Department of Public Health
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ASSOCIATIONS BETWEEN CIRCADIAN FACTORS AND NONCOMMUNICABLE DISEASES

A POPULATION-BASED STUDY IN FINLAND

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ACADEMIC DISSERTATION

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ABSTRACT

The aim of this thesis was to study the association between circadian factors and common noncommunicable diseases. To our knowledge, these associations have not been investigated before in a large population-based cohort. The study of these associations is important as the global morbidity and mortality rates for noncommunicable diseases are increasing. Thus, there is a need to better understand the etiology of these diseases.

The data to conduct the four studies included in this thesis was derived from The National FINRISK 2012 Study. A random sample of 10,000 Finns aged 25 to 74 from five different geographical areas in Finland was invited to participate in the study. The overall participation rate was 64%. The participants reported their sleeping habits and disturbances, seasonal variations in mood and behavior as well as their circadian preference to the daily activities. As a part of their health examination, the participants were also asked about their diagnoses or treatments they had received for a set of common noncommunicable diseases and medical conditions during the past 12 months. Here, the results are first presented based on a single-item (study I–III) and the final analysis (study IV) with regression analyses controlled for covariates.

According to our results, the average duration of self-reported sleep in the Finnish working-age population has declined as compared to previous years. Now, 63% of the population is sleeping on average 7-8 hours daily, and the population is distributed into evening types (13.5%), intermediate types (42.7%), and morning types (43.8%). Seasonal variations in sleep duration, social activity, mood, and energy level, as well as in weight and appetite are rather common. As hypothesized, circadian factors were associated with several noncommunicable diseases. The odds for evening chronotype for depression and other psychiatric illnesses was significant in single-item analysis and remained significant in the final analysis. Higher seasonality and more frequent sleep problems were reported throughout the studies I–IV. Of all the circadian factors, sleep quality was the most sensitive probe yielding associations with noncommunicable diseases.

Insufficient and poor sleep, eveningness and seasonal variations are common among Finnish adult population and associated with the increased odds for several noncommunicable diseases. By recognizing those with the increased risk to develop noncommunicable diseases, we could improve the assessment of health status, health care practices and health policies.

Keywords
Circadian factors, non-communicable diseases, chronotype, population, seasonal factors, sleep.

TIIVISTELMÄ

Tämän tutkimuksen tarkoituksena oli analysoida vuorokausirytmiin liittyvien tekijöiden yhteyttä kansantauteihin. Näitä yhteyksiä ei ole aiemmin tutkittu suurissa väestöpohjaisissa aineistoissa. Näiden tautiyhteyksien tutkiminen on tärkeää, koska sairastavuus ja kuolleisuus väestössä yleisiin tarttumattomiin tauteihin ovat globaalisti suurenemassa. Tämän takia on tarve ymmärtää paremmin näiden sairauksien etiologiaa.

Tämän tutkimuksen neljän osatyön aineisto perustui vuoden 2012 kansalliseen FINRISKI-tutkimukseen. Satunnaisotannassa 25-vuotiaista 74-vuotiaisiin 10 000 suomalaista kutsuttiin osallistumaan tutkimukseen viidellä maantieteellisellä alueella Suomessa. Osallistumisaktiivisuus tutkimukseen oli 64 prosenttia. Tutkimukseen osallistuneet vastasivat tutkimuslomakkeilla kysymyksiin nukkumisestaan ja univaikeuksistaan, mielialansa ja käyttäytymisensä vuodenaikaisvaihtelusta sekä päivittäisten toimiensa mieltymyksistä ajoittamisesta. Osana terveystarkastusta tutkittavilta kysyttiin, oliko heillä edeltäneen vuoden aikana ollut tiettyjä lääkärin toteamia tai hoitamia sairauksia. Tässä tutkimuksessa esitetään tulokset näistä vastauksista yksittäisten kysymysten (osatyöt I-III) ja kolmen aihepiirin kysymykset kokoavan (osatyö IV) regressioanalyysin osalta taustamuuttujineen.

Keskimääräinen yöunen pituus on työikäisillä suomalaisilla lyhentynyt. Työikäisestä väestöstä 63 % nukkuu keskimäärin 7–8 tuntia yössä. Väestö jakautuu iltavirkkuihin (13,5 %), päivävirkkuihin (42,7 %) ja aamuvirkkuihin (43,8 %). Unen pituuden, sosiaalisen aktiivisuuden, mielialan ja toimintatarmon sekä painon ja ruokahalun vuodenaikaisvaihtelut ovat verraten yleisiä. Vuorokausirytmiin vaikuttavat tekijät liittyivät moniin väestössä yleisiin tarttumattomiin tauteihin. Iltavirkuilla riski sairastaa masennusta tai muita psyykkisiä sairauksia oli merkitsevä yksittäisten kysymysten tarkastelussa ja säilyi merkitsevänä kysymysten yhteistarkastelussa. Iltavirkuilla oli myös muita suurempi vuodenaikaisvaihtelu ja useammin univaikeuksia. Unen laatu oli herkimmin yhteydessä väestössä yleisiin tarttumattomiin tauteihin.

Riittämätön ja huonolaatuinen uni, iltavirkkuus sekä mielialan ja käyttäytymisen vuodenaikaisvaihtelut ovat yleisiä suomalaisessa aikuisväestössä ja liittyvät useampaan kansantautiin. Näiden tekijöiden huomioiminen nykyistä tarkemmin voisi parantaa väestön terveydentilan määrittämistä, hoitokäytäntöjä ja kansanterveysratkaisuja.

Avainsanat
Kronotyyppi, pitkäaikaissairaudet, uni, vuodenaikaisvaihtelu, vuorokausirytmi, väestö.

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

I Basnet S, Merikanto I, Lahti T, Männistö S, Laatikainen T, Vartiainen E, Partonen T. Seasonal variations in mood and behavior associate with common chronic diseases and symptoms in a population-based study.
Psychiatry Research 2016; 238: 181-188.
doi:10.1016/j.psychres.2016.02.023

II Basnet S, Merikanto I, Lahti T, Männistö S, Laatikainen T, Vartiainen E, Partonen T. Associations of common chronic non-communicable diseases and medical conditions with sleep-related problems in a population-based health examination study.
Sleep Science 2016; 9(3): 249-254.
doi:10.1016/j.slsci.2016.11.003

III Basnet S, Merikanto I, Lahti T, Männistö S, Laatikainen T, Vartiainen E, Partonen T. Associations of common noncommunicable medical conditions and chronic diseases with chronotype in a population-based health examination study.
Chronobiology International 2017; 34(4): 462-470.
doi:10.1080/07420528.2017.1295050

IV Basnet S, Merikanto I, Lahti T, Männistö S, Laatikainen T, Vartiainen E, Partonen T. Seasonality, morningness-eveningness, and sleep in common non-communicable medical conditions and chronic diseases in a population.
Sleep Science 2018; 11(2): 85-91.
doi:10.5935/1984-0063.20180017

The publications are referred to in the text by their Roman numerals.

ABBREVIATIONS

BMAL1	Brain and muscle aryl hydrocarbon receptor nuclear translocator-like protein 1
BMI	Body mass index
BP	Blood pressure
CCGs	Clock-controlled genes
CDC	Centres for Disease Control and Prevention
COPD	Chronic obstructive pulmonary disease
CI	Confidence interval
CKD	Chronic kidney disease
CRY	Cryptochrome
CSM	Composite Scale of Morningness
CVDs	Cardiovascular diseases
DSM	Diagnostic and Statistical Manual of Mental Disorders
EMT	Epithelial–mesenchymal transition
ETs	Evening types
GBD	Global burden of disease
GI	Gastrointestinal
GSS	Global seasonality score
IARC	International Agency for Research on Cancer
ITs	Intermediate types
LRI	Lower respiratory infection
MCTQ	Munich ChronoType Questionnaire
MDD	Major depressive disorder
MEQ	Morningness–eveningness questionnaire
MTs	Morning types
NCDs	Noncommunicable diseases
ORs	Odds ratios
PER	Period
REM	Rapid eye movement
RHT	Retinohypothalamic tract
SAD	Seasonal affective disorder
SCN	Suprachiasmatic nucleus
SPAQ	Seasonal Pattern Assessment Questionnaire
SPSS	Statistical Package for Social Science
S-SAD	Sub-syndromal seasonal affective disorder
THL	National Institute for Health and Welfare
TTFLs	Trancriptional–translational feedback loops
T2D	Type 2 diabetes
TSD	Total sleep deprivation
WHO	World Health Organization

1 INTRODUCTION

In the 21st century, noncommunicable diseases (NCDs) such as cardiovascular and respiratory diseases, cancers and diabetes, are the leading cause of both global morbidity and mortality (World Health Organization (WHO 2017a). Currently, NCDs are accountable for 70% (Figure 1) and communicable diseases such as HIV/AIDS, diarrhea, tuberculosis, and road injuries attribute to 30% of the global mortality. In Finland, the mortality rate caused by NCDs is even higher than global mortality, as high as 92% of all deaths (WHO 2014). Thus, there is a need to develop effective preventive measures for NCDs as well as their diagnostics and treatment options (WHO 2017a), which may improve the prognosis of these diseases significantly.

The prevention of NCDs has so far focused mainly on reducing their commonly known risk factors such as tobacco use, physical inactivity, unhealthy diets, and the harmful use of alcohol (WHO 2017a). However, as circadian factors are important regulators of our physiological functions from metabolism to cell proliferation (Froy 2010; Luyster et al. 2012; Baron and Reid 2014), we hypothesize, that they may also have an important role in the etiology of NCDs. To study this issue, we used a large population-based sample. If circadian factors and their misalignment due to sleep deprivation, individual chronotype, shift work, daylight saving time transitions or other causes are shown to be associated with NCDs, we can improve both health care practices and health policies with this information.

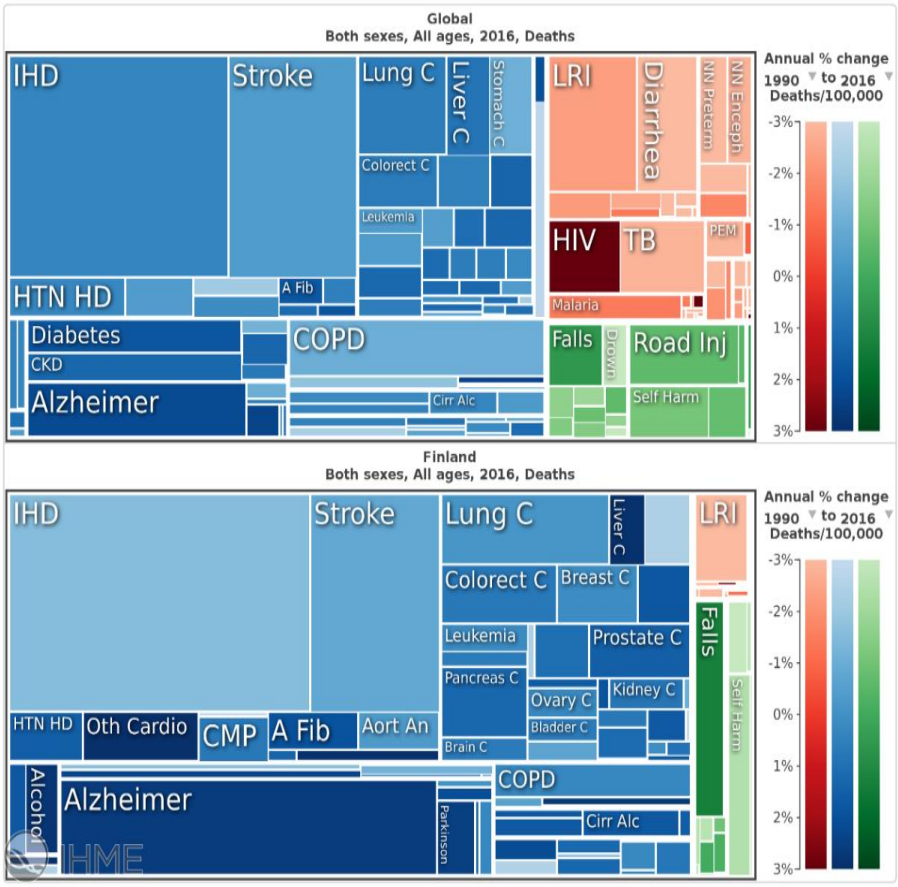


Figure 1 Annual % change in causes of mortality around the world and in Finland in all age groups since 1990 to 2016. The red and orange bar (starting from LRI) represents communicable diseases and injuries, the blue bars NCDs (starting from IHD) and the green bar (starting from falls) are other causes of mortality such as accidents in the tree diagram (extracted from GBD Compare Data Visualization 2017). Some figure legend: IHD-Ischemic heart diseases; HTN HD-hypertensive heart diseases; CMP-Cardiomyopathy and myocarditis; LRI- Lower respiratory infection etc.

2 REVIEW OF THE LITERATURE

2.1 THE CLOCK IN THE BRAIN

The word circadian comes from Latin words 'circa dies' meaning "about a day" (for review, e.g., Albrecht 2006). The term 'circadian' was coined in 1959 by Franz Halberg, who is also known as the Father of American chronobiology. His research was a breakthrough in chronobiology, as he discovered that circadian rhythms are partly endogenous and can be influenced by environmental factors, like meal and light (Butkov, Mattice, and Brooks 2007). The earliest scientific description of a circadian rhythm, however, dates to the work of the French scientist de Mairan in the 1720s. He described the endogenously controlled daily leaf movements in a plant even in the absence of the sunlight (Schwartz and Daan 2017). Later, in the 1970s Ron Konopka and Seymour Benzer isolated the first mutant in the fruitfly (*Drosophila melanogaster*) to map *period (per)* gene, as the first discovered genetic component of a circadian clock (Konopka and Benzer 1971).

At the molecular level, *per* and the other endogenous clock genes that have been discovered since the 1970s interact to generate circadian rhythms in mammals as based on transcriptional-translational feedback loops (TTFLs). According to the current knowledge, *BMAL1* (brain and muscle aryl hydrocarbon receptor nuclear translocator-like protein 1)/*CLOCK* complexes are the central transcription factors while period genes (*per 1/2/3*), cryptochrome genes (*cry 1/2*), and clock-controlled genes (*CCGs*) are the transcriptional repressors, also known as the target genes. *BMAL1 /CLOCK* activates the expression of *PER* and *CRY* genes that periodically provide feedback to suppress the activity of the later complexes via a negative feedback loop to generate and regulate circadian rhythms (Shostak 2017). These genetic oscillations last a period length of about 24 hours (Sahar and Sassone-Corsi 2010) and enable organisms to adapt their behavior, hormonal regulation, cardiac functions, and other physiological functions to the repeated changes in the environment (Partonen and Magnusson 2001; Panda et al. 2002; Reppert and Weaver 2002).

The circadian clock system of mammals consists of a master clock as well as several peripheral clocks (Sahar and Sassone-Corsi 2010). The master clock is a network of up to 20,000 neurons located at the suprachiasmatic nucleus (SCN) of the brain. This neural network exhibits endogenous rhythmicity. In normal conditions, this oscillation is synchronized by daylight when SCN receives direct photic information from the retina of the eye via the retinohypothalamic tract (RHT) (Lucas et al. 2001). Neural and humoral messages of the oscillation of the master

clock are further mediated to synchronize several peripheral clocks located elsewhere in the body, for example in the liver, pancreas, and adipose tissue (Dibner, Schibler, and Albrecht 2010). In addition to daylight, heritable factors, as well as several other factors such as age, physical activity, and mealtime, can synchronize the periods of both clocks (Baron and Reid 2014; Hood and Amir 2017) as shown in Figure 2. Figure 3 shows the central clock present in the SCN of the brain signaling to the peripheral organs, which have peripheral clocks. SCN affects the phase of the peripheral clocks and indirectly regulates the timing of the physiological functions of vital organs like heart and kidney (Takeda and Maemura 2011). Thus, the proper operation of these clocks, is in many ways essential to our well-being.

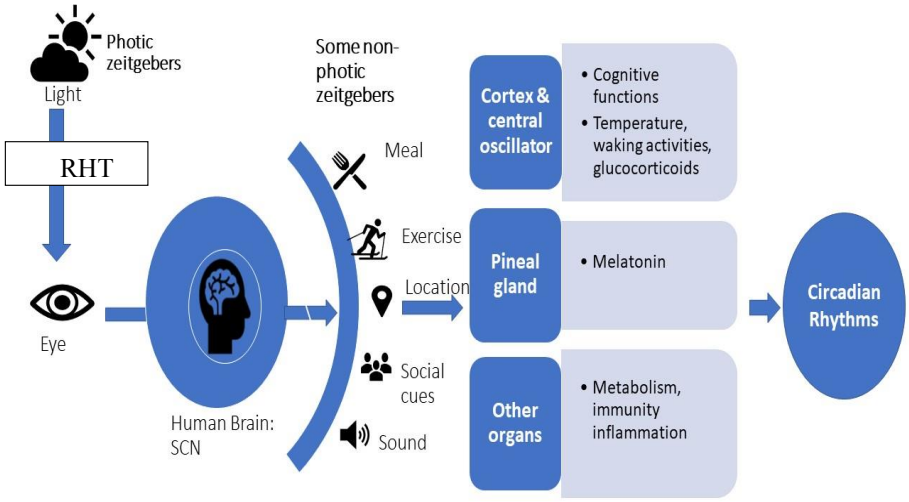


Figure 2 The photic stimuli of the light pass from the eye to the SCN via RHT. The extra non-photic time-givers (zeitgebers) also provide information to the SCN and influence the timing of our bodily functions (Adapted from Hood and Amir 2017).

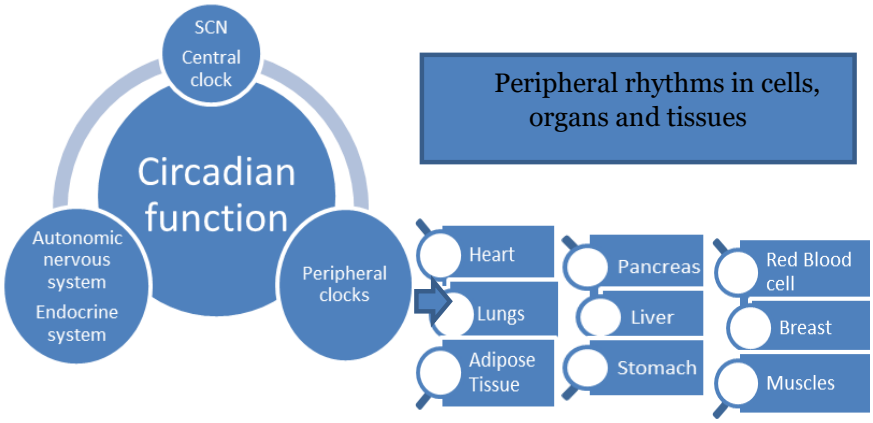


Figure 3 Schematic of the central clock located in the SCN of the brain signals to the peripheral organs, which have their own peripheral clocks (Adapted from Takeda and Maemura 2011).

2.2 CIRCADIAN FACTORS AND MORBIDITY

Circadian stability is important for the normal functioning of our body and its misalignment has been linked with the development of several NCDs such as metabolic syndrome, cancer, cardiovascular diseases as well as with depression (Bunney and Bunney 2000; Canaple, Kakizawa, and Laudet 2003; Mahowald and Schenck 2005; Curtis and Fitzgerald 2006; Levi 2006; Wijnen and Young 2006; McClung 2007; Baron and Reid 2014). Circadian misalignment (i.e., the circadian timing system being misaligned with the external environment) can be caused, for example, by changes in eating schedules, jet lag or irregular working hours. The most common cause, however, is poor and insufficient sleep, which eventually increases the risk of impaired health and diseases.

Evidently, the peripheral clocks are as important as the master clock in their role in synchronizing the physiology and behavior of an organism to environmental cues. By being present in all of the vital tissues and organs, these clocks ensure that homeostasis is maintained and the diseases stay at bay. Their exact mechanisms of action are not yet fully understood, but the available evidence suggests that the outcomes of circadian misalignment are seen as disturbances in our metabolic, cardiovascular, endocrinological, immune, and cognitive functions (Lekander et al. 2013; Markwald et al. 2013; Weil et al. 2013; Yu et al. 2013; Depner, Stothard, and Wright 2014). Recently, the discoveries of the circadian clock genes and the peripheral circadian oscillations have also broadened our

understanding of this relationship (Baron and Reid 2014; Hall, Rosbash, and Young 2017). However, further research is needed to fully understand the mechanisms of circadian misalignment and morbidity.

2.2.1 SLEEP

Globally, as many as 800 million people are estimated to suffer from poor sleep quality (Levine 2015). In the United States of America (USA), for example, the duration and quality of sleep of the adult population has reportedly decreased from 9.0 to 6.8 hours between 1919 and 2005 (National Sleep Foundation 2009) and in Finland, a similar trend has been reported (Kronholm et al. 2008; Koponen et al. 2018). This is a major public health concern as insufficient and poor sleep is known to cause several problems from degraded quality of life to declined productivity and increased morbidity (Sridhar and Madhu 1994; Centers for Diseases Control and Prevention 2017).

Sleep is fundamental for our health and wellbeing. Sleep loss and untreated sleep disorders enable metabolic changes and increase the risk of high blood pressure and obesity, as well as NCDs, such as heart diseases, diabetes, and the risk of all-cause mortality (Office of Diseases Prevention and Health Promotion 2014a). Circadian disruption may also ultimately promote the development of certain cancers (Chen et al. 2005; Chu et al. 2008) such as breast cancer.

2.2.2 SEASONALITY

Due to the northern location of Finland, changes in lighting conditions are rather extreme between summers and winters. Sunlight is the most important synchronizer of the functions of both the central and the peripheral clocks. The annual changes in the amount and timing of sunlight may cause circadian misalignment and related problems (Laposky et al. 2008). For example, seasonal changes in lighting conditions have been associated with cardiovascular diseases (CVDs), diabetes, cancers, rheumatic diseases, and mental health problems (Hawley et al. 2001; Øyane et al. 2010; Ernst 2012; Merikanto et al. 2016). In addition, many studies have linked seasonal variations with weight, blood pressure, serum cholesterol, glucose, and uric acid levels (Yanovski et al. 2000; Ockene et al. 2004; Liang 2007; Rintamäki et al. 2008; Hayashi, Ohshige, Sawai, Yamasue, and Tochikubo 2008; Alpérovitch et al. 2009). Studies have also reported higher morbidity and mortality rates of NCDs during winter than during the summer months (Mercer 2003; Rumana et al. 2008). In 14 European countries, the surplus number of all-cause deaths occurring during the winter seasons (December to March inclusive) compared with the average of the non-winter seasons was as high as 16% (Healy 2003).

2.2.3 CHRONOTYPE

Chronotype describes our natural tendency aligned with our daily routine to wake up, be active and fall asleep at certain times of the day. Some of us can be defined as morning types (MTs) with the preference for morning activities and early bedtimes, whereas others as evening types (ETs) with the preference for evening activities and late mornings. However, most of us are intermediate types (ITs) with no preference for early mornings or late evenings. According to a study by Roenneberg et al. 2003, chronotype shows a normal bell-shaped distribution within a population. However, in Finland, it is not exactly bell-shaped (FINRISK 2007 and 2012 databases) as 49.8% of the Finnish adult population are MTs, 43.1% ITs and 8.6% ETs (Merikanto et al. 2013).

As the timing of our behavior varies according to our chronotype, several other functions from cognitive performance to metabolism and gene expression patterns vary accordingly (Brown et al. 2008; Roenneberg 2012; Brambilla et al. 2012; Juda, Vetter, and Roenneberg 2013). Depending on chronotype one can also suffer from so-called social jet lag caused by the collision of innate and external timings. For example, ETs working daytime schedules and MTs working nighttime schedules are prone to suffer from social jet lag (Juda, Vetter, and Roenneberg 2013). In the long-term, this may lead to sleep deprivation, and, for example, deteriorate immune system and increase inflammation and oxidative stress of the body causing morbidity (Buxton et al. 2012). Especially eveningness has been linked with higher morbidity and mortality. For example, substance abuse, mental health problems, pulmonary diseases, and metabolic syndrome seem to be more common among ETs than among other chronotypes (Merikanto et al. 2012, 2013, 2015, 2016; Voinescu, Szentagotai, and David 2012; Yu et al. 2015). Thus, chronotype may predict one's health and longevity and could be used for the prevention and identification of several diseases (Horne and Ostberg 1976).

2.2.4 CARDIOVASCULAR DISEASES

CVDs include a variety of different kinds of illnesses such as coronary heart diseases, cerebrovascular diseases, raised blood pressure (hypertension), peripheral artery diseases, rheumatic heart diseases, congenital heart diseases and heart failure (Office of Diseases Prevention and Health Promotion 2014b; WHO 2017a). CVDs are accountable for approximately 17.3 million deaths and cause globally 30% of the overall mortality annually (WHO 2005). According to the current estimation, by 2030 almost 23.6 million people will die annually due to CVDs around the world (WHO 2018a).

Most commonly known risk-factors for CVDs are unhealthy dietary habits, substance abuse as well as physical inactivity, and related elevations in blood pressure, blood lipid and glucose levels and in body mass index (BMI) (WHO 2018). Circadian misalignment has also been shown to be related to CVD pathology due to its impacts on blood pressure, heart rate, and other cardiac functions (Staels 2006).

2.2.5 DIABETES

Diabetes is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (American Diabetes Association 2009). It is characterized by fasting blood glucose level of 126 mg/dl (equal to 7.0 mmol/l) or higher affecting body's organs, mostly blood vessels and nerves (American Heart Association 2015). Its symptoms include excessive urination, thirst, constant hunger, weight loss, vision changes, and fatigue. Without proper treatment, it may cause several serious consequences such as blindness, kidney failure, heart attacks, and strokes.

Genetic and lifestyle-related factors such as obesity predispose to the development of type 2 diabetes (T2D) (Belo et al. 2008; Leproult, Holmbäck, and Van Cauter 2014; Morris et al. 2016), also known as a non-insulin dependent diabetes or adult-onset diabetes (Staels 2006). It causes around 90% of all diabetes cases and affects annually approximately (WHO 2016) 347 million people worldwide (American Diabetes Association 2014). Patients with T2D suffer from insulin resistance (Crommen and Simon 2017). Also, circadian misalignment has been shown to increase the risk to develop T2D by causing adverse effects on insulin action and insulin release as well as by affecting the levels of ghrelin and leptin, hormones regulating appetite, metabolism and calorie burning. Thus, alongside with

weight loss and healthy nutrition (Markwald et al. 2013; Roenneberg et al. 2012), avoidance of circadian misalignment is important for the prevention of the development of T2D (Markwald et al. 2013; Javeed and Matveyenko 2018).

2.2.6 CANCER

Cancer usually begins when a normal cell starts to mutate. This is usually influenced by several environmental factors (Pukkala and Rautalahti 2013). Annually, cancers are accountable for approximately 8.8 million deaths around the world and this rate has been estimated to continue to rise in the future. By 2030, cancers are estimated to cause as many as 13.1 million deaths annually. According to WHO, the most common types of cancers are lung cancer (1.4 million deaths/year), stomach cancer (737,000 deaths/year), liver cancer (695,000 deaths/year), colorectal cancer (609,000 deaths/year), and breast cancer (458,000 deaths/year) (WHO, 2018). In 2011, more than 30 000 new cases of cancers were diagnosed in Finland, and the most common was breast cancer in women and prostate cancer in men (Pukkala and Rautalahti 2013).

Circadian misalignment has been suggested to be an independent risk factor for cancer development (Keith, Oleszczuk, and Laguens 2001, Sahar and Sassone-Corsi 2010) as it alters gene expression and cell proliferation as shown in Figure 4. This leads to uncontrollable cell replication and eventually to tumor growth (Blakeman et al. 2016; Bu et al. 2018). During recent years several cancer types, such as breast cancer, non-Hodgkin lymphoma, and colorectal cancer, have been linked to the disruption of circadian rhythms (Schernhammer et al. 2001; Lahti et al. 2008; Innominato et al. 2009) and in October 2007, the WHO's International Agency for Research on Cancer (IARC) classified *shift work with circadian disruption* as a probable human carcinogen (group 2A carcinogen) (Erren et al. 2010).

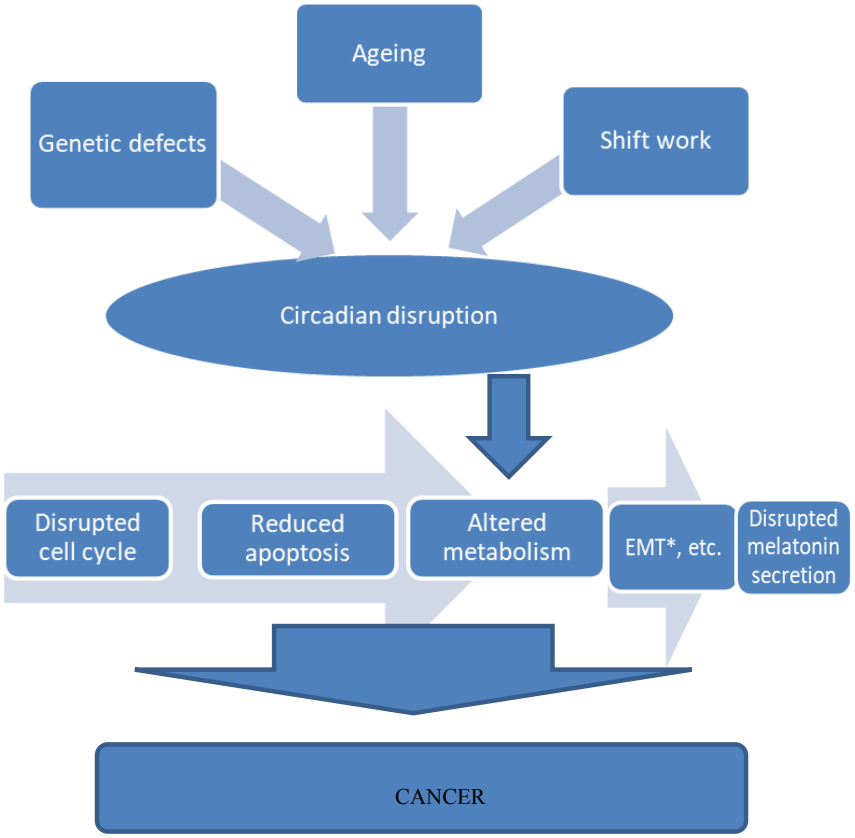


Figure 4 *Schematic of factors enabling circadian disruption and the development of cancer. *Epithelial–mesenchymal transition (EMT) (Adapted from Blakeman 2016).*

2.2.7 CHRONIC RESPIRATORY DISEASES

Chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and bronchial asthma are diseases of the airways and other structures of the lungs. Annually, around 251 million cases of COPD and 3.17 million deaths caused by it are being reported globally (WHO 2017b). Thus, COPD can be estimated to cause around 5% of overall global mortality. According to the Organisation for Respiratory Health in Finland, 5-10% of adult Finns are estimated to suffer from COPD and 10% from asthma (Masoli et al. 2004). Worldwide, asthma affects over 300 million people (Masoli et al. 2004).

Risk factors for the development of these diseases include tobacco smoke, air pollution, occupational chemicals and dust, and frequent lower respiratory infections during childhood as well as circadian misalignment (Koyanagi et al. 2014; Merikanto et al. 2014; Sundar et al. 2014).

2.2.8 DEPRESSION

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM)-5, there are altogether nine specifiers of o major depressive episode, including among others seasonal pattern, melancholic, atypical, and mixed features.

Depression, according to the WHO (WHO 2018b), is the most prevalent mental disorder affecting more than 350 million people worldwide. For long it has been known that one of the core symptoms of depression is sleep disruption (Borbély 1982; Germain and Kupfer 2008). Depressive patients often suffer from altered sleep architecture, i.e. a decreased slow wave sleep production and disturbed rapid eye movement (REM). It has also been shown that alterations in REM sleep may precede the clinical expression of depression (Palagini et al. 2013). Recently, ETs have been reported to be more prone to depression than MTs (Merikanto et al. 2013, Antypa et al. 2016).

Seasonal Affective Disorder (SAD) is usually characterized by atypical depressive symptoms. Key symptoms of SAD include carbohydrate craving, increased food intake, excessive sleeping, and fatigue (Rosenthal et al. 1984). In Finland, the prevalence of SAD is almost 1% (Magnusson and Partonen 2005). Also, SAD has been shown to be frequently accompanied by major disturbances in the circadian clockwork such as phase delays or elasticity, period lengthenings, and blunted amplitudes (Bunney and Bunney 2000; Lamont et al. 2007). The extremely short day in Finland during the winter months is one possible contributor to these disruptions. In SAD patients, disruption of the circadian clock system occurs due to changes in eating and sleeping schedules, body temperature, cortisol and

melatonin release, and in the levels of neurotransmitters (serotonin, noradrenaline, and dopamine) (Partonen and Lönnqvist 1998; Westrin and Lam 2007).

SAD can be treated with scheduled exposures to bright light, which is usually administered during the morning hours. Also, several other treatment options such as total sleep deprivation (TSD) have been applied. It has been suggested that the effects of these treatments are at least partly transmitted by their actions on the altered circadian clockwork of SAD patients (Bunney and Bunney 2013).

2.2.9 OTHER CHRONIC DISEASES

Despite the growing evidence of circadian misalignment in CVDs, metabolic disorders, and in cancer, there is still a limited number of investigations on the link between circadian disruption in gastrointestinal, musculoskeletal or renal functions. Circadian investigations in many common NCDs are still in an early phase, and not many epidemiological findings are available. Currently, the available ones are mostly from clinical studies (Stow and Gumz 2011).

Circadian clocks and sleep affect the physiology of almost all of the organs along the digestive tract. The skeletal muscles consisting of the bones, cartilage, and tendons alone comprise about 40% of the body's weight. The peripheral clocks in these organs maintain the structural components and regulate energy metabolism. Humans are no exception from animals, as these clocks may be disturbed to turn into misaligned and pathological (Dudek and Meng 2014).

Kidneys, similar to other vital organs, have peripheral clocks with many CCGs and their proteins exhibiting rhythmic expression. These clocks maintain proper blood pressure (BP) rhythms, renal function, and electrolyte balance, which all exhibit diurnal rhythms (Stow and Gumz 2011). Disruptions in these rhythms are often associated with hypertension and CVDs (Goldman 1951; Dyer et al. 1998). Decreasing melatonin amplitudes with advancing renal disease have been reported emphasizing the need for further investigation into the circadian mechanisms in chronic kidney disease (CKD) (Koch et al. 2010).

3 AIMS

The purpose of this thesis was to study the associations of circadian factors and NCDs in a large population-based cohort. The specific aims of the study are listed below:

1. To study the association between seasonal affective disorder and NCDs in a population sample (I). Hypothesis: The more severe the seasonal variations in mood and behavior are, the more frequent common NCDs are.

2. To study the association between sleep problems and NCDs in a population sample (II). Hypothesis: The more severe sleep problems are, the more frequent common NCDs are.

3. To study the association between chronotype and NCDs in a population sample (III). Hypothesis: The more eveningness there is, the more frequent common NCDs are.

4. To study the associations between seasonality, sleep problems and chronotype with NCDs in a population sample (IV). Hypothesis: High seasonality, insufficient sleep and evening chronotype contribute significantly to the presence of common NCDs.

4 MATERIALS AND METHODS

4.1 DATA

The data used in this study are comprised of a population survey, the National FINRISK 2012 Study. The National FINRISK Study is a cross-sectional health examination survey conducted every five years by the National Institute for Health and Welfare (THL) in Finland since 1972. The idea of the survey was established already during the famous North Karelia project which started in the early 1970s when Finland had the highest CVD mortality rate in the world (Jousilahti et al. 2016). Since then morbidity and mortality rates and their causes have been carefully monitored in Finland.

In 2012, a random sample of 10,000 Finns, aged 25–74 years, were invited to participate in the National FINRISK study. The sample was derived from the population information system of the National Population Register Center.

The data collection was conducted according to the guidelines of the Declaration of Helsinki, its amendments and international ethical standards. The Ethics Committee of the Hospital District of Helsinki and Uusimaa approved the research protocols for the National FINRISK 2012 study (I-IV). The permission for the studies included in this thesis (attached in Appendix 1) was obtained from THL, Finland. All participants gave their written and informed consent.

4.2 MEASUREMENTS

Figure 5 shows the conceptual framework of this thesis. The associations between circadian factors and NCDs were studied using self-reported questionnaires (attached in Appendix 2) as well as data obtained during a health examination survey were executed by a trained nurse in a local health care center or other facilities near the participant's residence. Table 1 shows the list of measures and variables used in studies I-IV.

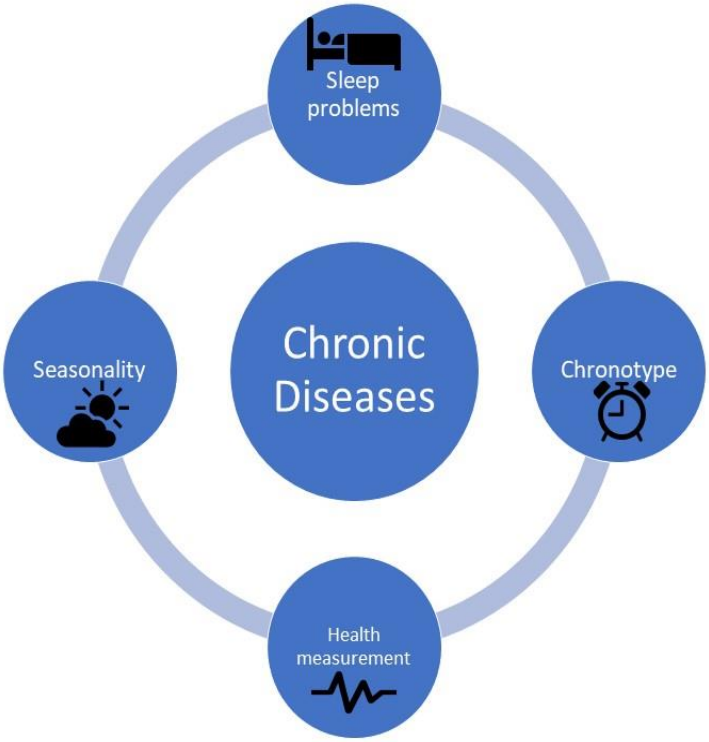


Figure 5 *Schematic of the conceptual framework for the study I-IV.*

4.2.1 GLOBAL SEASONALITY SCORE

To study the association between seasonality and NCDs, the participants (n=4770) were asked to fill in a modified Seasonal Pattern Assessment Questionnaire (SPAQ). The original SPAQ is a widely used instrument for the screening of SAD (Rosenthal, Bradt, and Wehr 1987). It asks the participant's experiences according to the seasons by using six items — sleep duration, social activity, mood, weight, appetite, and energy level — on a 5-point scale from 0 (no changes) to 4 (extremely marked changes). The scores on these six items are summed to produce a Global Seasonality Score (GSS), which can thus range from 0 (no seasonality) to 24 (extreme seasonality). The six items were scored from 0 (no changes) to 3 (marked changes) in the modification.

In addition to the six items, one item asks whether these seasonal changes, if any, are a problem ('No' or 'Yes'), and if they are, to what extent on a 5-point scale from 1 (mild) to 5 (disabling). The problem item was scored from 0 (none) to 4 (severe) in the modification.

The GSS has been shown to have acceptable reliability and validity in epidemiological studies (Thompson et al. 1988; Magnusson 1996). A GSS of 11 or above together with a problem rating of at least moderate are indicative of SAD, and a GSS of 9 or 10 together with a problem rating of at least mild are indicative of sub-syndromal seasonal affective disorder (s-SAD).

4.2.2 SLEEP PARAMETERS

To study the associations between sleep problems and NCDs, the participants were asked to subjectively report their total sleep (from bedtime to wake up) and nap duration (average number of hours and minutes slept) (n=6238) as well as their sleep quality (either nearly always or often slept enough, or rarely or hardly ever slept enough) (n=5878). They also reported differences in bedtime and wake up time during workdays and weekends to measure their sleep debt (the total sleep debt = bedtime minus wake-up time during weekdays and workdays) (n=5878), and the seasonal variation in the duration of their sleep (n=4852) on a 4-point scale from 0 (no variation) to 3 (marked variation).

4.2.3 MORNINGNESS-EVENINGNESS QUESTIONNAIRE

To study the association of chronotype and NCDs, the chronotype of the participants was assessed. Methods to identify chronotype include both subjective self-report questionnaires, devices to measure rest-activity cycle (accelerometers), behavioral measures (i.e., timing of sleep phase, personality, and lifestyle factors) and physiological measures (i.e., variations in heart rate, blood pressure, melatonin concentration, and core body temperature) (Roeser et al. 2012). However, in epidemiological studies, most often subjective questionnaires such as the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ) (Horne and Ostberg 1976), the Munich ChronoType Questionnaire (MCTQ) (Zavada et al. 2005) or the Composite Scale of Morningness (CSM) (Smith, Reilly, and Midkiff 1989) are used for chronotype assessment. The chronotype assessment in study III and IV was based on the Morningness–Eveningness Score (MES) derived from the participants (n=4414) who filled in a modified MEQ. The MES is a sum calculated from the six MEQ items, ranging from 5 to 27 points. From the MES, three chronotype categories can be derived; definitely or moderately ET (5–12 points), IT (13–18 points), and definitely or moderately MT (19–27 points).

4.2.4 COVARIATES

The National FINRISK 2012 study included self-administered questionnaires that had structured questions on socioeconomic factors (age, gender, marital status, education, and living region) and health behavior (smoking, alcohol consumption, exercise). In addition, it included a health status examination (height, weight, BMI, systolic and diastolic blood pressure, waist circumference, daily energy consumption, bioimpedance, cholesterol levels, and treatments for cholesterol and pulse). During the health examination the participant's medical history was also studied by asking whether the participant had been diagnosed or treated within the past 12 months due to NCDs (such as hypertension, high cholesterol, cardiac insufficiency, angina pectoris, T2D, cancer, bronchial asthma, COPD, depressive disorder, psychiatric illnesses, gallstones, rheumatoid arthritis, other joint diseases, degenerative arthritis of the back, renal failure, or proteinuria).

Table 1 *Measures and variables analyzed for studies I-IV.*

Measure	Study	Variables
Seasonality	I	GSS items (6 items) Problem perceived GSS item's score
Sleep	II	Total duration of sleep and nap times Sleep quality Sleep debt Seasonal variation in sleep duration
Chronotype	III	MES Score Chronotype (ET, IT or MT) MEQ items (4,7,9,15,17 and 19)
Seasonality, Sleep problems and Chronotype	IV	GSS items (6 items) Sleep quality MEQ items (4,7,9,15,17 and 19)
Covariates	I-IV	Age BMI Gender Marital status Education Living region Smoking Alcohol consumption Exercise
Health measurements	IV	Systolic blood pressure Diastolic blood pressure Waist circumference Energy consumption

Chronic diseases	I-IV	CVD's (hypertension, high cholesterol, cardiac insufficiency, angina pectoris) Diabetes (type 2) Cancer Chronic respiratory diseases (Bronchial asthma, COPD) Depression and psychiatric illnesses Other chronic diseases (Gallstones and musculoskeletal diseases, renal failure and proteinuria)

4.3 STATISTICAL ANALYSIS

The data were analyzed using appropriate statistical methods by using the Statistical Package for the Social Science (SPSS) statistics software. Study protocols, aims, and parameters of interest provided the rationale for the variables selected for analysis in each study. Group differences were measured, and the statistical significance was tested as described more in detail in each original article (attached in appendix 3).

To sum up briefly, first, a chi-squared test was used to measure the distributions between the explanatory variables of interest and background factors. Second, logistic regression models with NCDs as the dependent variables (yes or no) and the explanatory variables of interest as the independent variables were generated, after controlling for the background factors used for covariates (age, gender, education, civil status, alcohol consumption, physical activity, smoking, and area of residence).

5 RESULTS

5.1 PARTICIPANTS

A random sample of 6424 Finns from five different geographical regions in Finland participated in the National Finrisk 2012 Study. Of them 47.3% were male (3041) and 52.7% female (3383). The mean age of the participants was 51 years, ranging from 25 to 74. Background characteristics of the participants and the sample sizes are described more in detail in Table 2.

Table 2 *Background characteristics of the participants and the sample sizes for data gathered.*

Background characteristics	Sample (n)	% of the participants
Age		
25–34 years	1044	16.3
35–44 years	1193	18.6
45–54 years	1302	20.3
55–64 years	1397	21.7
65–74 years	1488	23.2
All	**6424**	**mean=51 years**
BMI		
Underweight (BMI<18)	25	0.4
Normal weight (BMI=18–24.99)	2154	37
Overweight (BMI≥25–29.99)	2249	38.7
Obese (>30)	1386	23.8
All	**5814**	**mean = 27.11**
Sex		
Male	3041	47.3
Female	3383	52.7
All	**6424**	
Living situation		
Living together [a]	4605	71.9
Living alone [b]	1803	28.1
All	**6408**	

Table 2 *Background characteristics of the participants and the sample sizes for data gathered.*

Educational attainment		
Low education [c]	2125	33.7
Medium education[d]	2115	33.5
High education[e]	2070	32.8
All	**6310**	
Region		
Resident in North Karelia and Kuopio	1282	20
Resident in North Savonia	1334	20.8
Resident in Turku and Loimaa	1262	19.6
Resident in Helsinki and Vantaa	1219	19
Resident in Oulu	1327	20.7
All	**6424**	
Smoking status		
Smokers [f]	1447	43
Non-smokers[g]	1921	57
All	**6096**	
Alcohol intake		
Alcohol intake[h]	5582	87.2
No alcohol intake[i]	821	12.8
All	**6403**	
Exercise		
Regular exercise [j]	4997	78.3
No exercise[k]	1386	21.7
All	**6383**	

[a] together (either married, cohabitating, or registered partnership), [b]alone (either single, separated, divorced, or widowed); [c] low (less than 4 years of high-school),[d] medium (either only high-school or 1 to 3 years post-high-school),[e] high (4 or more years post-high-school) level of education; [f] smokers (either smoked daily or occasionally), [g]non-smokers (smoked not at all); [h]alcohol intake (at least once or more than once a month), [i]no alcohol intake (not at all or quit using alcohol); [j] regular exercise (at least 3 to 4 hours per week or several times a week), [k]no exercise (less than 3 hours per week).

5.2 SEASONALITY

Altogether about 70% of the participants had seasonal variations in sleep duration, social activity, mood and energy levels and about 40% of them in weight and appetite. According to GSS majority of the participants 76.34% (n=3580) reported normal seasonality while 6.4% (n=304) -17.16% (n=805) reported SAD and s-SAD.

Health examination survey results, except weight, were all significantly associated with GSS items in study I. Of all 16 NCDs studied, as many as 13 had significant odds for one or more GSS items. These significant odds are shown in non-shaded boxes in Table 3. CVDs and their risk factors, T2D, cancers, bronchial asthma as well as depression and other mental health problems were all associated with seasonality measures. Particularly CVDs, angina pectoris, and systolic blood pressure were significantly associated with all the six items of GSS. In addition, hypertension was associated with seasonal variations items in appetite, weight, and sleep duration. While, cardiac insufficiency with seasonal variations items in weight, and appetite, and with s-SAD and the subjective experience of problems caused by seasonal variations.

T2D was significantly associated with increased seasonal variations in appetite as well as with s-SAD, SAD and the subjective experience of problems caused by seasonal variations. Cancer, on the other hand, was significantly associated with decreased odds for seasonal variations in weight and appetite. Of chronic respiratory diseases, bronchial asthma was associated with seasonal variations in social activity and weight, SAD and with the subjective experience of problems caused by seasonal variations. COPD was associated with SAD and seasonal variations in weight. Also, for depression and other mental health problems associations with GSS items were found.

When seasonality, morningness-eveningness, and sleep parameters were analyzed simultaneously in the final statistical model in study IV, the number of significant findings reduced. In study IV significant associations with seasonality were only found for systolic blood pressure, waist circumference as well as for variations in weight and appetite. Also, associations of seasonal variations in mood and appetite and depression were reported in study IV.

Table 3 *Odds ratios (OR) with 95% confidence intervals (CI) for GSS items in study I and the same items analyzed simultaneously in the final analysis with sleep, and morningness-eveningness in relation with 16 outcome measures in Study IV.*

	GSS-items									
	Sleep length (n=4852)	Social activity (n=4827)	Mood (n=4832)		Weight (n=4825)		Appetite (n=4837)		Energy level (n=4832)	
	Study I	Study I	Study I	Study IV	Study I	Study IV	Study I	Study IV	Study I	Study IV
	OR (95% CI)									
Hypertension	1.26 (1.0-1.50)*				1.38 (1.13-1.70)**		1.35 (1.10-1.66)**			
High cholesterol							1.22 (0.99-1.51)*			
Cardiac insufficiency					1.67 (1.04-2.68)*		1.61 (1.0-2.60)*			
Angina pectoris	1.93 (1.07-3.47)*	2.47 (1.34-4.56)**	2.42 (1.30-4.53)**		1.99 (1.21-3.25)**		2.11(1.30-3.44)**		2.33 (1.22-4.43)**	
Diabetes							1.51 (1.09-2.08)**			
Cancer					0.52 (0.28-0.95)*		0.49 (0.25-0.94)*			0.26 (0.07-0.84) *
Bronchial Asthma		1.58 (1.07-2.33)*			1.56 (1.14-2.13)**					
COPD					2.44 (1.29-4.63)**					
Depression	1.61 (1.10-2.37)**	2.18 (1.42-3.36)****	3.94 (2.32-6.69)****	0.46 (0.20-0.99)*	1.81 (1.32-2.47)****		2.23 (1.62-3.08)****	0.51 (0.29-0.87)**	3.12 (1.90-5.12)****	
Rheumatoid arthritis								3.18 (1.06-9.55) *		
Other joint disease			1.35 (1.01-1.79)*		1.59 (1.24-2.03)****	0.66 (0.44-0.98) *	1.39 (1.09-1.79)**			
Degenerative arthritis			1.48 (1.15-1.89)**	0.58 (0.38-0.87)**	1.26 (1.02-1.55)*				1.35 (1.05-1.74)*	
Proteinuria									7.79 (0.99-56.69)*	

Covariates of the regression models in both studies include BMI, age, gender, living region, civil status, education level, alcohol intake, and smoking. NOTE: Only significant results are presented in the boxes without shades, the shaded box represents non-significant results not presented in the tables (details in articles I-IV) p=*<0.05, **<0.01, ***<0.001, ****<0.0001.

5.3 SLEEP

The associations between sleep parameters (sleep duration, sleep debt and sleep quality) and NCDs was explored in studies II and IV. Table 4 shows the significant results for poor sleep quality. The majority (63%) of the participants slept for 7-8 hours a night. Some participant (19%) slept less than 7 hours and 17% more than 8 hours a night. Poor sleep quality was reported by some (14%) participants (n=839) while the majority (85.70%) (n=5040) reported good sleep quality.

According to our results, in study II, angina pectoris and hypertension were associated with seasonal variations in sleep duration. In addition, angina pectoris was also associated with having a sleep debt. Cardiac insufficiency, on the other hand, was associated with poor sleep quality. No significant associations between sleep parameters and T2D, cancers, bronchial asthma, COPD, renal failure, and proteinuria were found. However, gallstones and degenerative arthritis were significantly associated with poor sleep quality. In participants with depression and other mental health problems, bedtimes were later, and sleep and nap durations longer than among the other participants. The odds for poor sleep quality and seasonal variations in sleep duration were significantly increased in depression.

When seasonality, morningness-eveningness, and sleep parameters were analyzed simultaneously in the final statistical model in study IV, depression remains significantly associated with poor sleep quality as well as with longer sleep duration.

Table 4 *Odds ratios (OR) with 95% confidence intervals (CI) for sleep quality and covariates in study I, and for sleep quality when analyzed simultaneously in the final statistical model with seasonality, and morningness-eveningness.*

	STUDY II	STUDY IV
	Poor Sleep Quality (n=5878)	
	OR (95% CI)	
Cardiac insufficiency	2.72 (1.51-4.91)***	3.55 (1.37-9.14)**
Bronchial asthma		2.41 (1.30-4.47)**
COPD		4.90 (1.26-18.93)*
Depression	1.89 (1.34-2.68)****	3.33 (1.82-6.08)****
Gallstones	6.25 (2.22-17.58)***	21.60 (2.76-168.80)**
Degenerative arthritis	1.63 (1.24-2.15)****	1.69 (1.09-2.60)**

Covariates of the regression models in both studies include BMI, age, gender, living region, civil status, education level, alcohol intake, and smoking. NOTE: Only significant results are presented in the boxes without shades, the shaded box represents non-significant results not presented in the tables (details in articles I-IV) p=*<0.05, **<0.01, ***<0.001, ****<0.0001.

5.4 CHRONOTYPE

According to our results, 43.8% of the participants were MTs, 42.7% ITs and 13.5% ETs. The association of chronotype and NCDs was explored in studies III and IV. The significant results are presented in Table 5. According to study III, as compared to MTs, ETs and ITs had increased odds for depression and other mental health problems. Also, cardiac insufficiency was associated with eveningness. Interestingly, the greater the eveningness scores were, the more common it was to have a diagnosis and/or treatment for cardiac insufficiency. Different forms of morning tiredness were also common among participants with cardiac insufficiency, angina pectoris, degenerative arthritis, and depression. However, no associations between chronotype and hypertension, high cholesterol levels, rheumatoid arthritis, cancer, renal failure or proteinuria were found.

When seasonality, morningness-eveningness, and sleep parameters were analyzed simultaneously in the final statistical model in study IV, bronchial asthma was found to be significantly associated with morning tiredness (see Table 6 for details).

Table 5 *Odds ratios (OR) with 95% confidence intervals (CI) for evening types in study III, and for evening types simultaneously in the final statistical model with seasonality, and sleep in relation to the 16 outcome measures in Study IV.*

	STUDY III	STUDY IV
	Evening type (n=595)	
	OR (95% CI)	
Bronchial asthma		0.46 (0.27-0.77)**
COPD	3.62 (1.29-10.12)*	
Depression	2.43 (1.52-3.90)***	
Gallstones	5.24 (1.05-26.11)*	
Other psychiatric illnesses	5.17 (2.32-11.52)***	

Covariates of the regression models in both studies include BMI, age, gender, living region, civil status, education level, alcohol intake, and smoking. NOTE: Only significant results are presented in the boxes without shades, the shaded box represents non-significant results not presented in the tables (details in articles I-IV) p=*<0.05, **<0.01, ***<0.001, ****<0.0001.

Table 6 *Odds ratios (OR) with 95% confidence intervals (CI) for seasonality, sleep quality and evening chronotype in study I-III and Study IV.*

	STUDY I-III			STUDY IV	
	SAD (n=304)	**Poor Sleep Quality (n=5878)**	**Evening type (n=595)**	**Poor Sleep Quality (n=5878)**	**Evening type**
	OR (95% CI)				
Hypertension	2.39 (1.60-3.55)***				
High cholesterol	1.95 (1.30-2.93)***				
Cardiac insufficiency		2.72 (1.51-4.91)***		3.55 (1.37-9.14) **	
Angina Pectoris	2.66 (1.15-6.16)*				
Diabetes	2.78 (1.56-4.96)****				
Bronchial asthma	1.93 (1.17-3.20)*			2.41 (1.30-4.47)**	0.46 (0.27-0.77)**
COPD	2.86 (0.97-8.43)*		3.62 (1.29-10.12)*	4.90 (1.26-18.93)*	
Depression	8.73 (5.74-13.27)****	1.89 (1.34-2.68)****	2.43 (1.52-3.90)***	3.33 (1.82-6.08)****	
Other psychiatric illnesses	6.62 (3.40-12.91)****		5.17 (2.32-11.52)***		
Gallstone	15.98 (4.67-54.65)****	6.25 (2.22-17.58)***	5.24 (1.05-26.11)*	21.60 (2.76-168.80)**	
Other joint disease	2.01 (1.27-3.19)**				
Degenerative arthritis	1.77 (1.20-2.59)**	1.63 (1.24-2.15)****		1.69 (1.09-2.60)**	
Renal failure	5.62 (1.29-24.42)*				
Proteinuria	4.47 (1.34-14.86)*				

Covariates of the regression models in both studies include BMI, age, gender, living region, civil status, education level, alcohol intake, and smoking. NOTE: Only significant results are presented in the boxes without shades, the shaded box represents non-significant results not presented in the tables (details in articles I-IV) p=*<0.05, **<0.01, ***<0.001, ****<0.0001.

6 DISCUSSION

To our knowledge, there are only a limited number of earlier population studies in which the associations of seasonality, sleep parameters and chronotype with NCDs were assessed. Thus, the findings of our studies are novel, and in some parts, groundbreaking.

Our main finding is that circadian factors are commonly associated with NCDs. This finding supports the earlier evidence of circadian basis of metabolic and mood disorders, cancers, and COPDs (Lahti, Merikanto, and Partonen 2012; Merikanto et al. 2012, 2013, 2015, 2016; Lucassen et al. 2013; Merikanto, Englund, et al. 2014; Merikanto, Lahti, et al. 2014; Covassin and Singh 2016), but also broadens the understanding of the extent of this phenomenon, as the data on the role of circadian factors especially in the gallstones, musculoskeletal diseases, proteinuria, and renal failure has previously been scarce. Table 7 shows the prevalence of all the common NCDs that were explored in 2007 and 2012 according to the National FINRISK studies.

Table 7 *Prevalence of NCDs in Finland based on 2007 and 2012 FINRISK data.*

Year	2007		2012		2007		2012	
	No				Yes			
	N	%	N	%	N	%	N	%
Hypertension	3688	74.7	4701	74.20	1247	25.30	1634	25.80
High cholesterol			5019	79.30			1307	20.70
Cardiac insufficiency	4820	97.60	6151	97.10	121	2.40	186	2.90
Angina pectoris	4792	97.00	6137	96.80	150	3.00	203	3.20
T2D	4714	95.50	5877	92.70	223	4.50	462	7.30
Cancer	4843	98.00	6202	97.80	97	2.00	142	2.20
Bronchial asthma	6284	94.70	5854	92.40	355	5.30	480	7.60
COPD			6266	98.80			73	1.20
Depression	6164	92.80	5827	92.00	478	7.20	507	8.00
Other psychiatric illnesses	4847	98.20	6174	97.40	87	1.80	164	2.60
Gallstones	4886	98.90	6278	99.00	55	1.10	64	1.00
Rheumatoid arthritis	6544	98.50	6201	97.90	102	1.50	134	2.10
Other joint diseases	5913	89.20	5440	86.00	719	10.80	883	14.00
Degenerative arthritis	5569	83.90	5149	81.40	1067	16.10	1178	18.60
Renal failure			6299	99.40			40	0.60
Proteinuria			6247	98.80			76	1.20

6.1 SEASONALITY

In the present study, 40-70% of the participants with common NCDs reported seasonal variations in GSS items. In study I, weight and appetite had seasonal variations in several NCDs. The significance remained for mood and appetite, while only for mood in degenerative arthritis in studies I and IV. The number of significant findings obtained with the single-item analysis for seasonality (study I) reduced from 80% to 30%, when tested with the final model together with sleep and morningness-eveningness variables (study IV).

6.2 SLEEP

The main finding is that sleep problems were prevalent in NCDs in the present study as is reported in a meta-analysis, the presence of disturbed sleep pattern in affective disorder, by Benca and colleague (Benca et al. 1992) and for other NCDs (Ohkuma et al. 2014; Covassin and Singh 2016).

The number of significant findings obtained with the single-item analysis for sleep (study II) increased from 25% to 38% in the final analysis together with seasonality and morningness-eveningness variables (study IV), suggesting that sleep quality is the most sensitive probe for yielding associations with NCDs in a population-based study.

Of note, the average duration of sleep in Finnish working-age population is decreasing. The finding is consistent with that reported at a global scale and in Finland (Kronholm et al. 2008; National Sleep Foundation 2009).

6.3 CHRONOTYPE

According to our results, the Finnish working-age population is currently distributed to 43.8% of MTs, 42.7% of ITs, and 13.5% of ETs. In 2007, 49.8% of the Finnish population were MTs, 43.1% ITs and 8.6% ETs (Merikanto et al. 2013). The increase by 5 %-units in the proportion of ETs from 2007 to 2012 is consistent with a previous study in Finland (Broms et al. 2014), suggesting that the Finnish adult population is inclining towards eveningness. Broms et al. (2014) reported that the proportion of ETs, which was 9.1% of the population in the 1980s, increased up to 12.9% in the 21st century in Finland.

The number of significant findings obtained in the single-item analysis in chronotype (study III) decreased from 25% to 12% when analyzed in the final analysis with seasonality and sleep (study IV).

6.4 CARDIOVASCULAR DISEASES

CVD risk factors were significantly associated with having sleep problems, especially in cardiac insufficiency, throughout the studies. This is in line with a previous study (Takeda and Maemura 2011).

In addition, sleep problems have been common in clinical and epidemiological studies which have assessed seasonality and CVDs. The mortality of the population is reported to be higher during winter months than during summer months in Finland. A similar trend has been reported in other countries as well (Jakovljević et al. 1996; Rumana et al. 2008). In European cities the mortality rate has increased up to 16%, suggesting the existence of a seasonality factor in the disease outcome.

Our findings are also in line with a recent UK Biobank study (Knutson and von Schantz 2018) that suggested morningness to be protective against CVDs.

6.5 DIABETES

Diabetes did not yield any significant associations in the final analysis (study IV), but in study I diabetes was significantly associated with the seasonal variation in appetite. This result is in contrast with a recent population-based study in which an association of diabetes with eveningness was reported to yield a significant odds ratio of 1.30 (Knutson and von Schantz 2018).

6.6 CANCER

Cancer did not yield any significant association in the studies. Further research with more sophisticated methods is required to assess this topic.

6.7 CHRONIC RESPIRATORY DISEASES

In the final analysis, only bronchial asthma was associated with eveningness and poor sleep quality. In the single-item analysis, COPD had significant odds for ETs. The results suggest the association of respiratory diseases with eveningness. The finding is in line with previous research, which showed higher odds for eveningness and bronchial asthma (Merikanto, Englund, et al. 2014; Knutson and von Schantz 2018).

6.8 DEPRESSION AND OTHER PSYCHIATRIC ILLNESSES

The odds concerning sleep problems and seasonality remained significant (ORs of 1.89 to 8.73) for depression throughout the studies (I, II and IV). However, the number of significant findings declined in the final analysis for eveningness. This is in line with several earlier studies. In the single-item analysis, the odds ratio of 5.17 was obtained for other psychiatric illness, but not in the final analysis. The current finding suggests the importance of sleep features over chronotype in depressive disorder. There are also some seasonality problems for mood and appetite in the final analysis, while for all the items of seasonality in single item analysis suggesting the importance of screening seasonality and sleep problems in depression.

The odds for eveningness and psychiatric illnesses were the strongest as up to 5.11 and in line with the mortality analysis in the UK Biobank study reporting the strongest odds of up to 1.94 (Knutson and von Schantz 2018). Of interest, in the present study, the odds of eveningness was more than 2.5-fold for all the diseases that yielded significant odds, while the UK Biobank cohort reported the strongest odds of 1.94. Hence, the present study produced stronger odds for eveningness and NCDs. However, the odds as obtained in single-item analysis declined and remain significant only for depression and bronchial asthma in the final analysis.

6.9 OTHER CHRONIC DISEASES

Gallstones had the highest and the most significant odds for both seasonality and poor sleep quality in the final and single-item analysis, respectively. There are no previous studies to compare the results to, but there is a study that shows significant association of eveningness with gastrointestinal or abdominal disorders consistent with our result in study I (Knutson and von Schantz 2018).

No significant association was observed in the final analysis, while in the single-item analysis seasonality was significantly associated with renal failure and proteinuria. However, there is no earlier evidence to compare to.

6.10 LIMITATIONS AND STRENGTHS

There are limitations in our studies. First, we used self-reported questionnaires. Therefore, some misclassifications may have occurred. To minimize such biases, however only structured and validated questionnaires were used in our studies. Second, the study design was cross-sectional due to which causal relationship cannot be demonstrated. Last, some of our novel findings need to be cautiously interpreted due to a small number of cases in some of the NCD groups like gallstones, proteinuria, and renal failure.

Despite limitations, the studies also had their strengths. First, our results are generalizable, and the potential risk of selection bias is reduced due to the large, population-based dataset used. Second, the study design is reliable as the National FINRISK Study is an established survey conducted every five years in Finland. Third, despite that the assessment of NCDs reported here was based on the subjective responses of the participants, they were also clinically verified with the previous diagnoses assessed by a medical doctor.

6.11 CONCLUSIONS

The present study found several associations between various NCDs and circadian factors including insufficient and poor sleep, eveningness and seasonal variations. These were common among Finnish working-age population. These factors could possibly predispose to NCDs. By recognizing those with the increased risk of deteriorating circadian factors to develop NCDs, we can improve both health care practices and health policies. The prevalence of NCDs is steadily increasing not only around the globe but also in Finland, as is evident from the present results, hence new methods to prevent and treat them are urgently needed.

Ever since the 1700s when the circadian rhythm in a plant was first identified, research activities which focus on circadian factors have emerged. In the 1960s when the external control of the dark–light transitions or the administration of melatonin modified human circadian response (Wurtman 1963a, b; Aschoff 1965), various treatment strategies successfully set a groundbreaking course. Henceforth, various circadian factors were also investigated in the etiology of several NCDs. For example, there was evidence that the environmental cues driving the individual's chronotype have the capacity to entrain the circadian clock and contribute to and modify the risk of common NCDs and later the relapse rates. In the future, this information should be utilized in developing preventive, diagnostic and intervention measures. In addition, it should also be considered in evidence-based planning and evaluation of health policies. For example, with regulations concerning working times, school schedules as well as noise and light pollution, societies can either prevent circadian misalignment or increase it, and thus also have a major impact on the morbidity rates of the population in the long run.

Rapid shifts of populations towards eveningness and insufficient sleep, which is evident in the modern lifestyle, call for more research in understanding circadian factors to validate the present results for other chronic conditions in musculoskeletal, renal, proteinuria and gastrointestinal diseases. There is still a lack of evidence on how this research can be used in the treatment of NCDs. For these reasons, it is important that circadian screening in the treatment and prevention of NCDs is developed.

Lastly, the preliminary results from the FinHealth 2017 survey, a National Health Examination study of Finnish adults after the FINRISK 2012, suggest that obesity and insufficient sleep continues to increase among the Finnish population. These factors further compromise the circadian rhythms and may contribute to the development of NCDs. Hence, urgent action is needed to address these issues in the prevention, treatment, and screening of NCD's in Finland.

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To a new summit……

Cheers

Syaron

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Total number of references-130

APPENDICES

APPENDIX 1-Ethical Permission

APPENDIX 2 – Self-report questionnaire

APPENDIX 3- Manuscripts

HELSINGIN JA UUDENMAAN
SAIRAANHOITOPIIRI
Konsernihallinto/ Eettiset toimikunnat
Koordinoiva eettinen toimikunta

LAUSUNTO PYYDETYISTÄ KORJAUKSISTA

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PL 30
00271 Helsinki

KANSALLINEN FINRISKI 2012 –TERVEYSTUTKIMUS

Viite: 162/13/03/00/11

Tutkimussuunnitelma on hyväksytty eettisen toimikunnan kokouksessa 20.9.2011 ja siitä on annettu puoltava lausunto edellyttäen korjauksia. Toimikunta on valtuuttanut kokouksen puheenjohtajan hyväksymään pyydetyt korjaukset liitteineen.

Pyydetyt korjaukset käyvät ilmi toimitetuista asiakirjoista:

- Saatekirje, Erkki Vartiainen 17.10.2011
- Tutkimussuunnitelma, versio 6, 1.12.2011
- Tiedote tutkittavalle ja suostumusasiakirja, versio 4, 251111
- Kyselylomake Finriski2012, Liite 5, versio 2, 15.11.2011
- Ruoankäyttökysely, Liite 6, versio 2, 15.11.2011
- Kyselylomake Finriski-tutkimuksessa käyneelle, Liite 7, versio 2, 15.11.2011
- Puheenjohtaja Katia Käyhkön kirje Ylijohtaja Erkki Vartiaiselle 8.11.2011
- Ylijohtaja Erkki Vartiaisen vastine 9.11.2011
- Lausuntokopio § 199 / 20.9.2011

Tutkimussuunnitelma ja sen liitteet täyttävät toimikunnan mukaan tutkimuslain (794/2010) 17 §:n 2 momentin mukaiset edellytykset.

Päätös

Toimikunnan puolesta kokouksen puheenjohtaja päätti hyväksyä pyydetyt korjaukset ja antaa niistä puoltavan lausunnon.

Lausunto on maksuton (STM:n asetus 840/2010, 1 §).

Vakuudeksi

Helsingissä 1.12.2011

Katia Käyhkö
puheenjohtaja
Koordinoiva eettinen toimikunta

TERVEYDEN JA HYVINVOINNIN LAITOS

Lomaketarra

FINRISKI 2012
NATIONAL HEALTH STUDY

QUESTIONNAIRE

Please fill out this form and take it with you to the study site.

INSTRUCTIONS FOR RESPONDENT

Answer the questions by checking the appropriate box with an "X" or by writing out the information in the space provided for it.

Read each question carefully before answering. For each question, choose only one most suitable alternative.

EXAMPLE 1. Have you ever had allergic eye symptoms?

- ☐ no
- ☒ yes, during the last 12 months
- ☐ yes, the last time was over a year ago

Please answer all questions – a negative answer should also be indicated by checking the “no” alternative with an "X"or by marking “0” in the space reserved for the answer.

EXAMPLE 2. Has a doctor diagnosed or treated you for any of the following diseases during the past year (last 12 months)?

	no	yes
Rheumatoid arthritis	☒	☐
Other disease of the joints	☐	☒

EXAMPLE 3. How many of your household members are

under 7 years 1

7-17 years old 0

(Please mark 0 for none.)

Some questions have certain alternatives that end with the instruction “Proceed to question ...”, in which case you can proceed directly to the question indicated and leave the questions in between unanswered.

If you find it difficult to answer some questions, you can ask for advice and complete your answers at the study site.

Please follow the instructions closely and avoid any superfluous markings.

Please mark the main date on which you filled this form:



2012

QUESTIONNAIRE

1. Gender

- ☐ male
- ☐ female

2. What is your marital status?

- ☐ married
- ☐ cohabiting
- ☐ single
- ☐ separated or divorced
- ☐ widow
- ☐ registered partnership

3. What is your education?
Mark your highest educational degree.

- ☐ elementary school, basic education
- ☐ lower secondary education
- ☐ vocational school/equivalent
- ☐ upper secondary education/high school
- ☐ non-university lower education
- ☐ non-university higher education
- ☐ university education

4. How many years have you attended school and studied full time *(basic levels included)*?

____ years

5. How many members are there presently in your household *(yourself included)*?

____ members

6. How many of your household members are *(Please mark 0 for none.)*

under 7 years ____
7 - 17 years old ____

7. What kind of work do you do most of the year?

- ☐ farming, cattle minding, forestry, farmer's wife
- ☐ factory, mining, construction or similar work
- ☐ office work, service profession (nurse, sales etc.), mental work (planning, designing, administrative, director, expert etc.)
- ☐ studying or going to school
- ☐ home maker, mother at home, house wife
- ☐ pensioner
- ☐ unemployed

8. How large was your household's income last year *(before tax deduction)*?

- ☐ less than 15000 €
- ☐ 15 001 - 25 000 €
- ☐ 25 001 - 35 000 €
- ☐ 35 001 - 45 000 €
- ☐ 45 001 - 50 000 €
- ☐ 50 001 - 60 000 €
- ☐ 60 001 - 70 000 €
- ☐ 70 001 - 80 000 €
- ☐ 80 001 - 90 000 €
- ☐ more than 90 000 €

HEALTH STATUS

9. How do you find your current health status? Is it

- ☐ excellent
- ☐ quite good
- ☐ average
- ☐ quite poor
- ☐ very poor

10. Has a doctor diagnosed or treated you for any of the following diseases during the past year (last 12 months)?

	no	yes
Increased blood pressure, hypertension	☐	☐
High cholesterol	☐	☐
Cardiac insufficiency	☐	☐
Effort angina (Angina pectoris)	☐	☐
Diabetes	☐	☐
Cancer	☐	☐
Asthma	☐	☐
Chronic obstructive pulmonary disease (COPD)	☐	☐
Gallstones, gall bladder inflammation	☐	☐
Rheumatoid arthritis	☐	☐
Other disease of the joints	☐	☐
Degenerative arthritis of the back, other illness of the back	☐	☐
Depression	☐	☐
Other psychological illness	☐	☐
Renal failure	☐	☐
Proteinuria	☐	☐

Other chronic illness, which:

11. Have you ever had your cholesterol level checked? When was the last time?

- ☐ during the last 6 months
- ☐ 6 months - 1 year ago
- ☐ 1 year - 5 years ago
- ☐ over 5 years ago
- ☐ never (proceed to question 15)
- ☐ I do not know (proceed to question 15)

12. Have you ever been diagnosed for high or heightened blood cholesterol level?

- ☐ no
- ☐ yes

13. If your cholesterol level was examined did you receive dietary counsel to lower your cholesterol level?

- ☐ no
- ☐ yes

14. Do you currently use prescription medicine to lower your cholesterol level?

- ☐ no
- ☐ yes

15. Have you ever had your blood pressure measured? *When was the last time?*

- ☐ during the last 6 months
- ☐ 6 months - 1 year ago
- ☐ 1 year - 5 years ago
- ☐ over 5 years ago
- ☐ never (proceed to question 19)

16. Have you ever been diagnosed for high or heightened blood pressure?

- ☐ no (proceed to question 19)
- ☐ yes

17. Have you ever used medicine for high blood pressure?

- ☐ no (proceed to question 19)
- ☐ yes

18. When was the last time you took medicine for high blood pressure?

- ☐ today or yesterday
- ☐ 2 - 7 days ago
- ☐ 1 week - 6 months ago
- ☐ 6 months - 1 year ago
- ☐ 1 year - 5 years ago
- ☐ over 5 years ago

19. Have you ever had your blood sugar level measured? *When was the last time?*

- ☐ during the last 6 months
- ☐ 6 months - 1 year ago
- ☐ 1 year - 5 years ago
- ☐ over 5 years ago
- ☐ never (proceed to question 23)
- ☐ I do not know (proceed to question 23)

20. Have you ever been diagnosed for diabetes?

- ☐ no (proceed to question 23)
- ☐ no, but I have been diagnosed for elevated blood glucose levels or prediabetes
- ☐ yes, type 1 diabetes (childhood-onset diabetes), in the year _____
- ☐ yes, type 2 diabetes (adult-onset diabetes) , in the year _____
- ☐ yes, but I don't know which type, in the year _____
- ☐ yes, gestational diabetes, in the year _____

21. When diagnosed for diabetes were you given one of the following treatments?

- ☐ dietary counseling only
- ☐ tablet treatment
- ☐ insulin treatment
- ☐ none of the above

22. What prescription medicine do you now use for diabetes?

- ☐ nothing
- ☐ insulin
- ☐ tablets
- ☐ both insulin and tablets

23. Has a doctor ever diagnosed you for myocardial infarction?

- ☐ no
- ☐ yes, what year was the last one:

year ____

24. Has a doctor ever diagnosed you with stroke, cerebral hemorrhage or obstruction of a cerebral vessel?

- ☐ no
- ☐ yes, what year was the last one:

year ____

25. Have you ever had coronary (heart) bypass surgery?

- ☐ no
- ☐ yes, what year was the last one:

year ____

26. Have you ever had coronary (heart) angioplasty?

- ☐ no
- ☐ yes, what year was the last one:

year ____

27. Have you ever been diagnosed for asthma?

- ☐ no
- ☐ yes

28. Have you had asthma symptoms during the last 12 months?

- ☐ no
- ☐ yes

29. Do you usually cough phlegm when waking up on winter mornings?

- ☐ no
- ☐ yes

30. Do you usually cough phlegm during the day or at night during winter?

- ☐ no
- ☐ yes

31. Do you cough phlegm on most days or nights for at least 3 months yearly?

- ☐ no
- ☐ yes

32. Have you ever had hay fever or other allergic nasal symptoms?

- ☐ no
- ☐ yes, during the last 12 months
- ☐ yes, the last time was over a year ago

33. Have you ever had allergic eye symptoms?

- ☐ no
- ☐ yes, during the last 12 months
- ☐ yes, the last time was over a year ago

34. Have you ever had an itching rash which was called infantile eczema or atopic eczema?

- ☐ no
- ☐ yes, during the last 12 months
- ☐ yes, the last time was over a year ago

35. Have you during the last 12 months had a period of at least two weeks when, for most of the time, you have been low-spirited or depressed?

- ☐ no
- ☐ yes

36. Have you during the last 12 months had a period of at least two weeks when, for most of the time, you have lost interest in most things, such as hobbies, work or other things that usually give you pleasure?

- ☐ no
- ☐ yes

37. When was the last time you used the following medication?
Please answer on every line by checking the correct alternative with an X.

	During the past week	1-4 weeks ago	1-12 months ago	Over a year ago	Never
Painkillers for headache	☐	☐	☐	☐	☐
Painkillers for joint or muscle ache	☐	☐	☐	☐	☐
Painkillers for other ache	☐	☐	☐	☐	☐
Sleeping pills	☐	☐	☐	☐	☐
Tranquillizers	☐	☐	☐	☐	☐
Antidepressants	☐	☐	☐	☐	☐
Asthma medication	☐	☐	☐	☐	☐
Hay fever medication	☐	☐	☐	☐	☐
Acetylsalicylic acid to prevent myocardial infarction (e.g. Aspirin, Disperin, Primaspan)	☐	☐	☐	☐	☐
Medication to thin the blood (Marevan, Pradaxa)	☐	☐	☐	☐	☐
Antibiotics	☐	☐	☐	☐	☐

Other medication, which: _____

FUNCTIONAL ABILITY

38. Can you usually perform the following functions?

	Yes, I can without difficulty	Yes, but with difficulty	No
Dress yourself without help	☐	☐	☐
Clip your toenails	☐	☐	☐
Go up stairs without help (about one floor without resting)	☐	☐	☐
Walk about half a kilometre without resting	☐	☐	☐
Carry a weight of about 5 kg for at least a hundred metres	☐	☐	☐
Run for about a hundred metres	☐	☐	☐
Run for over half a kilometre	☐	☐	☐
Ride a bicycle	☐	☐	☐
Ride a train, bus or tram	☐	☐	☐
Read an ordinary newspaper (with or without glasses)	☐	☐	☐
Hear what is said in a conversation of several people (with or without a hearing aid)	☐	☐	☐

PHYSICAL ACTIVITY

39. How demanding is your work physically?
The activity at work is divided into four groups. If you do not work, check the first alternative with an X.

☐ My work is mainly done sitting down and I do not walk much during my working hours (e.g. a clocksmith, radio mechanic and industrial seamstress, office work at a desk).

☐ I walk quite much in my work, but I do not have to lift or carry heavy objects (e.g. a foreman and store assistant, light industrial worker, office work which requires walking).

☐ I have to walk and lift much or to take the stairs or go uphill (e.g. a carpenter or cattle minder / dairy work, engineering shop or other heavier industrial work).

☐ My work is heavy manual labor in which I have to lift or carry heavy objects, to dig, shovel or chop, etc. (e.g. forestry, heavy farm work, heavy construction or industrial work).

40. How much do you exercise and stress yourself physically in your leisure time? *If it varies much according to different seasons, check the alternative which best describes the average situation with an X.*

- ☐ In my leisure time I read, watch TV, and work in the household with tasks which do not make me move much and which do not physically tax me.
- ☐ In my spare time I walk, cycle or exercise otherwise at least 4 hours per week. This includes walking, fishing and hunting, light gardening etc. but excludes travel to work.
- ☐ In my spare time I exercise to maintain my physical condition, e.g. running, jogging, skiing, gymnastics, swimming, playing ball games or I do heavy gardening or the like for at least 3 hours per week.
- ☐ In my spare time I regularly exercise several times a week competitive sports such as running, orienteering, skiing, swimming, playing ball games or other heavy sports.

41. How many minutes do you walk, ride on a bicycle or otherwise exercise to get to work? *(Please count in both traveling to and from work.)*

- ☐ I do not work or I use only a motorised vehicle
- ☐ less than 15 minutes daily
- ☐ 15 - 29 minutes daily
- ☐ 30 - 44 minutes daily
- ☐ 45 - 59 minutes daily
- ☐ over an hour daily

42. How many minutes do you daily walk, cycle or engage in a hobby in your leisure time that requires moving about (yard work or gardening, fixing or cleaning the house)? *Do not count in the activity needed at work, travelling to work (question 41) or leisure time exercise (question 40).*

- ☐ less than 15 minutes per day
- ☐ 15 - 29 minutes per day
- ☐ 30 - 44 minutes daily
- ☐ 45 - 59 minutes daily
- ☐ over an hour per day

43. How many hours on average do you sit in a weekday? *Mark 0 if not at all.*

During the workday in office or equivalent	___	hours	___	minutes
At home watching television or videos	___	hours	___	minutes
At home at a computer	___	hours	___	minutes
In a vehicle	___	hours	___	minutes
Elsewhere	___	hours	___	minutes

SMOKING

44. Have you ever smoked?

- ☐ no (proceed to question 53)
- ☐ yes (proceed from question 45)

45. Have you during your life smoked at least 100 times (cigarettes, cigars or pipefuls)

- ☐ no (proceed to question 53)
- ☐ yes

46. Have you ever smoked regularly *(almost every day for at least a year)? How many years altogether?*

- ☐ I have never smoked regularly
- ☐ I have smoked regularly for ___ years

47. How old were you when you started smoking?

___ years

48. Do you smoke now *(cigarettes, cigars, pipefuls)?*

- ☐ yes, daily
- ☐ yes, occasionally
- ☐ not at all

49. When was the last time you smoked? *If you smoke continuously, check the first box.*

- ☐ yesterday or today
- ☐ 2 days - 1 month ago
- ☐ 1 month - 6 months ago (proceed to question 53)
- ☐ 6 months - 1 year ago (proceed to question 53)
- ☐ 1 - 5 years ago (proceed to question 53)
- ☐ 6 - 10 years ago (proceed to question 53)
- ☐ over 10 years ago (proceed to question 53)

50. How soon after waking up do you smoke?

- ☐ in 5 minutes
- ☐ in 6 - 30 minutes
- ☐ in 31 - 60 minutes
- ☐ more than 60 minutes after waking up

51. How much on average per day do you smoke or did smoke before you quit? Please mark each space. *(If you do not smoke or did not smoke at all, mark 0.)*

pcs per day

- ☐☐ manufactured cigarettes
- ☐☐ self-rolled cigarettes
- ☐☐ pipefuls
- ☐☐ cigars

52. If you were to try to quit smoking, do you think you would succeed?

- ☐ no
- ☐ yes
- ☐ I can't say
- ☐ I do not smoke nowadays

53. Have you during the past year (last 12 months) used nicotine replacement therapy *(gum, patches, tablets etc.)?*

- ☐ no, I have not
- ☐ yes, to help me stop smoking
- ☐ yes, for other reason

54. Do you use snuff?

- ☐ yes
  - ☐☐ portions daily
- ☐ sometimes
- ☐ not at all

55. How many hours do you daily spend in indoor spaces where you have to inhale other people's smoke?
(If not at all, mark 0.)
Round your answer to the nearest full hour.

hours

- ☐☐ at work
- ☐☐ at home
- ☐☐ other places

NUTRITION

56. On how many days a week between Monday and Friday do you eat the following meals?

	not at all	1–2 days	3-4 days	every day
Breakfast	☐	☐	☐	☐
Lunch	☐	☐	☐	☐
Dinner / supper	☐	☐	☐	☐

57. On how many days a week between Monday and Friday do you eat the following snacks?

	not at all	1–2 days	3-4 days	every day
Mid-morning snack	☐	☐	☐	☐
Afternoon snack	☐	☐	☐	☐
Late-night snack	☐	☐	☐	☐
Other snacks	☐	☐	☐	☐

58. Where do you usually eat lunch on weekdays? *Check only one alternative.*

- ☐ I do not have lunch
- ☐ I bring a packed lunch with me to work
- ☐ at home
- ☐ at a restaurant, bar or a fast food place
- ☐ at a workplace canteen or student cafeteria
- ☐ somewhere else

59. Does your place of work or study have a food service location where you can eat lunch?

- ☐ yes
- ☐ no
- ☐ I do not go to work or study

60. What kind of coffee do you usually drink *(check only one alternative)?*

- ☐ filtered coffee
- ☐ boiled coffee
- ☐ instant coffee
- ☐ other coffee drinks (e.g. espresso, cappuccino)
- ☐ I do not drink coffee

61. If you drink milk, what kind is it usually *(check only one alternative)?*

- ☐ raw milk
- ☐ whole milk (ca. 3 % fat)
- ☐ low fat milk (1.5% fat, incl. HYLA (low-lactose), organic milk, lactose-free milk)
- ☐ low fat milk (1% fat)
- ☐ skimmed milk (0% fat, incl. HYLA (low-lactose), organic milk, Gefilus, Valio Maito Plus, lactose-free milk, Evolus milk)
- ☐ I do not drink milk

62. What kind of fat do you usually use on your bread? *(Check only one alternative.)*

- ☐ nothing
- ☐ margarine spread with 40 % or less fat (e.g. Keiju Keveämpi 30, Keiju Kevyt 40, Flora Kevyt 40, Kevyt Becel 35, Kevyt Levi 40)
- ☐ margarine spread with 60 % fat (e.g. Keiju 60, Flora 60, Becel 60)
- ☐ margarine spread with 70 - 80 % fat (e.g. Keiju 70, Flora Kulta 80)
- ☐ mixture of butter and vegetable oil, blend fat (e.g. Oivariini, Ingmariini)
- ☐ butter
- ☐ vegetable sterol margarine (e.g. Becel pro.activ, Benecol)

63. What kind of fat do you usually use for cooking?
Do not count in baking. Check only one alternative.

- ☐ vegetable oil or liquid vegetable oil preparation (e.g. Flora Culinesse, Juokseva Sunnuntai)
- ☐ margarine spread with 60 % fat (e.g. Keiju 60, Flora 60)
- ☐ margarine spread with 70 - 80 % fat (e.g. Flora, Keiju)
- ☐ cooking margarine (e.g. Sunnuntai)
- ☐ mixture of butter and vegetable oil, blend fat (e.g. Oivariini, Ingmariini)
- ☐ butter
- ☐ vegetable sterol margarine (e.g. Becel pro.activ, Benecol)
- ☐ no fat at all
- ☐ we don't cook in our household

CONSUMPTION OF ALCOHOL

64. Do you use any alcoholic drinks, even occasionally *(e.g. beer, wine or spirits)?*

- ☐ yes, at least once a month
- ☐ yes, more seldom than once a month
- ☐ no, because I quit using alcohol ____ years ago
- ☐ I have never used alcohol (proceed to question 67)

65. Have you during the past year (last 12 months) had any alcohol *(beer, wine or spirits)?*

- ☐ yes
- ☐ no (proceed to question 67)

66. How many glasses (restaurant measures) or bottles did you drink during the last week (last 7 days) of the following *(if not at all, mark 0):*

Beer (class III) or medium strong cider (sold in markets, alcohol content 2.9-4.7%)	____ bottles / cans (1/3 liter)
Beer (class IV, alcohol content over 4.7%)	____ bottles / cans (1/3 liter)
Strong cider or long drinks (sold only in the ALKO stores, alcohol content over 4.7%)	____ bottles / cans (1/3 liter)
Spirits or other strong alcohol	____ restaurant measures (c. 4 cl)
Red wine	____ glasses (1 glass = c. 12 cl)
Other kind of wine	____ glasses (1 glass = c. 12 cl)

WEIGHT

67. How much did you weigh at 20 years of age?

____ kg

68. What has been your lowest weight in adulthood *(at over 20 years of age)?*

____ kg

69. How much have you weighed at most *(excluding women in pregnancy and when breast-feeding)?*

____ kg

70. How does your present weight differ from your weight a year ago?

- ☐ weight gain: about ____ kg
- ☐ it has stayed the same
- ☐ weight loss: about ____ kg

71. Do you consider yourself

- ☐ too thin
- ☐ a little too thin
- ☐ normal
- ☐ a little overweight
- ☐ too much overweight

SLEEP

72. What time do you usually go to bed *(to prepare to sleep)?*

On workdays / weekdays at

____ : ____ (e.g. 22:30)

On days off / weekends at

____ : ____ (e.g. 23:20)

73. What time do you usually get up from bed *(without going back again)?*

On workdays / weekdays at

____ : ____ (e.g. 07:15)

On days off / weekends at

____ : ____ (e.g. 10:30)

74. How many hours on average do you sleep?

in one night? ____ hours ____ min

in a period of 24 hours *(including all sleep and naps during both daytime and nighttime)?*

____ hours ____ min

75. Do you think you sleep enough?

- ☐ yes, nearly always
- ☐ yes, often
- ☐ rarely or hardly ever
- ☐ I can't say

76. There are so-called “morning people” (early to rise, early to bed) and “evening people” (late to rise, late to bed). Which are you?

- ☐ absolutely a “morning person”
- ☐ more “morning” than “evening person”
- ☐ more “evening” than “morning person”
- ☐ absolutely an “evening person”

77. Next we pose you some personal questions. Think of the past month. Please check the alternative which best describes how often the feeling or symptom in question has been on your mind.

	often	sometimes	not at all
Do you feel exhausted and overworked?	☐	☐	☐
Do you have nightmares?	☐	☐	☐
Do you have trouble sleeping?	☐	☐	☐
Do you have headaches?	☐	☐	☐

OTHER QUESTIONS

78. Next we ask you to assess your quality of life (how good you consider your life as a whole) during the past month (30 days). Assess your quality of life by circling the number that best describes your quality of life. The number 0 represents the worst possible and 10 the best possible quality of life.

0 1 2 3 4 5 6 7 8 9 10

Worst possible quality of life — Best possible quality of life

79. How satisfied are you with your economic situation?

- ☐ very satisfied
- ☐ satisfied
- ☐ somewhat satisfied
- ☐ unsatisfied
- ☐ very unsatisfied

80. How satisfied are you with your accomplishments in life?

- ☐ very satisfied
- ☐ satisfied
- ☐ somewhat satisfied
- ☐ unsatisfied
- ☐ very unsatisfied

81. How satisfied are you with your family life?

- ☐ very satisfied
- ☐ satisfied
- ☐ somewhat satisfied
- ☐ unsatisfied
- ☐ very unsatisfied
- ☐ I do not have a family

<u>FOR MEN</u>, THE QUESTIONNAIRE ENDS HERE.

THANK YOU FOR YOUR ANSWERS!

PLEASE TAKE THE QUESTIONNAIRE WITH YOU TO THE STUDY SITE.

THE FOLLOWING QUESTIONS ARE FOR WOMEN ONLY

82. Have you used or do you at present use contraceptive pills?

- ☐ yes, I do at present and I have used them for ____ years
- ☐ no, but I have previously used them for ____ years
- ☐ no, I have never used them

83. Have you used or do you at present use a non-hormonal intrauterine device (IUD) for contraception?

- ☐ yes, I do at present and I have used one for ____ years
- ☐ no, but I have previously used one for ____ years
- ☐ no, I have never used one

84. Have you used or do you at present use a hormonal intrauterine device (IUD) for contraception?

- ☐ yes, I do at present and I have used one for ____ years
- ☐ no, but I have previously used one for ____ years
- ☐ no, I have never used one

85. Have you for the last 6 months used hormone replacement therapy in the form of tablets, gel or patches?

- ☐ yes, name of medicine:

  _____

  _____
- ☐ no

86. How long have you used hormone replacement therapy?

for ____ years

87. Do you still menstruate?

- ☐ yes, regularly
- ☐ yes, irregularly
- ☐ no, I last menstruated ____ years ago

88. Are you pregnant at present?

- ☐ no
- ☐ yes

89. Are you breast-feeding at present?

- ☐ no
- ☐ yes

90. Have you given birth to a child / children?

- ☐ no
- ☐ yes, in the following years:

____, ____

____, ____

____, ____

____, ____

____, ____

____, ____

____, ____

____, ____

____

(Continue here when necessary)

91. Have you ever had trouble becoming pregnant and having children?

- ☐ I don't know because I have never tried
- ☐ no
- ☐ yes, the last time was less than 2 years ago
- ☐ yes, the last time was 2-5 year ago
- ☐ yes, the last time was more than 5 years ago

92. Have you undergone a hysterectomy?

- ☐ no
- ☐ yes, removal of womb and ovaries, at the age of ____
- ☐ yes, removal of womb and one ovary at most, at the age of ____

THANK YOU FOR YOUR ANSWERS!

PLEASE TAKE THE QUESTIONNAIRE WITH YOU TO THE EXAMINATION.

TO BE FILLED BY THE NURSE AT THE PHYSICAL EXAMINATION

1. Saapumisaika

pvm ___ / ___ 2012

klo ___ : ___

2. Suostumus

	Kyllä	Ei
Kohta 1	☐	☐
Kohta 2	☐	☐

3. Pituus

___ , ___ cm (1 mm:n tarkkuudella)

4. Paino

___ , ___ kg (100 g:n tarkkuudella)

5. Painoindeksi

___ , ___ kg/m^2

6. Rasvaprosentti

___ , ___ %

7. Rasvaton massa

___ , ___ kg (100 g:n tarkkuudella)

8. Verenpaineen mittaaja

___

9 . Huoneen lämpötila

___ astetta

10. Olkavarren ympärysmitta

___ , ___ cm
(puolen cm:n tarkkuudella)

11. Verenpaine

1 ___ / ___ mmHg

2 ___ / ___ mmHg

3 ___ / ___ mmHg

12. Pulssi

___ / 30 s

13. Vyötärön ympärysmitta

___ , ___ cm
(puolen cm:n tarkkuudella)

14. Lantion ympärysmitta

___ , ___ cm
(puolen cm:n tarkkuudella)

15. Paasto

___ tuntia

16. Jos alle 4 tuntia, niin mitä syönyt?

- ☐ kevyt lounas (keitto/salaatti)
- ☐ tavallinen lounas
- ☐ raskas lounas
- ☐ välipala
- ☐ kahvi

17. Akuutti infektio

- ☐ ei
- ☐ kyllä, hengitystieinfektio
- ☐ kyllä, muu, mikä?

18. Verinäyte otettu

☐ ei
☐ kyllä
☐ kyllä, osittain. Näyte saatu putkista :
1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
6 ☐ 7 ☐ 8 ☐ 9 ☐

____ Näytteenottaja

19. Huomautuksia näytteenotossa

☐ näyte otettiin makuulla
☐ infektioriski
☐ staasi unohtunut avata
☐ näyte otettiin oikeasta käsivarresta
☐ muuta, mitä

20. Näytteenottoaika

pvm ____ / ____ 2012

klo ____ : ____

21. Kuukautiskierron keskimääräinen kesto

____ päivää

22. Jos tutkittavalla on vielä kuukautiset, mikä on viimeisten kuukautisten alkamispäivämäärä

(päivä/kuukausi): ____ / ____

23. Onko tutkittava käyttänyt seuraavia tuotteita viimeisen vuorokauden aikana?

Kyllä	Ei	
☐	☐	Poltettavia tupakkatuotteita (savuke, sikari, piippu, sähkösavuke) kello: ____ : ____
☐	☐	Nuuskaa kello: ____ : ____
☐	☐	Nikotiinikorvaushoitotuotteita (purkka, laastari, tabletti, inhalaattori) kello: ____ : ____

24. Huomautuksia

☐ itse ilmoitettu pituus
☐ itse ilmoitettu paino
☐ epäsäännöllinen epätasainen rytmi (flimmeri)
☐ verenpaine mitattu vasemmasta käsivarresta
☐ diastoliseksi arvoksi merkitty Korotkoffin IV vaihe
☐ kieltäytyi ravintohaastattelusta
☐ bioimpedanssia ei mitattu.
Syy: 1 ☐ 2 ☐ 3 ☐

muuta, mitä:

Lähtöaika klo ____ : ____

Havaintotunnus

____

Tutkittavan nimikirjaimet

____

Lomaketarra

TERVEYDEN JA HYVINVOINNIN LAITOS

Lomaketarra

FINRISKI 2012
NATIONAL HEALTH STUDY

POST-EXAMINATION QUESTIONNAIRE for FINRISK participant

Mail this form to the National Institute for Health and Welfare in the envelope you received at the examination (postage paid).

INSTRUCTIONS FOR RESPONDENT

Answer the questions by marking the appropriate number with an X or by writing out the information in the space provided for it.

Read each question carefully before answering.

EXAMPLE 1. Have you ever had allergic eye symptom?

- ☐ no
- ☒ yes, during the last 12 months
- ☐ yes, the last time was over a year ago

Please answer all questions – a negative answer should also be indicated by marking the "no" alternative or by marking "0" in the space reserved for the answer.

EXAMPLE 2. How many of your household members are

under 7 years 1

7–17 years old 0

(Please mark 0 for none)

Some questions have certain alternatives that end with the instruction "Proceed to question ...", in which case you can proceed directly to the question indicated and leave the questions in between unanswered.

Please follow the instructions closely and avoid any superfluous markings.

Please mark the main date on which you filled this form:

day	month	2012

QUESTIONNAIRE

USE OF HEALTH SERVICES

1. How many times during the past year (last 12 months) have you been to see a doctor *(not a dentist)? (Mark 0 if not at all.)*

___ times

2. How many times during the past year (last 12 months) have you been to see a public health nurse or the nurse has been to see you at home? *(Mark 0 if not at all.)*

___ times

3. How many days have you been in hospital during the last 12 months? *(If not at all, please answer 0.)*

___ days

4. How many full working days were you away from work or did not attend to your usual chores because of illness during the past year (last 12 months)? *(If not at all, answer 0.)*

___ days

5. Do you receive disability pension for a disease or inability?

- ☐ no
- ☐ yes, partial disability pension
- ☐ yes, temporary disability pension
- ☐ yes, permanent disability pension

6. When have you last had a check up or seen a doctor for a medical examination, not for symptoms or illness but for ex. work place check up, driving license check up, or maternity clinic?

- ☐ during the last 6 months
- ☐ 6 months - 1 year ago
- ☐ 1 year - 5 years ago
- ☐ over 5 years ago
- ☐ never

7. Do you have a chronic disease or other long-term health problem (which has lasted or is expected to last 6 months or longer)?

- ☐ no
- ☐ yes

8. How much have health issues restricted your life in the last 6 months?

- ☐ not at all
- ☐ restricted a little
- ☐ restricted significantly

HOME MONITORING OF BLOOD PRESSURE

9. Do you use a blood pressure monitor at home?

- ☐ no (proceed to question 25)
- ☐ yes

10. Do you measure your blood pressure with

- ☐ an upper arm monitor, which make and model?

  _____
- ☐ a wrist monitor, which make and model?

  _____

11. What size upper arm cuff do you use?

- ☐ a small adult cuff (the most common type, width of cuff 12-13 cm)
- ☐ a medium adult cuff (width of cuff 14-16 cm)
- ☐ a large cuff (width of cuff ca. 18 cm)

12. Do you avoid smoking and drinking caffeinated drinks (coffee, tee, cola drinks) during the half an hour before the measurement?

- ☐ no
- ☐ yes

13. Do you mainly monitor your blood pressure when

- ☐ lying down
- ☐ sitting
- ☐ standing

14. Do you monitor your blood pressure

- ☐ only in the mornings (6:00 - 9:00)
- ☐ only in the daytime (9:00 - 18:00)
- ☐ only in the evenings (18:00 - 21:00)
- ☐ in the mornings (6:00 - 9:00) and in the evenings (18:00 - 21:00)
- ☐ in the mornings (6:00 - 9:00) and in the daytime (9:00 - 18:00)
- ☐ in the daytime (9:00 - 18:00) and in the evenings (18:00 - 21:00)
- ☐ usually at some other time, when? _____

15. At the place of monitoring, before the first measurement

- ☐ I put the cuff around my upper arm and take measurements immediately
- ☐ I sit for less than 5 minutes but more than 2 minutes with the cuff around my upper arm
- ☐ I sit for at least 5 minutes with the cuff around my upper arm

16. How many measurements do you take in one monitoring session?

- ☐ one
- ☐ two
- ☐ three or more

17. Do you write down

- ☐ all results
- ☐ only the lowest result
- ☐ only the last result
- ☐ I usually don't write down the measurements
- ☐ other, what? _____

18. Do you perform measurements

- ☐ irregularly, ____ times a year
- ☐ regularly in monitoring sequences of several days (which of the below):
  - ☐ monitoring sequence of 2-3 days
  - ☐ monitoring sequence of 4-7 days
  - ☐ monitoring sequence of 8 or more days

19. How many times a year do you perform the aforementioned regular sequence of blood pressure measurements?

- ☐ once
- ☐ 2-3 times
- ☐ 4-5 times
- ☐ 6-7 times
- ☐ 8 or more times

20. Do you calculate the averages of the regularly performed sequences of measurements or does someone calculate them for you?

- ☐ no
- ☐ yes, I do
- ☐ yes, a family member or acquaintance
- ☐ yes, a health care professional

21. Do you make use of the blood pressure measurements you take at home? *You can choose several alternatives.*

- ☐ no, I do not
- ☐ yes, to evaluate the influence of my lifestyle on blood pressure
- ☐ yes, to evaluate the influence of my medication on blood pressure
- ☐ for some other purpose, specify: _____

22. Does a doctor or nurse write down your blood pressure home monitoring measurements in your health records (the health-care databases)?

- ☐ no
- ☐ yes
- ☐ I don't know

23. Does your doctor use your blood pressure home monitoring measurements to evaluate your need for blood pressure treatment (medication and the need for its change)?

- ☐ no
- ☐ yes
- ☐ I don't know

24. What would you consider your ideal blood pressure level in home monitoring?

- ☐ less than 120/80 mmHg
- ☐ less than 130/85 mmHg, but more than 120/80 mmHg
- ☐ less than 140/90 mmHg, but more than 130/85 mmHg
- ☐ less than 150/95 mmHg, but more than 140/90 mmHg
- ☐ less than 160/100 mmHg, but more than 150/95 mmHg
- ☐ more than 160/100 mmHg

WEIGHT

25. Have you ever seriously tried to lose weight? If so, how many times?

- ☐ I have never tried to lose weight (proceed to question 29)
- ☐ 1-2 times
- ☐ 3-5 times
- ☐ 6 times or more

26. What has been your best result when trying to lose weight?

- ☐ less than 2 kg
- ☐ 2-5 kg
- ☐ 6-10 kg
- ☐ more than 10 kg

27. How many times in the last 10 years have you intentionally lost at least 5 kg of weight?

- ☐ never (proceed to question 29)
- ☐ ____ times

28. How many of these times have you ended up regaining all the lost weight?

- ☐ never
- ☐ ____ times

29. Are you trying to lose weight at present?

- ☐ yes
- ☐ no (proceed to question 31)

30. Which methods are you currently using to lose weight? *Choose one or more alternatives.*

- ☐ diet
- ☐ exercise
- ☐ prescription weight loss medication
- ☐ other diet products (health foods etc.)
- ☐ other methods (acupuncture etc.)

QUESTIONS CONCERNING HEALTH STATUS, ACCIDENTS AND WORKING ABILITY

31. Have you during the last month (past 30 days) had the following symptoms or illnesses?

	no	yes
Joint ache	☐	☐
Back ache	☐	☐
Swelling of the legs	☐	☐
Varicose veins	☐	☐
Constipation	☐	☐
Urinary incontinence	☐	☐
Continuous stomach aches	☐	☐
Nausea	☐	☐
Trouble to walk or limping because of trouble or handicap in a knee	☐	☐

32. Has your risk of diabetes been assessed during the past year (12 months) with e.g. a diabetes risk test or a blood glucose measurement?

- ☐ no
- ☐ yes

33. Has your risk of heart disease been assessed during the past year (12 months) with e.g. the FINRISK calculator or risk score questionnaire?

- ☐ no
- ☐ yes

34. Has a doctor treated you for any of the following accidents during the past year (last 12 months)?

	no	yes
Traffic accident involving a motorised vehicle	☐	☐
Other traffic accident *(e.g. on a bicycle)*	☐	☐
Accident at work or elsewhere indoors	☐	☐
Accident outdoors *(not on the way to or from work)*	☐	☐
Accident on the way to or from work *(if not traffic accident)*	☐	☐
Accident at home indoors	☐	☐
Accident at home in the yard	☐	☐
Sporting accident indoors *(fitness training or competitive sports)*	☐	☐
Sporting accident outdoors *(fitness training or competitive sports)*	☐	☐
Other leisure-time accident indoors	☐	☐
Other leisure-time accident outdoors	☐	☐

35. For how many whole days did you find it difficult or impossible to get through usual daily chores and actions because of the injuries caused by the accident?
(If none, answer 0.)

☐☐☐ days

36. Whether you are currently employed or not, assess your working ability at present. Are you

- ☐ fully able to work
- ☐ partly able to work
- ☐ fully unable to work

37. Assume that your working ability at its best has achieved 10 points. How many points would you give to your current working ability? (0 = fully unable to work, 10 = working ability at its best)

☐☐ points

38. Workload and influencing possibilities
How well do the following propositions describe your current work? If you are not working, assess your last job. Do you agree or disagree with the proposition?
Mark the alternative that best reflects your opinion for each proposition.

	completely agree	somewhat agree	neither agree nor disagree	somewhat disagree	completely disagree
I can make many independent decisions in my job	☐	☐	☐	☐	☐
I have a lot of say in how I can do my job	☐	☐	☐	☐	☐
I have very little freedom to decide how I do my job	☐	☐	☐	☐	☐
My job requires working very hard	☐	☐	☐	☐	☐
I'm expected to do an unreasonable amount of work	☐	☐	☐	☐	☐
I don't have enough time to get my work done	☐	☐	☐	☐	☐

ILLNESSES IN IMMEDIATE FAMILY

39. Has your father been diagnosed for

	no	yes	I don't know
Myocardial infarction when he was under 60 years	☐	☐	☐
Myocardial infarction when he was over 60 years	☐	☐	☐
Stroke when he was under 75 years	☐	☐	☐
Diabetes	☐	☐	☐
Heightened blood pressure, arterial hypertension	☐	☐	☐
Asthma	☐	☐	☐
Cancer	☐	☐	☐
Depression	☐	☐	☐

40. Has your mother been diagnosed for	no	yes	I don't know
Myocardial infarction when she was under 65 years	☐	☐	☐
Myocardial infarction when she was over 65 years	☐	☐	☐
Stroke when she was under 75 years	☐	☐	☐
Diabetes	☐	☐	☐
Heightened blood pressure, arterial hypertension	☐	☐	☐
Asthma	☐	☐	☐
Cancer	☐	☐	☐
Depression	☐	☐	☐

41. How many brothers or step-brothers do you have or have you had?
(If none, mark 0 and proceed to question 43.)

☐☐

42. Has at least one of your brothers or step-brothers been diagnosed for	no	yes	I don't know
Myocardial infarction when he was under 60 years	☐	☐	☐
Myocardial infarction when he was over 60 years	☐	☐	☐
Stroke when he was under 75 years	☐	☐	☐
Diabetes	☐	☐	☐
Heightened blood pressure, arterial hypertension	☐	☐	☐
Asthma	☐	☐	☐
Cancer	☐	☐	☐
Depression	☐	☐	☐

43. How many sisters or step-sisters do you have or have you had?
(If none, mark 0 and proceed to question 45.)

☐☐

44. Has at least one of your sisters or step-sisters been diagnosed for	no	yes	I don't know
Myocardial infarction when she was under 65 years	☐	☐	☐
Myocardial infarction when she was over 65 years	☐	☐	☐
Stroke when she was under 75 years	☐	☐	☐
Diabetes	☐	☐	☐
Heightened blood pressure, arterial hypertension	☐	☐	☐
Asthma	☐	☐	☐
Cancer	☐	☐	☐
Depression	☐	☐	☐

PHYSICAL ACTIVITY

45. How often do you in your leisure time exercise for at least 20 minutes so that you at least are mildly out of breath and sweaty *(the exercise of travelling to and from work not included)?*

- ☐ I have a disability or a disease which does not enable me to exercise
- ☐ less than once a week
- ☐ once a week
- ☐ 2 times a week
- ☐ 3 times a week
- ☐ 4 times a week
- ☐ 5 times a week or more often

46. How long does your usual leisure time activity take at a time?

- ☐ I do not exercise in my free time
- ☐ less than 15 minutes
- ☐ 15 - 29 minutes
- ☐ 30 - 59 minutes
- ☐ one hour or longer

47. How do you consider your current physical condition?

- ☐ very good
- ☐ quite good
- ☐ fair
- ☐ quite bad
- ☐ very bad

48. How much physical activity do you get weekly at work, on the way to or from work or in your spare time in total?

Think of the past year (12 months). Take into account regular weekly physical activity that lasts at least 10 minutes at a time.

Mark all the alternatives in sections 2-6 that describe your situation and mark in the blanks how much of the activity you perform (days per week, hours and minutes per week in total).

If you hardly ever perform regular weekly physical activity, choose alternative number 1 and leave the other sections unmarked.

- ☐ 1. almost no regular weekly physical activity
- ☐ 2. slow and leisurely endurance activity (=no sweating or faster breathing, e.g. leisurely walking)
  on ___ days per week, total ___ hours ___ minutes per week
- ☐ 3. rapid and brisk endurance activity (=some sweating and/or faster breathing, e.g. brisk walking)
  on ___ days per week, total ___ hours ___ minutes per week
- ☐ 4. strength-based and strenuous endurance activity (=much sweating and/or faster breathing, e.g. jogging or running)
  on ___ days per week, total ___ hours ___ minutes per week
- ☐ 5. muscle training (=e.g. circuit training or gym training which involves repeating exercises that affect different muscle groups at least 8-12 times)
  on ___ days per week, total ___ hours ___ minutes per week
- ☐ 6. balance training (=e.g. tai chi, dancing, sports games, balance exercises e.g. on one foot, on an uneven platform or on all fours)
  on ___ days per week, total ___ hours ___ minutes per week

SMOKING

49. In recent years, more and more restrictions have been placed on smoking in Finland. The following contains propositions regarding smoking and its restrictions. *Please mark on each line the alternative that best reflects your views.*

	completely disagree	somewhat disagree	neither agree nor disagree	somewhat agree	completely agree
Smoking is accepted in society	☐	☐	☐	☐	☐
Workplaces are successfully smoke-free in Finland	☐	☐	☐	☐	☐
Smokers take non-smokers into account when smoking	☐	☐	☐	☐	☐
It is difficult for minors to get tobacco products	☐	☐	☐	☐	☐
Smoking restrictions are enforced sufficiently	☐	☐	☐	☐	☐
Youth smoking must be restricted	☐	☐	☐	☐	☐
Tobacco must be sold in fewer places	☐	☐	☐	☐	☐
Health care personnel must be allowed to smoke during working hours	☐	☐	☐	☐	☐
Teachers must be allowed to smoke during working hours	☐	☐	☐	☐	☐
Smoking should not be allowed in any profession during working hours	☐	☐	☐	☐	☐
I like smoking	☐	☐	☐	☐	☐
I like the smell of tobacco	☐	☐	☐	☐	☐
Smoking on balconies should be forbidden by law	☐	☐	☐	☐	☐
All smoking is not harmful	☐	☐	☐	☐	☐
A non-smoker may get sick as a result of inhaling tobacco smoke	☐	☐	☐	☐	☐
The warning texts on cigarette packs are useful	☐	☐	☐	☐	☐
Nicotine replacement therapy products are easy to get	☐	☐	☐	☐	☐
Nicotine replacement products are too expensive	☐	☐	☐	☐	☐
Society should support people who quit smoking after getting sick from smoking	☐	☐	☐	☐	☐
Society should support everyone who quits smoking	☐	☐	☐	☐	☐
Smoking is a conscious choice, it is useless to blame the tobacco industry	☐	☐	☐	☐	☐
Smuggled tobacco is available around me	☐	☐	☐	☐	☐
A person who quits smoking needs the support of health care professionals	☐	☐	☐	☐	☐
The main obstacle to quitting is insufficient information about the hazards of smoking	☐	☐	☐	☐	☐
The main obstacle to quitting is the unwillingness to quit	☐	☐	☐	☐	☐

The following questions concern people who smoke or have smoked in the past. If you have never smoked, proceed to question 60.

50. What do you think of your present smoking? Do you think you smoke

- ☐ far too much
- ☐ a bit too much
- ☐ moderately
- ☐ I don’t smoke nowadays

51. Would you like to quit smoking?

- ☐ no
- ☐ yes
- ☐ I can't say
- ☐ I don’t smoke nowadays

Next, tell us about your smoking habits. Even if you have quit, recall what your smoking was like before you quit.

52. Is it difficult for you to refrain from smoking in places where smoking is banned?

- ☐ yes
- ☐ no

53. Which cigarette is the most difficult for you to give up?

- ☐ the first of the morning
- ☐ some other cigarette

54. Do you usually have a habit of smoking or using snuff more frequently in the first hours after waking than at other times of day?

- ☐ yes
- ☐ no

55. Do you smoke if you are so ill that you have to stay in bed for much of the day?

- ☐ yes
- ☐ no
- ☐ I can't say

56. What is the largest number of cigarettes you have ever smoked in a period of 24 hours?

____ cigarettes

57. Do you currently use electronic cigarettes?

- ☐ daily
- ☐ sometimes
- ☐ never

58. What is or was the significance of the following weight management issues for your smoking?
If you no longer smoke, answer according to the time when you last smoked.

	not at all or very little	a little	moderately	quite much	very much
How important is losing weight or maintaining your current weight for you compared to other health-related issues?	☐	☐	☐	☐	☐
How important is smoking for your weight management?	☐	☐	☐	☐	☐
How much does smoking help you in your weight management?	☐	☐	☐	☐	☐
If you were to quit smoking, how worried would you be about gaining weight afterwards?	☐	☐	☐	☐	☐
If you were to quit smoking, how likely would it be that you would gain weight?	☐	☐	☐	☐	☐
How important for your weight management is substituting meals with smoking or snuff?	☐	☐	☐	☐	☐

59. If you have quit smoking, did you gain weight after quitting?

- ☐ no
- ☐ yes. How much: ____ kg

NUTRITION

60. Which of the following describe your food choices? For each proposition, mark the alternative that best reflects your views.

It is important for me...	not important at all	not very important	all the same	important	very important
that my food can be prepared quickly	☐	☐	☐	☐	☐
that my food is local	☐	☐	☐	☐	☐
that my food is organic	☐	☐	☐	☐	☐
that my food is affordable	☐	☐	☐	☐	☐
that my food tastes good	☐	☐	☐	☐	☐
that my diet contains much meat, chicken or sausage	☐	☐	☐	☐	☐
to avoid bread, potatoes or pasta	☐	☐	☐	☐	☐
that my diet includes fish	☐	☐	☐	☐	☐
that my food does not contain many additives	☐	☐	☐	☐	☐
to eat in moderation	☐	☐	☐	☐	☐
to choose low-fat foods	☐	☐	☐	☐	☐
to favor high-fiber foods	☐	☐	☐	☐	☐
to avoid very salty foods	☐	☐	☐	☐	☐
to follow a low-carbohydrate diet	☐	☐	☐	☐	☐
to favor vegetable oil or vegetable oil spreads	☐	☐	☐	☐	☐
to eat many vegetables, fruits or berries	☐	☐	☐	☐	☐
to console myself with food (when sad or stressed)	☐	☐	☐	☐	☐
to choose food that helps me stay healthy	☐	☐	☐	☐	☐
to choose food that is good for the skin, nails or hair	☐	☐	☐	☐	☐
to chew my food well or to eat slowly	☐	☐	☐	☐	☐
that the food is similar to what I usually eat	☐	☐	☐	☐	☐
that the meal is colorful	☐	☐	☐	☐	☐

61. How often do you add salt to your food at the table?

- ☐ never
- ☐ usually when the food does not taste salty enough
- ☐ almost always

62. What kind of salt do you mostly use at home?

- ☐ ordinary iodized table salt (e.g. Jozo)
- ☐ non-iodized sea salt, rose salt, fleur de sel
- ☐ low-sodium salt (e.g. Pansuola, Seltin)
- ☐ aromatic salt, herbal salt (e.g. Herbamare)
- ☐ we do not use salt at home

63. When you eat outside the home, how salty is the food compared to home-made food?

- ☐ more salty
- ☐ as salty
- ☐ less salty

64. Do you consider ready meals (microwave meals, frozen food) more or less salty than home-made food?

- ☐ more salty
- ☐ as salty
- ☐ less salty

CONSUMPTION OF ALCOHOL

65. How often did you drink the following amounts daily during the last 12 months?

Instruction: Start answering from the first row.

Mark the most suitable 'How often?' alternative. Then continue row at a time down in the same manner.

Please mark only one alternative per row.

1 dose = bottle / can (1/3 liter) beer (class III)
or a glass (12 cl) of light wine
or a glass (8 cl) of strong wine
or a glass (4 cl) of spirits or other strong liquor

Bottle / can (0.33 liter) beer (class IV), Gin Long Drink or strong cider = 1.25 doses
Large bottle / can (0.5 liter) beer (class III) or medium-strong cider = 1.5 doses
Large bottle / can (0.5 liter) beer (class IV) = 2 doses
Bottle (0.75 liter) wine = 7 doses
Bottle (0.75 liter) strong wine = 10 doses
Bottle (0.5 liter) strong alcohol (e.g. Koskenkorva) = 12 doses

Daily doses	At least 4 times a week	2-3 times a week	About once a week	1-2 times a month	3-10 times a year	1-2 times a year	Never
18 or more	☐	☐	☐	☐	☐	☐	☐
13-17	☐	☐	☐	☐	☐	☐	☐
8-12	☐	☐	☐	☐	☐	☐	☐
5-7	☐	☐	☐	☐	☐	☐	☐
3-4	☐	☐	☐	☐	☐	☐	☐
1-2	☐	☐	☐	☐	☐	☐	☐

66. How often have you during the last 12 months had so much beer, wine or spirits that you have felt intoxicated?

- ☐ a few times a week or more often
- ☐ about once a week
- ☐ a few times a month
- ☐ about once a month
- ☐ about once in two months
- ☐ 4 - 5 times a year
- ☐ 2 - 3 times a year
- ☐ once a year
- ☐ not even once

LIFESTYLE CHANGE RECOMMENDATIONS

67. Has any of the following people recommended you for health reasons in the past year (12 months) to:
You may choose several alternatives on each row.

	no one	doctor or dentist	nurse	family member	someone else
exercise more	☐	☐	☐	☐	☐
change your eating habits	☐	☐	☐	☐	☐
lose weight	☐	☐	☐	☐	☐
reduce consumption of alcohol	☐	☐	☐	☐	☐
quit smoking	☐	☐	☐	☐	☐

SLEEP

68. Assuming your surroundings are comfortable, how easy is it for you to get up in the morning?

- ☐ not easy at all
- ☐ not very easy
- ☐ quite easy
- ☐ very easy

69. How tired do you feel in the morning during the first half hour?

- ☐ very tired
- ☐ quite tired
- ☐ quite rested
- ☐ very rested

70. Let's assume that you have decided to start a new sport. Your friend recommends you a programme involving practice twice a week an hour at a time. The best time for your friend is in the morning at 7:00-8:00. Considering only the daily rhythm that feels right for you, how do you think you would perform?

- ☐ I would be in good condition
- ☐ I would be in moderate condition
- ☐ it would feel quite difficult
- ☐ it would feel very difficult

71. Let's assume that you have to perform two hours of demanding physical work. You can plan your schedule as you wish. Considering only the daily rhythm that feels right for you, which of the following alternatives would you choose?

- ☐ 8:00-10:00
- ☐ 11:00-13:00
- ☐ 15:00-17:00
- ☐ 19:00-21:00

72. Let's assume that you could choose your working hours. Assume that your workday lasts five hours, the work is interesting and you get paid according to your results. Which five CONSECUTIVE hours would you choose? *Mark five hours of your choice:*

☐ *1-2*	☐ *2-3*	☐ *3-4*	☐ *4-5*	☐ *5-6*	☐ *6-7*	☐ *7-8*	☐ *8-9*
☐ *9-10*	☐ *10-11*	☐ *11-12*	☐ *12-13*	☐ *13-14*	☐ *14-15*	☐ *15-16*	☐ *16-17*
☐ *17-18*	☐ *18-19*	☐ *19-20*	☐ *20-21*	☐ *21-22*	☐ *22-23*	☐ *23-24*	☐ *24-01*

OTHER QUESTIONS

73. How much do the following things change for you according to different seasons?

	no change	changes somewhat	changes clearly	changes significantly
Duration of sleep	☐	☐	☐	☐
Social activity	☐	☐	☐	☐
Mood (general feeling of well-being)	☐	☐	☐	☐
Weight	☐	☐	☐	☐
Appetite	☐	☐	☐	☐
Energy to do things	☐	☐	☐	☐

74. If you have such seasonal variations, are they a problem for you?

- ☐ not a problem
- ☐ a slight problem
- ☐ a moderate problem
- ☐ a significant problem
- ☐ a serious problem

MOOD

75. The following contains a group of sequences of five propositions. Read each sequence of propositions carefully through and mark in each sequence the one proposition that best describes your current situation.

- ☐ I do not feel low-spirited or sad
- ☐ I feel low-spirited and sad
- ☐ I feel low-spirited and I cannot get rid of the feeling
- ☐ I feel so sad or unhappy that it hurts
- ☐ I feel so sad or unhappy that I can't bear it anymore

- ☐ I do not have an especially hopeless view of my future
- ☐ My future feels hopeless to me
- ☐ I feel that I have nothing to expect from the future
- ☐ I feel that I can never get rid of my worries
- ☐ My future feels hopeless to me, and I can't believe that things could change for the better

- ☐ I do not feel that I have failed in life
- ☐ I feel that I have failed more often than other people
- ☐ I feel that I have not achieved much that is worth mentioning
- ☐ My life so far has been just a series of failures
- ☐ I feel that I have completely failed as a person

- ☐ I do not feel particularly unsatisfied
- ☐ I feel bored most of the time
- ☐ I no longer enjoy things the way I used to
- ☐ I can't get satisfaction from anything anymore
- ☐ I am unsatisfied with everything

- ☐ I do not feel that I am worse than other people
- ☐ I criticize myself for my weaknesses and mistakes
- ☐ I scold myself for everything that goes wrong
- ☐ I think I have too many bad qualities
- ☐ I consider myself completely useless

- ☐ I am not disappointed in myself
- ☐ I am disappointed in myself
- ☐ I do not like myself
- ☐ I detest myself
- ☐ I hate myself

- ☐ I have never thought to hurt myself
- ☐ I sometimes think about hurting myself, but I am nonetheless not going to do it
- ☐ I feel it would be better if I was dead
- ☐ I feel it would be better for my family if I was dead
- ☐ I would like to be dead

- ☐ I have not lost my interest in other people
- ☐ I am less interested in other people than before
- ☐ I have lost my interest towards and feelings for other people almost completely
- ☐ I have lost all my interest towards other people, and I no longer care about them at all

- ☐ I make decisions as easily as before
- ☐ I am less certain and try to delay making decisions
- ☐ I have difficulties in making decisions
- ☐ I can no longer make decisions at all

- ☐ I feel that I do not look any worse than before
- ☐ I am worried that I look old or that I do not look pleasant
- ☐ I feel that my appearance has permanently changed so that I do not look pleasant
- ☐ I feel that I look ugly and repulsive

- ☐ I can work as well as before
- ☐ Whatever work I start requires extra effort from me
- ☐ I no longer work as well as before
- ☐ To do anything I must really force myself to do it
- ☐ I can no longer work at all

- ☐ I do not tire more than usually
- ☐ I tire more easily than before
- ☐ Anything can tire me
- ☐ I am too tired to do anything

- ☐ My appetite is no worse than before
- ☐ My appetite is worse than before
- ☐ My appetite is currently much worse than before
- ☐ I have no appetite at all anymore

BACKGROUND INFORMATION

76. Have you ever been employed?

- ☐ no
- ☐ yes

77. What is your profession?
(If you are at present pensioned or unemployed, write down the profession you last had.)

78. What is your present state of employment?

- ☐ permanent full-time employment
- ☐ permanent part-time employment
- ☐ temporary full-time employment
- ☐ temporary part-time employment
- ☐ independent contractor / entrepreneur
- ☐ full-time student
- ☐ I have been unemployed less than 6 months
- ☐ I have been unemployed 6 months - 1 year
- ☐ I have been unemployed over a year
- ☐ I am laid off or work shortened hours
- ☐ I am on maternity / paternity leave or on children's home care leave
- ☐ I'm pensioned
- ☐ on employment support: in training or employed
- ☐ out of work for other reason

79. What is your spouse's education? How many years has your spouse attended school and studied full time, basic levels included?

- ☐ ____ years
- ☐ I do not have a spouse

80. Where and how were you born?

- ☐ vaginal birth in a hospital or a maternity hospital
- ☐ vaginal birth at home or elsewhere outside the hospital
- ☐ born by Caesarean section in a hospital
- ☐ I cannot say

81. What was your home municipality at birth *(or province, if you do not know the municipality)? (If you were born abroad, write the country.)*

82. What was your mother's home municipality at birth *(or province, if you do not know the municipality)?*

83. What was your father's home municipality at birth *(or province, if you do not know the municipality)?*

THANK YOU FOR YOUR ANSWERS!

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