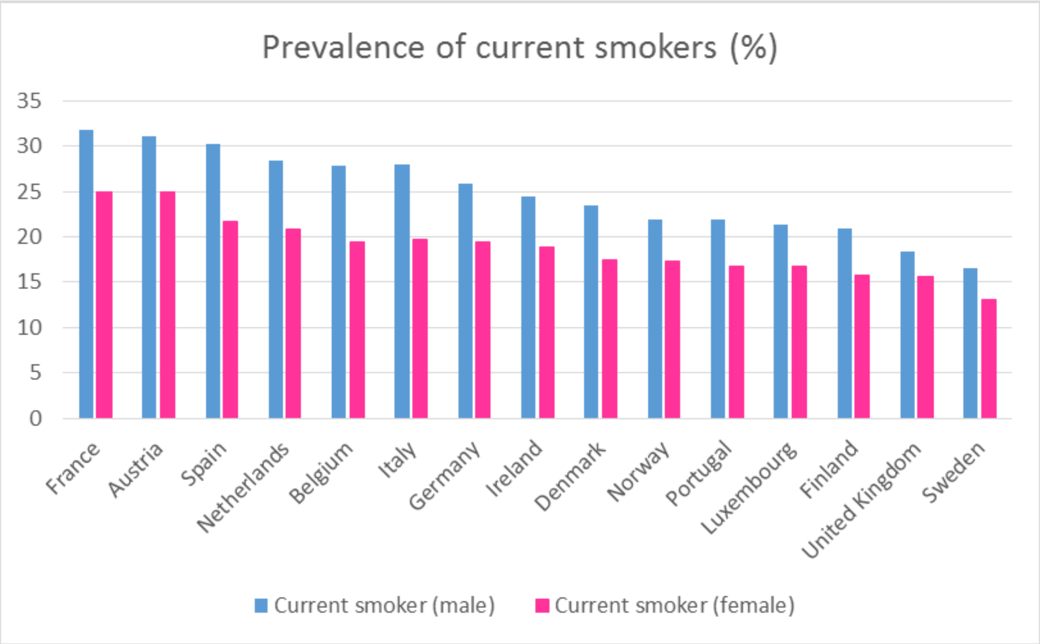

Figure 4.1: Smoking prevalence in Western European countries. Source Eurostat, 2014.

The prevalence of smoking is not evenly distributed across different age groups. Figure 4.2 shows the smoking prevalence in percentages per age groups for the total population in Western European countries in 2014. For the country of Switzerland, there was no data available. For France, Austria, Spain, Italy, the Netherlands, Portugal, Germany, Finland Denmark, Luxembourg and the United Kingdom, the largest age group of current smokers is the age group from 25 years to 34 years. Some of the countries, such as France, Austria and Spain, show a quick decline in smoking prevalence at the age of 65 and higher. Interestingly this decline is not visible in Sweden, even though Sweden has the lowest smoking prevalence of all Western European countries. For Sweden there is not a quick decline until the age group 75 years or over.

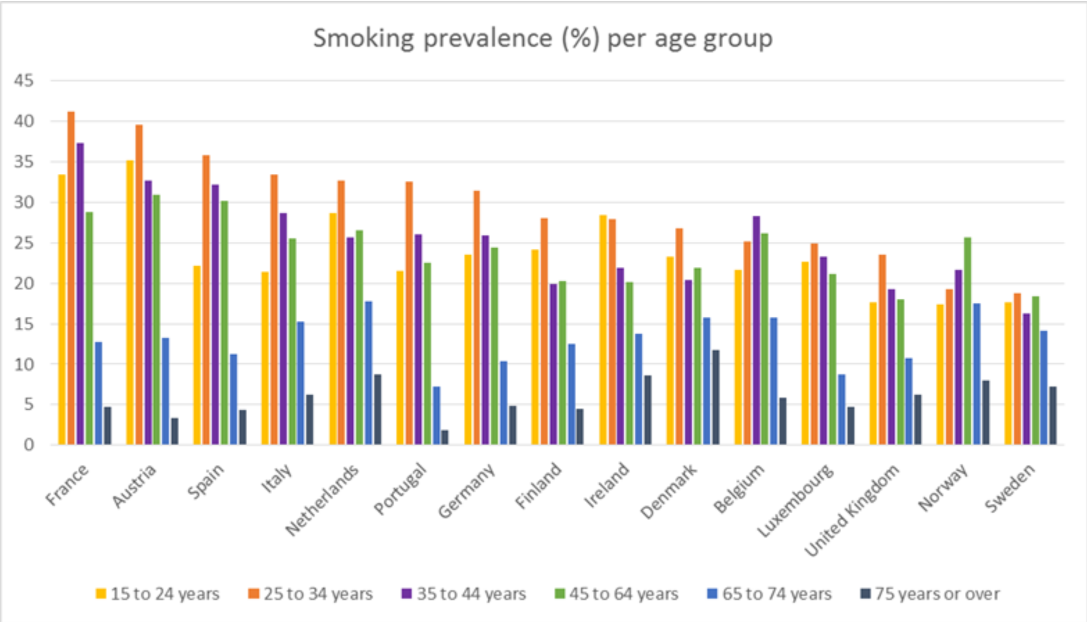

Figure 4.2: Smoking prevalence in percentages per age group in Western European countries. Source: Eurostat, 2014.

As shown in the methodology smoking is a risk factor for 28 causes of deaths for men and 29 causes of deaths for women. The risk factor attribution varies for each cause of death and between genders, age groups and countries. The risk factor attribution tends to be higher in the age group 50 to 69 years than in the age groups 15 to 49 years and 70 years and older. The risk factor attribution can range from below 10 percent for some causes of death to above 50 percent for other causes of death.

For men a couple of causes of death have a risk factor attribution over 50 percent in at least two age groups or all three. Theoretically, this means that for those causes of death, more than half could be attributed to smoking. This also means that these causes of death could be preventable if the individuals had not smoked. These causes of death include lung cancer, larynx cancer and pharynx cancer. Several causes of death have a risk factor attribution that drops significantly in one age group compared to the other two. Either the risk factor attribution is significantly lower in the youngest age group of 15 to 49 years and then increases in the later age groups, or the risk factor attribution is high in the first two age groups and drops in the age group of 70 years and older. These causes of death include chronic obstructive pulmonary disease, aortic aneurysm, peripheral artery disease and ischemic heart disease. For women, similar patterns can be noticed, only overall the risk factor attribution is lower than compared to men. More noticeably for women is that the risk factor attribution tends to drop more significantly compared to men in the oldest age group of 70 years and older. Thus, not only do women overall have a lower risk of smoking-attributable causes of death, women's risk of smoking-attributable causes of death in the oldest stages in life is also considerably lower than men.

But even though significant proportions of smoking-related causes of death can be attributed to smoking, in terms of risk, that doesn't necessarily mean they also produce higher number of deaths. Most of the smoking-related causes of death produce a significantly small number of deaths to the total age standardized smoking-attributable mortality rates. For both men and women only four causes of death have a significant impact on the ASMR. These are lung cancer, chronic obstructive pulmonary disease, ischemic heart disease and Alzheimer's disease and other dementias. This shows that some of the causes of death can have a high risk factor attribution to smoking, such as larynx cancer, pharynx cancer, aortic aneurysm and peripheral artery disease, but are not that lethal in the end. For most countries lung cancer tends to contribute the highest number of deaths to the ASMR, followed by either ischemic heart disease or chronic obstructive pulmonary disease, depending on the country. Alzheimer's disease and other dementias tend to be the fourth highest contributor of most countries. For men, the number of deaths of lung cancer per 100.000 standard population ranges from 72.4 in Belgium to 27.3 in Sweden. For ischemic heart disease the number of deaths per 100.000 standard population ranges from 34.2 in Austria to 13.7 in France. For chronic obstructive pulmonary disease the number of deaths per 100.000 standard population ranges from 36.5 in Denmark to 8.9 in France. And finally for the Alzheimer's disease and other dementias the number of deaths per 100.000 standard population ranges from 18.7 in the Netherlands to 5.5 in Austria. For women, all of the number of deaths are lower. For lung cancer it ranges from 50.2 in Denmark to 4.8 in Portugal. For ischemic heart disease it ranges from 16.9 in Sweden to 2.9 in Portugal. For chronic obstructive pulmonary disease it ranges from 38.7 in Denmark to 1.0 in Portugal. And finally for Alzheimer's disease and other dementias it ranges from 19.1 in Denmark to 1.3 in Portugal.

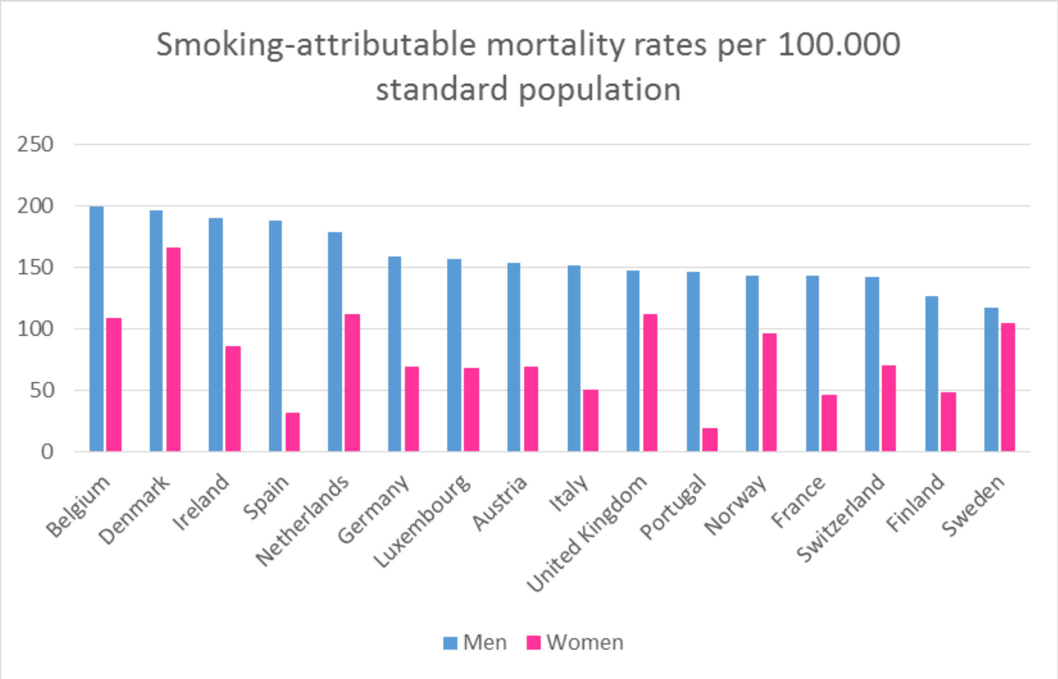

Figure 4.3: Smoking-attributable mortality rates per 100.000 standard population.

Figure 4.3 shows the total smoking-attributable mortality rates per 100.000 standard population. Most significant is the difference between men and women for some countries, such as Spain and Portugal. On the other hand countries like Denmark, United Kingdom and Sweden show only small differences between men and women. For men the smoking-attributable mortality rates per 100.000 standard population ranges from 199.3 in Belgium to 116.7 in Sweden. For women it ranges from 165.6 in Denmark to 18.1 in Portugal. The difference between the highest and lowest rate is for women significantly larger than for men. Denmark has the second highest mortality rate for men and the highest for women. The Scandinavian countries Norway, Sweden and Finland are clustered at the bottom, just the Netherlands, Germany and Luxembourg are clustered nearer to the top.

4.1.2 Alcohol-attributable mortality rates

The prevalence of alcohol consumption can be expressed in the percentage of daily and weekly drinkers in Western European countries. In figure 4.3 the percentages of the population in Western European countries that drink alcohol every day can be observed. The figure is missing data for the countries of Switzerland, the Netherlands and France, because data for these countries was not available. Portugal has the highest percentage of men and women who drink alcohol every day, with 38.6 percent for men and 11.9 percent for women. But the difference between men and women in Portugal is significant, since even though the percentage of Portuguese men is far ahead of the second highest percentage of daily drinking men of Spain, for women the differences between the percentages of the different countries are very small. For Spain the percentage of men is 24.8 percent and for women it is 7.5 percent. The Scandinavian countries Norway, Sweden and Finland all have low percentages of daily drinkers in their populations compared to the other Western European countries.

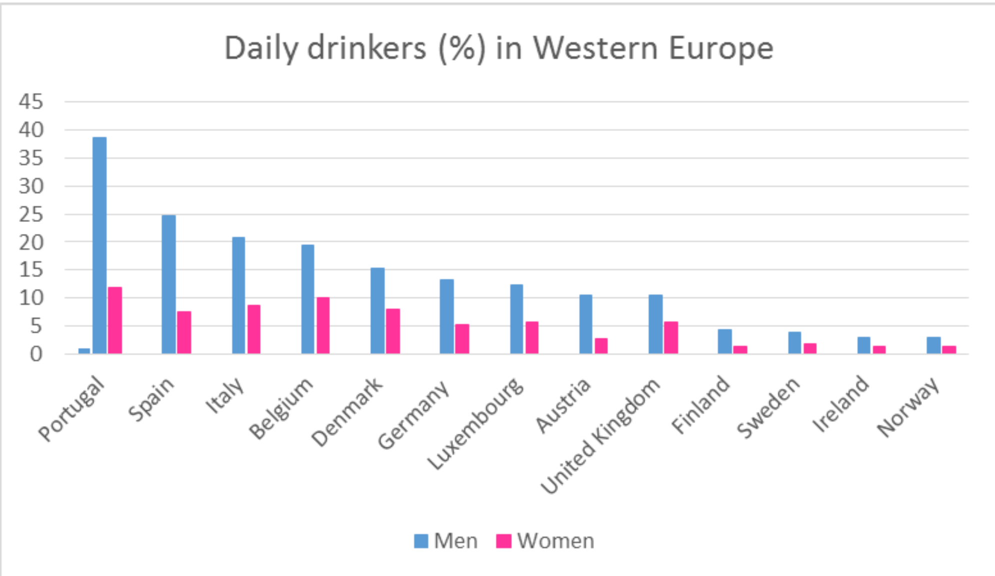

Figure 4.4: Percentage of population that drinks alcohol daily in Western Europe in 2014. Source: Eurostat, 2014.

For weekly drinkers the differences are less significant. In figure 4.5 the percentages of the population in Western European countries that drink alcohol every week, but not every day can be observed. This figure is missing data for the countries of Switzerland, the Netherlands and France, because data for these countries was not available. The country of Portugal, which was at the top of figure 4.2, now sits at the bottom with a percentage of 19 percent for the total population, 25.4 percent for men and 13.4 percent for women. Overall the percentages for weekly drinkers are higher in every country than for daily drinkers. Thus more people in Western European countries drink alcohol on a weekly occurrence, then on a daily occurrence. As figure 4.5 shows the United Kingdom has the highest percentage of weekly drinkers for both men and women, with 51.6 percent for men and 40.5 percent for women. Interestingly the prevalence of weekly drinkers seems to be lowest in Southern Western Europe, followed by Northern Western Europe. Mid-Western Europe seems to have the highest percentage of weekly drinkers.

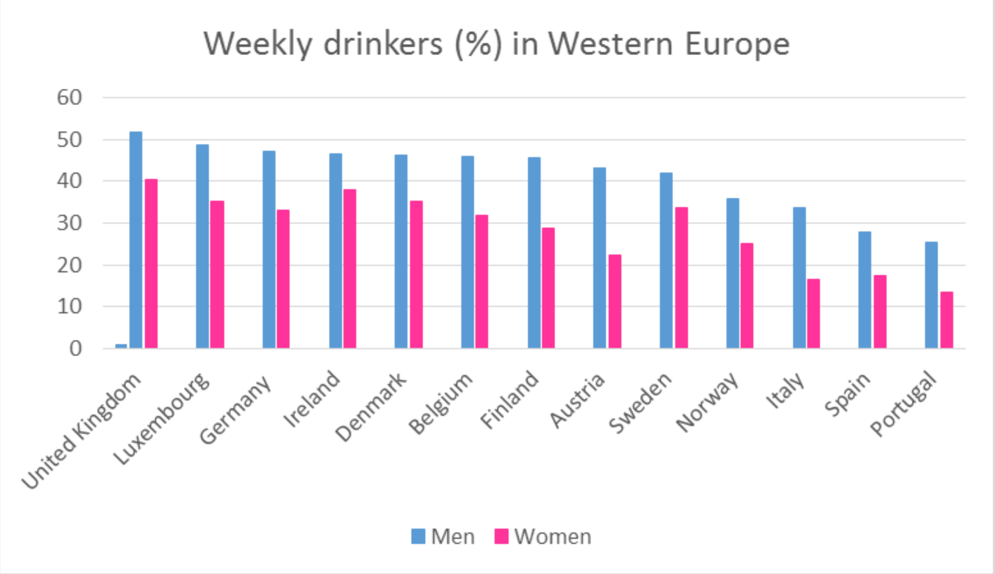

Figure 4.5: Percentage of population that drinks alcohol weekly, but not daily in Western Europe in 2014. Source: Eurostat, 2014.

For alcohol use, there is a risk factor attribution for 19 causes of death for men and women. Overall men have higher risk factor attribution than women for alcohol use. For both men and women the same causes of death have the highest risk factor attribution, namely alcohol use disorder, pharynx cancer, nasopharynx cancer, cancer of the lip and oral cavity, tuberculosis and esophageal cancer. Interestingly liver cancer has a relatively low risk factor attribution compared to these other causes of deaths, even though alcohol use is commonly associated with the liver. The risk factor attribution tends to be higher in the age group 50 to 69 years than in the age groups 15 to 49 years and 70 years and older, but only slightly. The risk factor attribution for alcohol use remains rather constant over the three age groups, with only a slight drop in the youngest and oldest age group.

But the causes of death that contribute the most to the mortality rates of the Western European countries are the ones with relatively low risk factor attribution. These causes of death include cancer of the colon and rectum, lower respiratory infections, hypertensive heart disease and liver cancer. There are also differences between the countries. For example for men in Portugal the highest contributions come from cancer of the colon and rectum at 16.2, lower respiratory infections at 14.4 and ischemic heart disease at 12.9. Luxembourg shows a similar trend with 12.2 deaths for cancer of the colon and rectum, 13.0 for lower respiratory infections and 14.5 for ischemic heart disease. But for men in Austria hypertensive heart disease is the highest contributor at 14.1, for men in Belgium, a stroke is the highest contributor at 18.5 and for men in Denmark it is alcohol use disorder with 17.8 deaths. It shows how a certain cause of death might be a major contributor to alcohol-attributable mortality in one country, but not at all in another country. For women the highest contributing causes of death are more similar in the countries, namely breast cancer and hypertensive heart disease. For breast cancer, the number of deaths per 100.000 standard population ranges from 11.1 in Denmark to 4.2 in Spain. For hypertensive heart disease it ranges from 16.4 in Austria to 1.8 in Ireland. Interestingly where ischemic heart disease can be a contributor to alcohol-attributable mortality rates for men, for women it is not a contributor at all.

Overall, alcohol-attributable mortality rates for women are significantly lower than for men. The alcohol-attributable mortality rates per 100.000 standard population for the Western European countries are shown in figure 4.6.

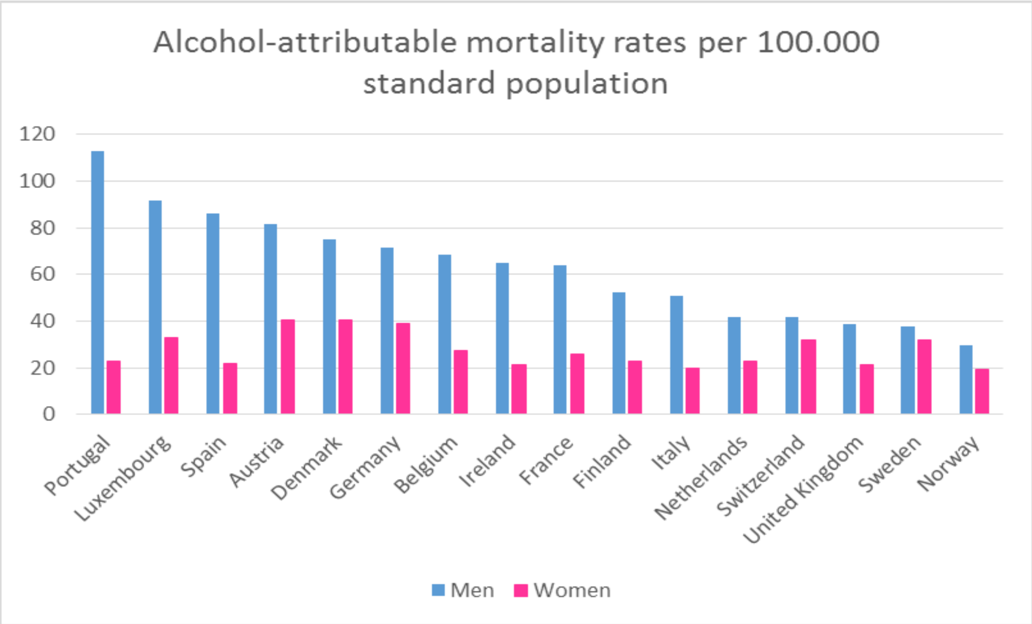

Figure 4.6: Alcohol-attributable mortality rates per 100.000 standard population.

It shows that Portugal has the highest alcohol-attributable mortality rate for men with 112.7 and Norway the lowest with 29.7. It also shows that Denmark has the highest alcohol-attributable mortality rate for women with 40.7, closely followed by Austria with 40.3, and that Norway has the lowest with 19.4, closely followed by Italy with 19.8. The differences between the countries for women are significantly smaller than for men. Within the countries the differences between men and women differ. Portugal has the biggest difference in alcohol-attributable mortality rates between men and women, whereas Sweden has the smallest difference between men and women. Norway has both for men and women the lowest alcohol-attributable mortality rate. Denmark has the highest alcohol-attributable mortality rate for women with 40.7, and also the fifth highest rate for men with 74.8. Where Portugal and Spain are clustered at the top for alcohol-attributable mortality rates of men, Sweden and Norway are clustered at the bottom, even though Sweden has one of the highest alcohol-attributable mortality rates for women with 31.7.

4.1.3 Obesity-attributable mortality rates

Overweight and obesity is measured by the body mass index. It is an index that looks at weight and height and is mostly used to classify overweight and obesity. The index is defined as a person's weight in kilograms divided by the square of his height in meters, thus kg/m^2 (WHO, 2020). A body mass index of 25 kg/m^2 to 30 kg/m^2 is considered overweight and from 30 kg/m^2 onwards is considered obese (Tamayo et al, 2013). Figures 4.7 and 4.8 show the prevalence of overweight and obesity in Western Europe respectively. For the country of Switzerland, there was no data available. There is not much differences between the Western European countries in the prevalence of overweight, but there is a difference between men and women in the prevalence of overweight. The percentage of men with overweight is higher than the percentage of women with overweight in all Western European countries. There is a relatively bigger difference in the prevalence of obesity between the Western European countries. The United Kingdom has the highest prevalence of obesity for women with 20.5 percent and the second highest for men with 19.7. Ireland has a slightly higher prevalence of obesity for men with 20.0 percent. Italy has the lowest prevalence of obesity for women with 10.3 percent and the second lowest for men with 11.3 percent. Only the Netherlands has a slightly lower obesity prevalence for men with 11.2 percent. The differences between men and women in prevalence of obesity is not as significant, as the differences between men and women in prevalence of overweight. The Northern European countries Norway and Sweden have relatively low obesity rates in figure 4.8, compared to the other countries, whereas Finland has the third highest in this figure. Of the Southern European countries only Italy has a relatively low rate of obesity, whereas Spain and Portugal are nearer to the top.

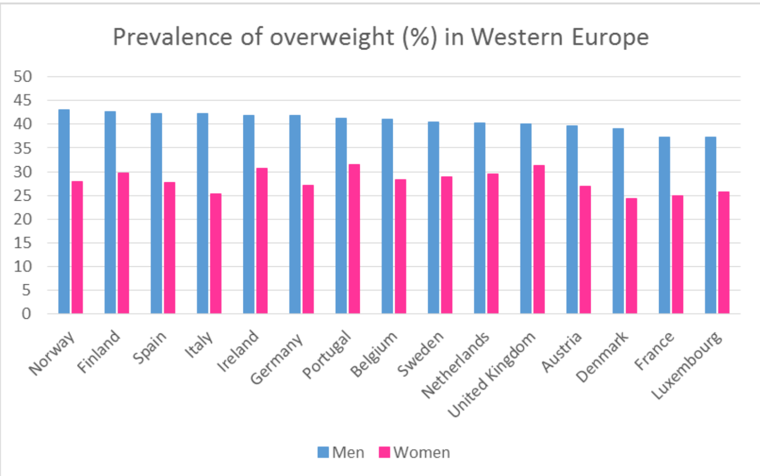

Figure 4.7: Percentage of the population in Western European countries with a body mass index of 25 to 30. Source: Eurostat, 2014.

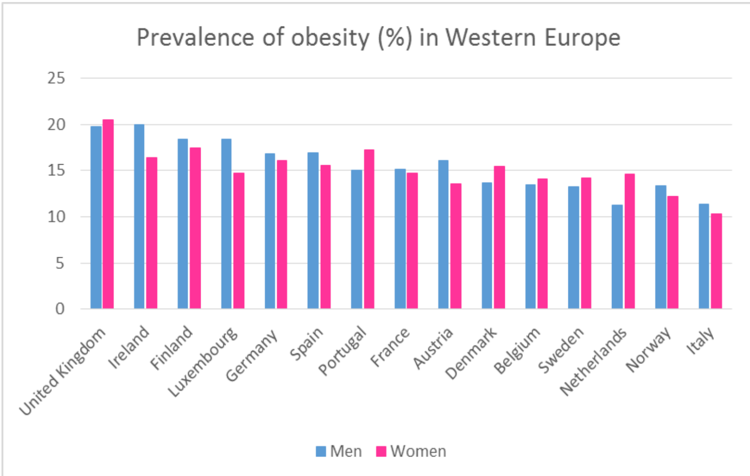

Figure 4.8: Percentage of the population in Western European countries with a body mass index of 30 or greater. Source: Eurostat, 2014.

Overweight and obesity has often been linked to physical activity. Figure 4.9 shows the percentage of the population of Western European countries that spent zero minutes per week on physical activity. For the countries of Switzerland, Belgium and the Netherlands, there was no data available. The South-Western European countries Italy, Portugal and Spain are all at the top, whereas the North-Western European countries Norway, Sweden and Finland are at the bottom of this figure. The differences between the Western countries are significant. Italy has the highest lack of physical activity with 59.4 percent for men and 70.0 percent for women, whereas Denmark has the lowest lack of physical activity with 21.1 percent for men and 16.3 percent for women. For half of the countries women tend to be more physically inactive than men. As the percentage of physical inactivity increases for both men and women, so does the difference between men and women.

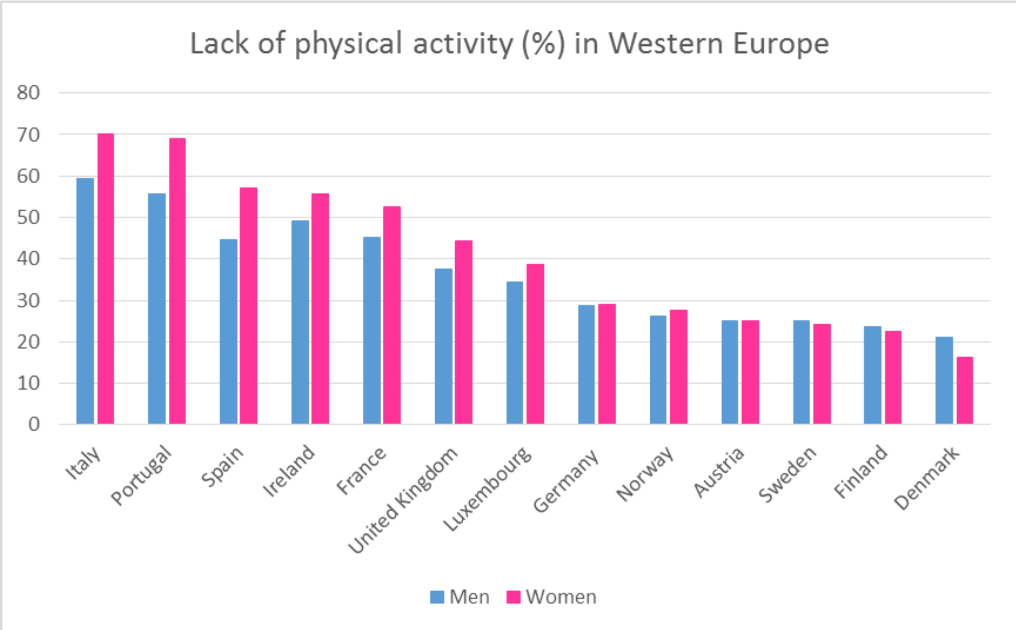

Figure 4.9: Percentage of the population of Western European countries that spent zero minutes per week on physical activity. Source Eurostat, 2014.

For obesity there is a risk factor attribution for 19 causes of death for men and 22 causes of death for women. Overall men and women seem to have similar risk factor attribution for most of the causes of death. The risk factor attribution does not remain constant over the life course for all causes of death. For some causes of death, such as hypertensive heart disease, ischemic heart disease and stroke, the risk factor attribution decreases in later stages of life and drops significantly in the age group of 70 years and older. For both men and women the causes of death with the overall highest risk factor attribution are hypertensive heart disease and stroke.

Highest contributing causes of death to obesity-attributable mortality rates for both men and women can be either or a combination of Alzheimer's disease and other dementias, ischemic heart disease, hypertensive heart disease and diabetes. For men the numbers of deaths per 100.000 standard population of Alzheimer's disease and other dementias ranges from 17.9 in Finland to 3.8 in Austria. For ischemic heart disease it ranges from 33.2 in Austria to 12.0 in France. For hypertensive heart disease it ranges from 14.7 in Austria to 2.5 in Belgium. And for diabetes it ranges from 12.5 in Portugal to 3.6 in Finland. For women the numbers of deaths per 100.000 standard population of Alzheimer's disease and other dementias ranges from 34.4 in Finland to 6.3 in Austria. For ischemic heart disease it ranges from 26.9 in Finland to 6.0 in France. For hypertensive heart disease it ranges from 30.3 in Austria to 3.5 in Ireland. And for diabetes it ranges from 14.1 in Portugal to 2.7 in Finland. The highest contributing cause of death differs per country, but for men in most of the countries the highest contributing cause of death is ischemic heart disease by far, whereas for women it is typically a combination of two or more causes of death.

Overall obesity-attributable mortality rates are quite similar for both men and women, as can be seen in figure 4.10 below. Ireland is the exception, where the obesity-attributable mortality rate for men is significantly higher than for women. The obesity-attributable mortality rate for men is 85.7, which is the third highest among the Western European countries, whereas the obesity-attributable mortality rate for women is 45.5, which is the lowest among the countries.

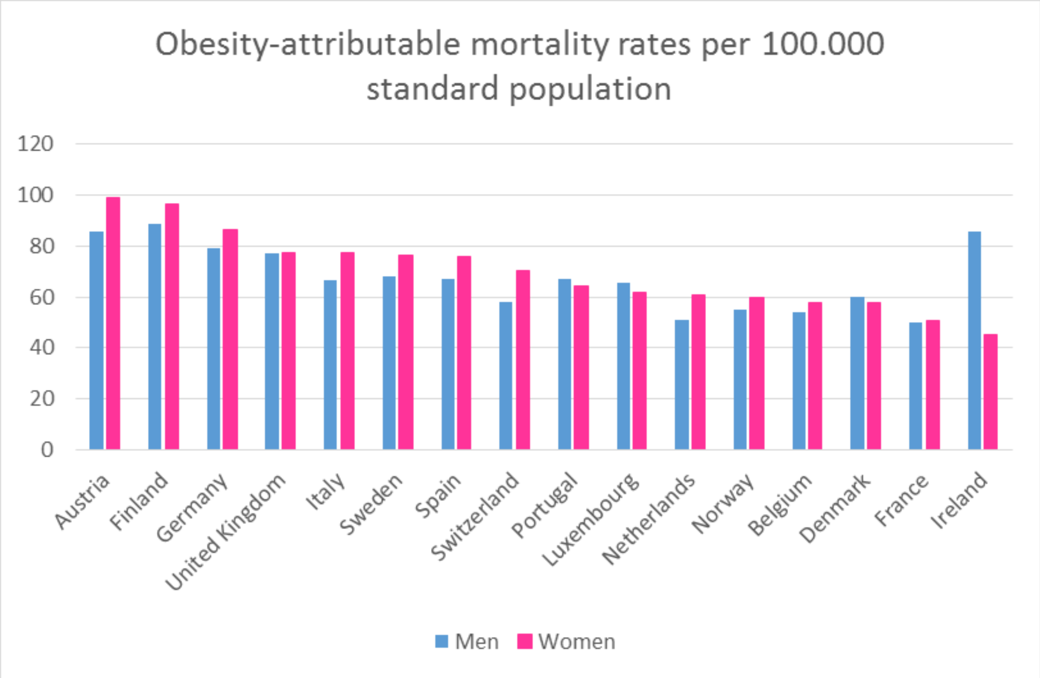

Figure 4.10: Obesity-attributable mortality rates per 100.000 standard population.

For some of the other countries obesity-attributable mortality rate is slightly higher for women than for men. Austria has the highest obesity-attributable mortality rate for women with 99.2, and the second highest for men with 85.8. France has the lowest obesity-attributable mortality rate for men with 50.1, and the second lowest for women with 50.7. The Benelux countries, along with Denmark and France are clustered near the bottom, whereas Germany is nearer to the top. Also Finland and Sweden are nearer to the top, whereas Norway is nearer to the bottom. Thus differences can be seen between neighboring countries.

4.1.4. All-cause mortality vs lifestyle-attributable mortality

Now it is important to see how much the lifestyle-attributable mortality rates contribute to the total mortality rates for all causes of death for men and women in the Western European countries. Figures 4.11 and 4.12 show the smoking-attributable, alcohol-attributable and obesity-attributable mortality rates as part of the total all-cause mortality rates of each Western European country. There are differences between the countries, and between men and women. For men the overall all-cause mortality rates are similar to the all-cause mortality rates for women, but for men the proportion of the all-cause mortality rates that can be attributed to smoking, alcohol and obesity is higher. For men this proportion ranges from 20.8 percent for Finland to 37.3 percent for Spain, whereas for women this proportion ranges from 11.4 percent for Portugal to 26.3 for Denmark. Thus for Spain over one third of their total mortality rates can be attributed to lifestyle risk factors. Even though Finland has the lowest proportion of all-cause mortality that can be attributed to lifestyle risk factors, it has the highest all-cause mortality rate. For men, for most of the countries, smoking-attributable mortality contributes the most to the all-cause mortality rate, followed by obesity-attributable mortality and then alcohol-attributable mortality. Except for Spain, Portugal, Denmark and Luxembourg, where alcohol-attributable mortality is the second highest contributor and obesity-attributable mortality is the lowest contributor. For women either smoking- or obesity-attributable mortality contributes the most to the all-cause mortality rate, depending on the country. For women it shows that for the Southern-Western European countries, such as Spain, Italy and Portugal obesity-attributable mortality contributes more than smoking-attributable mortality, whereas for North-Western European countries, such as Norway and Sweden, but also Denmark, the Netherlands, Belgium and the United Kingdom, smoking-attributable mortality contributes more than obesity-attributable mortality.

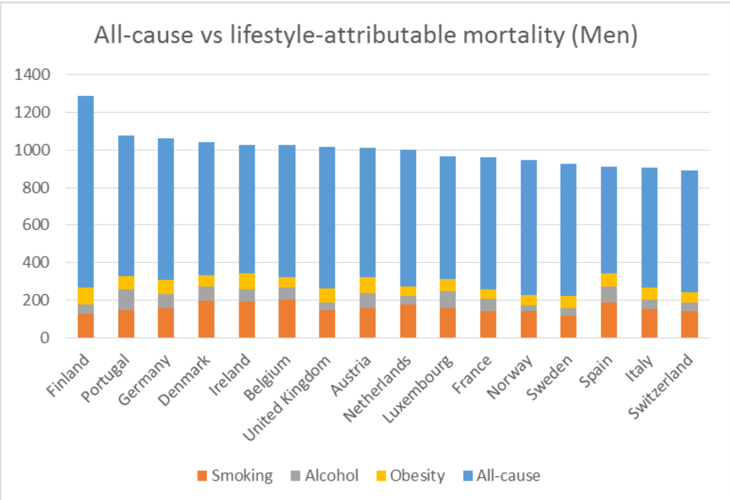

Figure 4.11: All-cause and lifestyle-attributable mortality rates per 100.000 standard population for men.

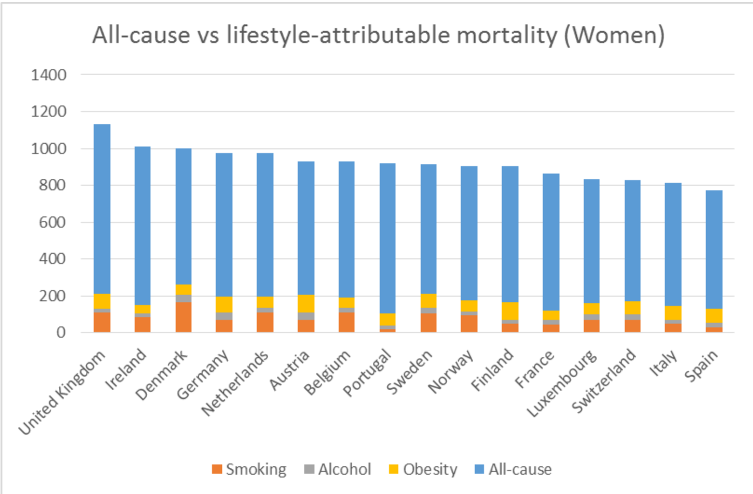

Figure 4.12: All-cause and lifestyle-attributable mortality rates per 100.000 standard population for women.

4.2 Potential Gain of Life Expectancy

Figures 4.13 and 4.14 show the life expectancy at birth and the potential gain in life expectancy, if smoking-attributable, alcohol-attributable and obesity-attributable causes of death were to be completely eliminated. There are differences between the countries and between men and women. For all Western European countries is the life expectancy for women higher than for men. The life expectancy at birth for women ranges from 82.8 in Denmark to 86.2 in Spain, whereas for men the life expectancy at birth ranges from 78 in Portugal to 81.1 in Switzerland. The potential gain in life expectancy is in most countries higher for men than for women. For men, the most years can be gained from smoking-attributable causes of death. The PGLE for smoking of men ranges from 1.9 years in Portugal to 2.9 in Spain. For most countries, in figure 4.13, the PGLE for alcohol has the lowest contribution of the three lifestyle risk factors. Except for Spain and Portugal, where the PGLE for alcohol is higher than the PGLE for obesity. Overall, the combined potential gain in life expectancy of all three lifestyle risk factors for men ranges from 2.6 years in Sweden to 4.7 years in Spain, of which 2.9 years can be gained from the elimination of smoking-attributable causes of death alone. Spain already has the third-highest life expectancy at birth for men, but it could gain the most years of all Western European countries, if the lifestyle-attributable causes of death were to be eliminated. The Scandinavian countries Norway, Sweden and Finland would gain the least amount of years for men in life expectancy, with Norway and Finland, both at a PGLE of 2.9 and Sweden at 2.6. For women in figure 4.14, the most years can be gained from the elimination of either smoking-attributable or obesity-attributable causes of death, depending on the country. A divide can be observed between North-Western Europe and South-Western Europe, where in the North-Western European countries, such as Norway, Sweden, Denmark, the Netherlands, Belgium and Luxembourg, the most years can be gained from the elimination of smoking-attributable causes of death. But in South-Western European countries, such as Spain, Portugal, Italy and France, the most years can be gained from the elimination of obesity-attributable causes of death. The overall, combined potential gain in life expectancy of all three lifestyle risk factors for women, ranges from 1.2 years in Portugal to 3.1 years in Denmark.

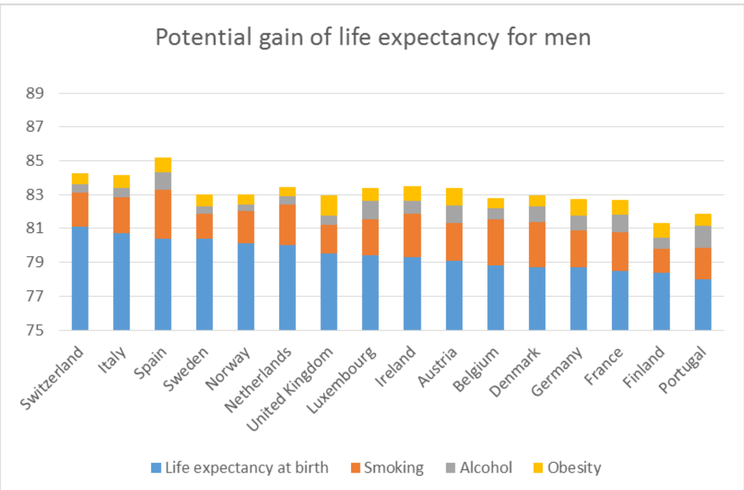

Figure 4.13: Potential gain of life expectancy for men.

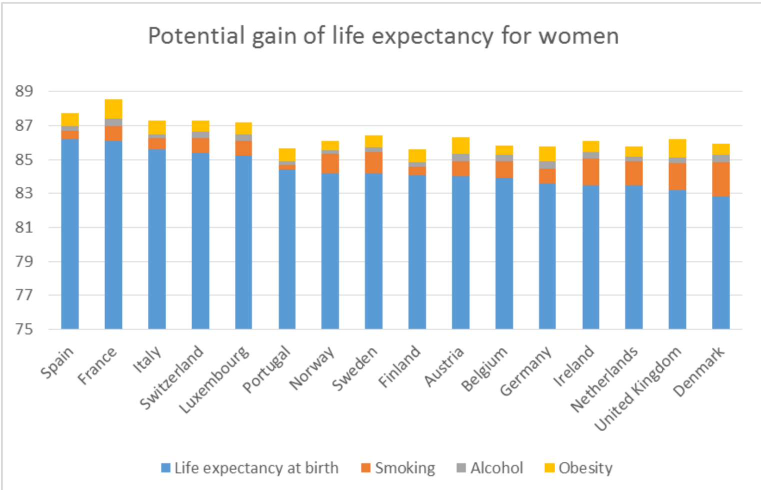

Figure 4.14: Potential gain of life expectancy for women.

5. Discussion and conclusion

5.1 Discussion of the results

In the results differences between countries can be observed. The aim of this research was to examine to what extent country differences in life expectancy and mortality could be due to smoking, alcohol and obesity. From this objective, the following research question was formulated: 'To what extent are there differences between Western European countries in life expectancy and mortality, due to smoking, alcohol and obesity?'. To answer this main research question, several sub-questions were formulated as well. The first sub-question was formulated as follows: 'How does the prevalence of smoking, alcohol and obesity relate to mortality and life expectancy in Western European countries?'. Now on the prevalence of smoking, alcohol and obesity, the results show that for all the Western European countries, the prevalence of smoking and alcohol is higher for men than for women. The prevalence of obesity is similar among men and women, even though the prevalence of overweight is higher for men than for women, and the prevalence of physical inactivity is higher for women than for men. At the same time the smoking-attributable and alcohol-attributable mortality rates are also higher for men than for women, whereas the obesity-attributable mortality is similar between men and women. The Scandinavian countries Norway, Sweden and Finland show both low prevalence of smoking and alcohol, as well as low smoking-attributable and alcohol-attributable mortality. But for obesity Finland shows high prevalence, and both Finland and Sweden show high obesity-attributable mortality. Denmark and Belgium show the opposite trend, where both show high prevalence and mortality of smoking and alcohol, for both men and women, but then shows low prevalence and mortality of obesity as well. Austria shows a trend, where it shows high prevalence of smoking, but average mortality of smoking, and it shows low prevalence of alcohol and obesity, but then high related mortality rates. Overall there doesn't seem to be a clear link between prevalence of the risk factor and attributable mortality.

The second sub-question was formulated as follows: 'How can certain causes of death be attributed to either smoking, alcohol or obesity?'. For smoking some causes of death attributed to smoking have high risk factor attribution, but then show a low number of deaths. This means that smokers have a high risk of developing the disease, but at the same time have a low chance of dying from it. The risk factor attribution to smoking also shows that for certain causes of death, it is lower either early in life or later in life. The decrease in risk factor attribution later in life is significantly larger for women than for men. Overall the risk factor attribution to smoking is higher for men than for women, and this difference even increases in the age group 70 years and older. Thus this could explain why for some countries, there are significant differences between men and women in smoking-attributable mortality. This differs from the risk factor attribution to alcohol, which remains constant over the life course. The risk factor attribution to alcohol also shows that causes of death with relatively low risk factor attribution to alcohol still contribute the most deaths to the alcohol-attributable mortality rate. Alcohol is the only risk factor that shows differences in which causes of death contribute the most deaths to the alcohol-attributable mortality rates of men. The risk factor attribution to alcohol is also higher for men than for women. Similarly to the risk factor attribution to smoking, the differences between men and women in risk factor attribution could at least partly explain the differences in alcohol-attributable mortality. The risk factor attribution to obesity shows similar risk for both men and women, which parallels the obesity-attributable mortality rates, which are also similar for both men and women.

The third sub-question was formulated as follows: 'What are the differences in smoking-attributable, alcohol-attributable, obesity-attributable mortality rates between Western European countries and how do they contribute to the all-cause mortality rates?'. The results show differences between the countries, between men and women and between the three lifestyle risk factors. The differences between men and women are most notable in Spain and Portugal, where the smoking-attributable and alcohol-attributable mortality is significantly higher for men than for women. The obesity-attributable mortality is similar between men and women for most countries, except for Ireland, where it is higher for men than for women. The Scandinavian countries Norway, Sweden and Finland all show relatively low smoking-attributable and alcohol-attributable mortality rates, but relatively high obesity-attributable mortality rates. Denmark then shows the opposite trend, where it show relatively high smoking-attributable and alcohol-attributable mortality rates, but then relatively low obesity-attributable mortality rates. Spain and Portugal show a somewhat similar trend, where it has relatively high smoking-attributable and alcohol-attributable mortality, but only for men and then both countries have neither low nor high obesity-attributable mortality, compared to the rest of Western Europe. For men, for most of the countries, smoking-attributable mortality contributes the most to the all-cause mortality rate, followed by obesity-attributable mortality and then alcohol-attributable mortality. For women either smoking- or obesity-attributable mortality contributes the most to the all-cause mortality rate, depending on the country. Overall, the all-cause mortality rates are similar for men and women, but the results for men show a higher proportion of the all-cause mortality that can be attributed to smoking, alcohol and obesity.

The last sub-question was formulated as follows: 'How is life expectancy in Western European countries affected by smoking, obesity and alcohol?'. Overall, the life expectancy of men is more affected by smoking, obesity and alcohol, than the life expectancy of women. Similar to how men show a higher proportion of their all-cause mortality that can be attributed to smoking, alcohol and obesity. For men, the most years can be gained from smoking-attributable causes of death, whereas for women, the most years can be gained from either smoking-attributable or obesity-attributable causes of death, depending on the country. Women already have a higher life expectancy at birth than men, and the countries with the lowest life expectancy at birth for women also gain the most years, which are the Netherlands, United Kingdom and Denmark. For men, the North-Western European countries, Norway Sweden and Finland gain the least amount of years, whereas Spain gains the most.

To answer the main research question, which is stated as follows: 'To what extent are there differences between Western European countries in life expectancy and mortality, due to smoking, alcohol and obesity?, the results show a divide between North and South Western Europe. For the risk factors smoking and alcohol, the Southern countries show highest mortality for men, but the lowest mortality for women. The Northern countries show the opposite trend, where these countries have the lowest mortality for men, highest mortality for women. The Southern countries also have largest differences between men and women, whereas the Northern countries show the least differences between men and women. This divide between North and South is not observed for obesity. But it can be observed in life expectancy as well. For men, the Southern countries gain more years in life expectancy than the Northern countries. For women, the Southern countries gain the most years in life expectancy from obesity-attributable causes of death, whereas the Northern countries gain the most from smoking-attributable causes of death.

5.2 Discussion of hypotheses

Based on the literature, a number of hypotheses could be formulated. The first hypothesis was formulated as follows:

1. The highest smoking prevalence and mortality will be found in Germany, Austria and Denmark, whereas the lowest smoking prevalence and mortality will be found in the Scandinavian countries, and the Southern European countries will be in the middle.

For the prevalence of smoking this hypothesis proved to be correct in some places and incorrect in others. Even though Austria did have the highest prevalence of smoking for women and the second highest for men, Germany and Denmark were in the middle, compared to the other countries. Southwestern European countries, Spain and Italy were expected to be in the middle, but had higher smoking prevalence for both men and women, than Germany and Denmark. Interestingly, this goes against the literature, as Janssen (2020) stated that Southwestern European countries have not experienced a smoking epidemic at the same level as Northwestern European countries, and Mackenbach et al (2013) stated that Germany, Austria and Denmark would have higher prevalence of smoking, due to weak and poorly enforced tobacco controlling policies. The hypothesis for the Scandinavian countries was correct though, as they ranked near the bottom in prevalence of smoking. This could be explained by the more effective tobacco controlling policies that were implemented in the Scandinavian countries, compared to other countries, according to Marcon et al (2018). For mortality this hypothesis also proved to be correct in some places and incorrect in others. Denmark does have the highest smoking-attributable mortality for women and the second highest for men, but Germany and Austria rank lower compared to the other countries. Other Northwestern European countries, such as Belgium, Ireland and Netherlands rank higher. The Scandinavian countries, Norway, Sweden and Finland, do have the lowest smoking-attributable mortality for men, but for women, these countries are among the highest. As the second hypothesis stated:

2. The highest smoking prevalence and mortality for women will be found in Northwestern Europe, whereas the lowest smoking prevalence and mortality for women will be found in Southwestern Europe.

This hypothesis is correct, as the highest smoking-attributable mortality can be found in Norway, Sweden, Denmark, the United Kingdom and the Netherlands. And the further down to Southwestern Europe, the lower the smoking-attributable mortality becomes. As countries such as Spain, Italy and Portugal have the lowest, compared to other countries. As Janssen (2020) stated that women started smoking later than men, and thus they have yet to reach their peak in smoking-attributable mortality, whereas for men, the smoking-attributable mortality has been declining the last few decades. Janssen (2020) also stated that the smoking epidemic never reach the same level in Southwestern Europe, as it did in Northwestern Europe. Thus this seems to explain why women have such high smoking-attributable mortality in Northwestern Europe and significantly lower smoking-attributable mortality in Southwestern Europe.

The third hypothesis was stated as following:

3. The highest alcohol consumption and mortality is expected in Southwestern Europe, whereas the lowest alcohol consumption is expected in Northwestern Europe.

The highest percentages of daily drinkers are found in Portugal, Spain and Italy, especially for men. For women, the highest percentage of daily drinkers are found in Portugal, Spain and Italy, as well as Belgium, Denmark, Germany, Luxembourg and the United Kingdom. On the other hand the highest percentages of weekly drinkers can be found in Northwestern countries, excluding the Scandinavian countries, whereas the lowest percentages of weekly drinkers can be found in Portugal, Spain and Italy. The hypothesis is thus not entirely correct, but it can be explained through the drinking patterns that can be observed in these countries. As Trias-Llimos et al (2018) states that in Southwestern Europe alcohol consumption is part of daily meals, especially at dinner, whereas Allamani et al (2000) states that in Northwestern Europe alcohol consumption usually happens on the weekends and not during meals. The highest alcohol-attributable mortality for men can be found Southwestern European countries, such as Portugal and Spain, but also in Northwestern European

countries, such as Luxembourg and Austria. The highest alcohol-attributable mortality for women can found in Northwestern European countries, rather than Southwestern European countries. Thus the hypothesis here is not correct. However, as stated by Constanzo et al (2019), there is still much debate about, whether moderate alcohol consumption can actually have better health benefits than zero alcohol consumption, and whether heavy, but weekly alcohol consumption is worse than moderate, but daily alcohol consumption. As to the differences between men and women, there is not much research about it, although there are some that predict that gender norms might be the explaining factor, at least in Southwestern Europe, where men tend to drink more alcohol as a sign of masculinity, whereas women tend drink fewer alcohol, as drinking more would be seen as unfeminine (Sánchez-López et al, 2013).
The fourth and final hypothesis was stated as following:

4. The highest obesity prevalence and mortality is expected in Northwestern Europe, specifically the UK, Finland and Germany, whereas the lowest obesity prevalence and mortality is expected in Southwestern Europe.

The highest obesity prevalence was found in the United Kingdom, and Finland and Germany were also near the top. But even though Italy had the lowest prevalence of obesity, Spain and Portugal had also relatively high prevalence of obesity. Thus the hypothesis is not entirely correct for prevalence of obesity. Italy is also an exception to the link between obesity and physical inactivity, as stated by Pietiläinen et al (2008), as Italy has the lowest prevalence of obesity and the highest percentage of physical inactivity. For Southern European countries it is speculated that the Mediterranean diet, which consists of high amounts of fresh fruits, vegetables and olive oil, has historically been a factor in the relatively low rates of obesity, according to Mackenbach et al (2013). But the results rather show that this is no longer the case, at least not for all countries. Mackenbach et al (2013) explains this by stating that globalization has caused food production and consumption to become increasingly similar between Western European countries. However the United Kingdom, Finland and Germany do have the highest obesity-attributable mortality behind Austria, so this part of the hypothesis is correct. But the Southwestern European countries do not have the lowest obesity-attributable mortality. France and Denmark do, amongst other countries, and Mackenbach et al (2013) states that these two countries have taken action on food consumption and have tried to influence healthier nutrition, which could explain their lower obesity-attributable mortality.

5.3 Reflection

A cross-sectional study design is used when the purpose of the study is descriptive and the aim is to describe a population or a sub-group in regards to a given outcome or given factors. However they are limited, because they are carried out at one specific time point, they give no information on the development of a specific aspect over a longer period of time (Levin, 2006). Since this study focus on self-reported life style risk behaviors at a specific point in time, there cannot be any view on how these behaviors change or have changed over time (Ding et al, 2015). Part of the secondary data used in this research is based on surveys, which are often distributed to the whole population that is researched, to make sure that the sample of respondents are representative of that population. The most common problem with surveys is non-response (Levin, 2006), and specifically non-response that results in biased response. This happens when either people with a particular characteristic are more likely to respond than people without that particular characteristic or when people tend to be more likely to report desirable behaviors than undesirable behaviors (Ding et al, 2015). Additionally, studies that are conducted at a specific geographical scale will always cause that some variations at a lower geographical scale will not be shown. As national estimates or numbers will be based on averages of the entire area. The high and low values of that area will not be visible (Dwyer-Lindgren, 2017).

Quantitative research provides information in breadth from a large number of respondents or units, which makes this type of research reliable, because it provides consistency. Quantitative research can be repeatedly executed under the same conditions with the same subjects, and the results will remain consistent (Yilmaz, 2013). But this also means that quantitative research does not provide much depth in return. Quantitative research methods can be seen as too shallow, and further qualitative research might be needed to more in depth information about certain phenomena. That is why quantitative research is often complimented by qualitative research (Bryman, 1984). Quantitative research is limited by the number of variables that can be looked at in one study and is limited by the variables that are defined by the researcher. Quantitative research is not as flexible as qualitative research in dealing with unexpected variables that might emerge during the research (Muijs, 2004). Quantitative research is based on the view that phenomenon have an objective reality that is independent of the subjects that are being studied. Thus the subjects being studied should also remain separated and independent of the researcher to avoid the researcher influences the subjects (Yilmaz, 2013). Due to the objective nature of quantitative research it is difficult to apply subjective meaning to the findings or results of quantitative studies. The view of quantitative research and its underlying epistemology realism can be problematic, as reality cannot always be measured completely objectively. The object(s) of study and the results of study are influenced by the beliefs of the researchers and the political and social climate at the time the research is done (Muijs, 2004). The data is based on calculations and estimations. Mistakes can be made, while retrieving the data or working on it. Errors can already be in the data, as the data is collected by different people at different institutions in different countries, while handling the data, errors can occur without noticing. And there is not always a mechanism in place that will help redistribute any sources of error, like miscoded causes of death that might affect the accuracy of estimations and calculations based on that data (Naghavi et al, 2017). Reality is in a way constructed by people and their observations, thus there is no pre-existing, fixed objective reality out there that can be observed. The process of observing reality changes and transforms reality in the process. Thus the truth is relative and can never be definitive. However this does not mean that looking for an objective reality is impossible to achieve by definition. Quantitative researchers should still try to uncover reality that is approximately as objective as possible. And if a total objective reality is not achievable, then social science should focus on confidence. This means that the findings of research should be reliable and should be able to predict certain outcomes (Muijs, 2004).

5.4 Recommendations for future research and policy

Further research should focus on smaller geographical scales. The results showed differences between Western European countries, thus further research should focus on a single country or a group of countries that showed higher lifestyle-related mortality, so that lower-scale variations become clear and the overall picture becomes fuller (Dwyer-Lindgren, 2017). Further research can also focus more on the timescale of lifestyle behavior. As this study focused on the most recent year that data was available, it cannot be observed whether unhealthy lifestyle behavior has increased or decreased in the observed countries over the last few decades and whether the contribution of unhealthy lifestyle behavior to life expectancy and mortality rates has increased or decreased for the observed countries. With this knowledge, future patterns and trends could be projected as well. Cohort dimension is an important element in this as well, but also in understanding complex public health problems and it can help facilitate targeted actions to birth cohorts at elevated risks, and in line with the ageing of current cohorts, inform future obesity-attributable mortality levels (Vidra, 2019).

Lifestyle-related diseases do not only cause deaths, but also cause long-term healthcare costs, related disabilities and premature death, which all have social and economic consequences and burdens (WHO, 2014). Therefor further research should also focus on health outcomes, such as years lost due to disability (YLDs), years of life lost (YLL) and disability-adjusted life years (DALYs).

Further gains in health require strengthening of policies that are at the moment weakly developed and enforced. For example weak tobacco controlling policies in Denmark, Austria and Germany and weak alcohol regulations in Finland and the United Kingdom (Mackenbach et al, 2013). As the World Health Organization has set a goal to reduce premature mortality from non-communicable diseases by 25 percent by 2025, this research shows which countries should be focused on, which lifestyle risk factor should be focused on in a specific country, and what causes of death related to a specific lifestyle risk factor in a specific country, should be focused on. Besides country differences in economic, political and emancipatory progress, it is important as well to look at country-specific tobacco control and alcohol regulating interventions. As lessons can be learned from good practice in the forerunner countries (Janssen, 2020). There is still much debate in the literature about lifestyle behavior as health determinants, as can be seen in the discussion of the hypothesis that the literature is not able to explain the results, or even contradicts them. As many studies focus on the relation between data, such as the relation between certain causes of death and structural indicators, such as GDP, educational level, and socioeconomic status (Alvarez-Galvez, 2016). There is still a knowledge gap as to why certain population show higher or lower cause-specific mortality. As structural indicators do not explain every differences in lifestyle behavior or cause-specific mortality. Further research could gain insights from looking further into what drives cultural differences and lifestyle differences, but also differences in healthcare systems, living conditions and race. Additionally further research should be done into why certain lifestyle-related causes of death contribute more deaths in one country than another. And why two countries might be mostly dealing with two different causes of death, but related to the same lifestyle risk factor. For example, for alcohol and men, the highest contributing cause of death to alcohol-attributable mortality differed per country. As this seems to be related to living conditions, healthcare systems or cultural/lifestyle influences, rather than socioeconomic status or GDP.

5.5 Conclusion

It can be concluded that lifestyle risk factors, smoking, alcohol consumption and obesity have had an impact on mortality rates and life expectancy of Western European countries, and that there are differences between these countries. Even though the prevalence of smoking has been on the decline over the last few decades, it is still very prevalent in Western Europe, and for most countries, smoking-attributable mortality is higher than alcohol-attributable and obesity-attributable mortality, except for some countries, where for women obesity-attributable mortality is higher than smoking-attributable mortality. Differences between men and women can also be found in prevalence of smoking and alcohol consumption, and smoking-attributable and alcohol-attributable mortality, but not in prevalence of obesity or obesity-attributable mortality. The Scandinavian countries seem to be healthier than the rest of Western Europe, as they show both low prevalence of smoking and alcohol, as well as low smoking-attributable and alcohol-attributable mortality. But for obesity these countries show higher prevalence and attributable mortality. Denmark and Belgium show the opposite trend where both show high prevalence and mortality of smoking and alcohol, for both men and women, but then show low prevalence and mortality of obesity as well. A divide between Northwestern and Southwestern Europe can also be observed. As for the risk factors smoking and alcohol, the Southern countries show highest mortality for men, but the lowest mortality for women. The Northern countries show the opposite trend, where these countries have the lowest mortality for men, highest mortality for women. The Southern countries also have largest differences between men and women, whereas the Northern countries show the least differences between men and women. This divide between North and South is not observed for obesity. But it can be observed in life expectancy as well. For men, the Southern countries gain more years in life expectancy than the Northern countries. For women, the Southern countries gain the most years in life expectancy from obesity-attributable causes of death, whereas the Northern countries gain the most from smoking-attributable causes of death.

Literature

Ahmad, O.B., Boschi-Pinto, C., Lopez, A.D., Murray, C.J.L., Lozano, R.& Inoue, M. (2001). *Age standardization of rates: a new WHO standard*. Geneva, World Health Organization, 2000 (GPE Discussion Paper, No. 31).

Allamani, A., Voller, F., Kubicka, L. & Bloomfield, K. (2000). Drinking cultures and the position of women in nine European countries. *Substance Abuse*, 21(4), 231-247.

Alvarez-Galvez, J. (2016). Discovering complex interrelationships between socioeconomic status and health in Europe: A case study applying Bayesian Networks. *Social Science Research*, 56, 133-143.

Barret, R., Kuzawa, C.W., McDade, T. & Armelagos, G.J. (1998). Emerging and re-emerging infectious diseases: The third epidemiologic transition. *Annual Review of Anthropology*, 27, 247-271.

Benmarhnia, T., Dionne, P.A. & Tchouaket, E. (2017). Investing in a healthy lifestyle strategy: is it worth it? *International Journal of Public Health,* 62(1), 3-13.

Bloom, D.E. & Canning, D. (2007). Commentary: The Preston curve 30 years on: still sparking fires. *International Journal of Epidemiology*, 36(3), 498-499.

Boniol, M. & Autier, P. (2010). Prevalence of main cancer lifestyle risk factors in Europe in 2000. *European Journal of Cancer*, 46(14), 2534-2544.

Bryman, A. (1984). The debate about quantitative and qualitative research: A question of method or epistemology? *The British Journal of Sociology*, 35(1), 75-92.

Caselli, G., Meslé, F. & Vallin, J. (2002). Epidemiologic transition theory exceptions. *Genus*, 58(1), 9-51.

Chiuve, S. & Rexrode, K.M. & Spiegelmann, D. & Logroscino, G. & Manson, J.E. & Rimm, E.B. (2008). Primary prevention of stroke by healthy lifestyle. *Circulation*. 18(9), 947-954.

Clarke, P. & Nieuwenhuijsen, E.R. (2009). Environments for healthy ageing: A critical review. *Maruritas*, 64 (1), 14-19.

Constanzo, S., De Gaetano, G., Di Castelnuovo, A., Djoussé, L., Poli, A. & Van Velden, D.P. (2019). Moderate alcohol consumption and lower total mortality risk: Justified doubts or established facts? *Nutrition, Metabolism & Cardiovascular Diseases*, 29(10), 1003-1008.

Dietz, W.H. (1996). The role of lifestyle in health: the epidemiology and consequences of inactivity. *Proceedings of the Nutrition Society*, 55(3), 829-840.

Ding, D., Rogers, K., Van der Ploeg, H., Stamatakis, E. & Bauman, A.E. (2015). Traditional and emerging lifestyle risk behaviors and all-cause mortality in middle-aged and older adults: Evidence from a large population-based Australian cohort. *PLOS Medicine, 12(12),* e1001917.

Dwyer-Lindgren, L. (2017). *Geographic patterns and disparities in health-related behaviors and outcomes in the United States.* Doctoral thesis, Erasmus University Rotterdam, the Netherlands.

EU Science Hub. (2020). *EU burden from non-communicable diseases and key risk factors*. Accessed on 23-04-2020 through https://ec.europa.eu/jrc/en/health-knowledge-gateway/societal-impacts/burden.

Gallus, S., Lugo, A., Murisic, B., Bosetti, C., Boffetta, P. & La Vecchia, C. (2015). Overweight and obesity in 16 European countries. *European Journal of Nutrition*, 54, 679-689.

González-Gross, M. & Meléndez, A. (2013). Sedentarism, active lifestyle and sport: impact on health and obesity prevention, Nutrición Hospitalaria, 28(5), 89-98.

Gracia, A. & Albisu, L.M. (2001). Food consumption in the European Union: Main determinants and country differences. *Agribusiness*, 17(4), 469-488.

Gual, A. & Colom, J. (2006). Why has alcohol consumption declined in countries of Southern Europe? *Addiction*, 92(s1), 21-31.

de Groot, L.C.P.M.G., Verheijden, M.W., de Henauw, S., Schroll, M. & van Staveren, W.A. (2004). Lifestyle, nutritional status, health and mortality in Elderly people across Europe: A review of the longitudinal results of the SENECA study. *Journal of Gerontology*, 59A(12), 1277-1284.

Haveman-Nies, A, De Groot, L., & Van Staveren, W.A. (2003). Dietary quality, lifestyle factors and healthy ageing in Europe: the SENECA study. *Age and Ageing*, 32 (4), 427-434.

Hewa, S. (2015). Theories of disease causation: Social epidemiology and epidemiological transition. *Galle Medical Journal*, 20(2), 26-32.

Institute for Health Metrics and Evaluation. (2018). *What data sources go into the GBD?* Accessed on 24-05-2020 through http://www.healthdata.org/acting-data/what-data-sources-go-gbd.

Islami, F., Torre, L.A. & Jemal, A. (2015). Global trends of lung cancer mortality and smoking prevalence. *Translational Lung Cancer Research*, 4(4), 327-338.

Jakob, J., Cornuz, J. & Diethelm, P. (2017). Prevalence of tobacco smoking in Switzerland: do reported numbers underestimate reality? *Swiss Medical Weekly*, 147, 14437.

Janssen, F. (2020). Similarities and differences between sexes and counties in the mortality imprint of the smoking epidemic in 34 low-mortality countries, 1950-2014. *Nicotine & Tobacco Research*, 22(7), 1210-1220.

Jarvis, M.J. (2001). Why people smoke. *BMJ*, 328, 277.

Kerr, J., Rosenberg, D. & Frank, L. (2012). The role of the built environment in healthy ageing: community design, physical activity and health among older adults. *Journal of Planning Literature*, 2 (1), 43-60.

Kotseva, K., Bacquer, D., Jennings, C., Gyberg, V., Backer, G., Rydén, L., Amouyel, P., Bruthans, J., Cifkova, R., Deckers, J., Sutter, J., Fraz, Z., Graham, I., Keber, I., Lehto, S., Moore, D., Pajak, A. & Wood, D. (2017). Time trends in lifestyle, risk factor control and use of evidence-based medications in patients with coronary heart disease in Europe. Results from 3 EUROASPIRE surveys, 1999-2013. *Global Heart*, 12(4), 315-322.

Kulhánová, I., Menvielle, G., Hoffmann, R., Eikemo, T.A., Kulik, M.C., Toch-Marquardt, M., Deboosere, P., Leinsalu, M., Lundberg, O., Regidor, E., Looman, C.W.N. & Mackenbach, J.P. (2016). The role of three lifestyle risk factors in reducing educational differences in ischaemic heart disease mortality in Europe. *The European Journal of Public Health*, 27(2), 203-210.

Kyro, C., Skeie, G., Dragsted, L.O., Christensen, J., Overvad, K., Hallmans, G., Johansson, I., Lund, E., Slimani, N., Johnson, N.F., Halkjaer, J., Tjonneland, A. & Olsen, A. (2010). Intake of whole grains in

Scandinavia is associated with healthy lifestyle, socio-economic and dietary factors. *Public Health Nutrition*, 14(10), 1787-1795.

Lai, D. & Hardy, R.J. (1999). Potential gains in life expectancy or years of potential life lost: impact of competing risks of death. *International Journal of epidemiology*, 28(5), 894-8.

Leigh, J.P., Hubert, H.B., & Romano, P.S. (2005). Lifestyle risk factors predict healthcare costs in an ageing cohort. *American Journal of Preventive Medicine*, 29(5), 379-387.

Levin, K.A. (2006). Study Design III: Cross-sectional studies. *Evidence-based Dentistry,* 7, 24-25.

Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, H., ... & Aryee, M. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*, 380(9859), 2224-2260.

Mackenbach, J.P. (1994). The epidemiologic transition theory. *Journal of Epidemiology and Community Health*, 48, 329-332.

Mackenbach, J.P. (2013). Convergence and divergence of life expectancy in Europe: a centennial view. *European Journal of Epidemiology,* 28, 229-240.

Mackenbach, J.P., Karanikolos, M. & McKee, M. (2013). The unequal health of Europeans: successes and failures of policies. *The Lancet*, 381(9872), 1125-1134.

Marcon, A., Pesce, G., Calciano, L., Bellisario, V., Dharmage, S.C., Garcia-Aymerich, J., Gislasson, T., Heinrich, J., Holm, M., Janson, C., Jarvis, D., Leynaert, B., Matheson, M.C., Pirina, P., Svanes, C., Villani, S., Zuberbier, T., Minelli, C. & Accordini, S. (2018). Trends in smoking initiation in Europe over 40 years: A retrospective cohort study. *PLoS One*, 13(8), e0201881.

Mathers, C.D., Ma Fat, D., Inoue, M., Rao, C. & Lopez, A.D. (2005). Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bulletin of the World Health Organization*, 83(3), 171-177.

McCusker, K. & Gunaydin, S. (2014). Research using qualitative, quantitative or mixed methods and choice based on the research. *Perfusion*¸ 30(7), 537-542.

Meslé, F. & Vallin, J. (2002). Mortality in Europe: The divergence between east and west. *Population*, 57(1), 157-197.

Mozaffarian, D., Kamineni, A., & Carnethon, M., Djoussé, L., Mukamal, K.J. & Siscovick, D. (2009). Lifestyle risk factors and new-onset diabetes mellitus in older adults. *The Cardiovascular Health Study*, 169(8), 798-807.

Moraeus, L., Lissner, L., Olsson, L. & Sjöberg, A. (2015). Age and time effects on children's lifestyle and overweight in Sweden. *BMC Public Health*, 15(1), 355.

Muijs, D. (2004). *Doing quantitative research in education with SPSS*. 1st edition. London: SAGE publications.

Naing, N.N. (2000). Easy way to learn standardization: direct and indirect methods. *The Malaysian journal of medical sciences MJMS*, 7(1), 10-15.

Naghavi, M., Abajobir, A.A., Abbafati, C., Abbas, K.M., Abd-Allah, F., Abera, S.F., … & Ahmadi, A. (2017). Global, regional and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*, 390(10100), 1151-1210.

O'Donnell, M.P., Schultz, A.B. & Yen, L. (2015). The portion of health care costs associated with lifestyle-related modifiable health risks based on a sample of 223.461 employees in seven industries. *Journal of Occupational and Environmental Medicine*, 57(12), 1284-1290.

Olsen, K.M. & Dahl, S.A. (2007). Health differences between European countries. *Social Science & Medicine*, 64(8), 1665-1678.

Omair, A. (2015). Selecting the appropriate study design for your research: Descriptive study designs. *Journal of Health Specialties*, 3(3), 153-156.

Omran, A.R. (2005). The epidemiologic transition: A theory of the epidemiology of population change. *The Milbank Quarterly*, 83(4), 731-757.

Pérez-Rodrigo, C., Gil, A., González-Gross, M., Ortega, R.M., Serra,Majem, L., Varela-Morreiras, G. & Aranceta-Bartrina, J. (2015). Clustering of dietary patterns, lifestyles and overweight among Spanish children and Adolescents in the ANIBES study. *Nutrients*, 8(1), 11.

Pietiläinen, K., Kaprio, J., Borg, P., Plasqui, G., Yki-Järvinen, H., Kujala, U.M., Rose, R.J., Westerterp, K.R. & Rissanen, A. (2008). Physical inactivity and obesity: A vicious circle. *Obesity*, 16(2), 409-414.

Ploubidis, G.B., Dale, C. & Grundy, E. (2012). Later life health in Europe: how important are country level influences? *European Journal of Ageing*, 9, 5-13.

Popkin, B.M. (2006). Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *The American Journal of Clinical Nutrition*, 84(2), 289-298.

Powles, J. (1992). Changes in disease patterns and related social trends. *Social Science & Medicine*, 35(4), 377-387.

Engs, R.C. (1995). Do traditional Western European drinking practices have origins in antiquity? *Addiction Research*, 2(3), 227-239.

Sánchez-López, M.P., Rivas-Diez, R. & Cuéllar-Flores, I. (2013). Masculinity and femininity as predictors of tobacco and alcohol consumption in Spanish University Students. *Health and Addictions*, 13(1), 15-22.

Sanderson, S.C., Waller, J., Jarvis, M.J., Humphries, S.E. & Wardle, J. (2009). Awareness of lifestyle risk factors for cancer and heart disease among adults in the UK. *Patient Education and Counseling*, 74(2), 221-227.

Santosa, A., Wall, S., Fottrell, E., Högberg, U. & Byass, P. (2014). The development and experience of epidemiological transition theory over four decades: a systematic review. *Global Health Action*, 7(1).

Schuit, A.J., van Loon, A.J.M. Tijhuis, M. & Ocké, M.C. (2002). Clustering of lifestyle risk factors in a general adult population. *Preventive Medicine*, 35(3), 219-224.

Sedgwick, P. (2014). Cross sectional studies: advantages and disadvantages. *BMJ,* 348:g2276.

Sherman, L.W. & Strang, H. (2004). Experimental ethnography: The marriage of qualitative and quantitative research. *The ANNALS of the American Academy of Political and Social Science*, 595(1), 204-222.

Statistics Canada. (2017). *Age-standardized rates*. Accessed on 18-05-2020 through https://www.statcan.gc.ca/eng/dai/btd/asr.

Sukamolson, S. (2007). Fundamentals of quantitative research. Chulalongkorn University, Language institute.

Tamayo, T., Rosenbauer, J., Wild, S.H., Spijkerman, A.M.W., Baan, C., Forouhi, N.G., Herder, C. & Rathmann, W. (2013). Diabetes in Europe: An Update. *Diabetes Research and Clinical Practice*, 103(2), 206-217.

Tinkler, P. (2001). Rebellion, modernity and romance: Smoking as a gendered practice in popular young women's magazines, Britain 1918-1939. *Women's studies International Forum*, 24(1), 111-122.

Trias-Llimós, S. (2018). *Alcohol-attributable mortality in Europe: Past trend and their effects on overall mortality variations*, PhD thesis. University of Groningen, the Netherlands.

Trias-Llimós, S., Martikainen, P., Mäkelä, P. & Janssen, F. (2018). Comparison of different approaches for estimating age-specific alcohol-attributable mortality: The cases of France and Finland. *Plos One*, 13(3): e0194478.

Tuli, F. (2010). The basis of distinction between qualitative and quantitative research in social science: Reflection on ontological, epistemological and methodological perspectives. *Ethiopian Journal of Education & Sciences*, 6(1), 97-108.

Vallin, J. & Meslé, F. (2004). Convergences and divergences in mortality. A new approach to health transition. *Demographic Research*, 2(2), 11-44.

Van Tuyckom, C., Van de Velde, S., & Bracke, P. (2012). Does country-context matter? A cross-national analysis of gender and leisure time physical inactivity in Europe.

Vagero, D. (2016). The east-west divide in Europe: Growing and shifting eastwards. *European Review*, 18(1), 23-34.

Vidra, N. (2019). *The obesity epidemic in Europe: Assessing the past and current mortality burden and the future of obesity*, PhD thesis. University of Groningen, the Netherlands.

WHO regional office for Europe. (2014). *Prevention and control of non-communicable diseases in the European Region: a progress report*. Accessed on 23-04-2020 through http://www.euro.who.int/__data/assets/pdf_file/0004/235975/Prevention-and-control-of-noncommunicable-diseases-in-the-European-Region-A-progress-report-Eng.pdf.

Wilkinson, R.G. (1994). The epidemiological transition: From material scarcity to social disadvantage? *Daedalus*, 123(4), 61-77.

Wong, M.D., Shapiro, M.F., Boscardin, J. & Ettner, S.L. (2002). Contribution of major diseases to disparities in mortality. *The New England Journal of Medicine*, 347(20), 1585-1592.

Wong, M.D., Chung, A.K., Li, M., Hsieh, H.J. Ettner, S.L. & Shapiro, M.F. (2006). The contribution of specific causes of death to sex differences in mortality. *Public Health Reports*, 121(6), 746-754.

World Health Organization. (2005a). *Reported information on mortality statistics Table 1: Information on civil registration system (part 1)*. Retrieved on 18-05-2020 through https://www.who.int/healthinfo/statistics/survey_2005/en/.

World Health Organization. (2005b). *Reported information on mortality statistics Table 2: Information on civil registration system (part 2)*. Retrieved on 18-05-2020 through https://www.who.int/healthinfo/statistics/survey_2005/en/.

World Health Organization. (2005c). *Reported information on mortality statistics Table 3: Information on cause of death data collection*. Retrieved on 18-05-2020 through https://www.who.int/healthinfo/statistics/survey_2005/en/.

World Health Organization. (2009). *Health in the European Union; Trends and analysis*. Copenhagen: World Health Organization; European Observatory on Health Systems and Policies.

World Health Organization. (2020). *Obesity and overweight*. Accessed on 02-05-2020 through https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions: epistemological, theoretical, and methodological differences. *European Journal of Education*, 48(2), 311-325.