Tampere University

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Pessimism as a Risk Factor for Coronary Heart Disease

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ACADEMIC DISSERTATION
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ACADEMIC DISSERTATION
Tampere University, Faculty of Medicine and Health Technology
Päijät-Häme Central Hospital, Department of Psychiatry
Finland

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PunaMusta Oy – Yliopistopaino
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To my family

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Mikko Pänkäläinen

ABSTRACT

Coronary heart disease (CHD) is one of the leading causes of death in the Western countries. Although extensive research has been conducted into CHD and a lot is known about the aetiology, pathogenesis and the treatment of the disease, nonetheless the incidence and prevalence of the disease remain remarkable.

Most of the research on CHD has concentrated rather naturally on the physiological factors, e.g. somatic risk factors. However, it is evident that there are also non-somatic factors affecting CHD, and their significance and mechanisms are largely unknown.

The purpose of the present study was to determine whether the stable personality traits of optimism and pessimism can influence CHD and to identify how this possible effect could be mediated.

This work comprised four studies. The study population for every study consisted of a regional sample of three cohorts aged 52–56, 62–66, and 72–76 years at baseline (N=2,815). At baseline, the properties of the optimism construct were recorded using the Life Orientation Test – Revised (LOT-R). The study subjects also filled in questionnaires concerning e.g. their health status and lifestyle. Variables connected with CHD were determined, including body mass index and the levels of blood pressure, blood glucose and blood cholesterol.

In substudy I, the connection between optimism and pessimism and the incidence of CHD during a ten-year follow-up was investigated. The connection between the optimism construct and CHD mortality was investigated in substudy II, and the level of inflammation as a mediator between the optimism construct and the incidence of CHD was evaluated in substudy III. Substudy IV assessed the effect of optimism and pessimism on dietary habits and on the ability to enhance these behaviors.

The results of LOT-R suggested that optimism and pessimism are independent variables, i.e. it seems that people can have simultaneously both optimistic and pessimistic properties and that these properties do not correlate with each other. According to this finding optimism and pessimism were handled as independent variables in every substudy.

Studies I and II revealed that pessimism is a clear risk factor for both CHD incidence and CHD mortality. In men, the most pessimistic fourth of the study population had an independent four-fold risk of developing CHD when compared to the least pessimistic fourth. When investigating the whole population, the most pessimistic fourth had a doubled risk of dying from CHD during the eleven years' follow-up when all known risk factors for CHD were taken into account. In study III, an elevated level of inflammation seemed to mediate a major proportion, approximately one third, of the elevated risk of incidence of CHD attributable to pessimism. Study IV revealed that pessimism is connected with dietary habits which are risk factors for CHD, and pessimism also makes it harder to improve those habits.

The findings demonstrate that optimism is practically not connected at all with the abovementioned variables, i.e. pessimism is the only variable in the optimism/pessimism construct to have any effect on CHD.

This connection between pessimism and CHD may open new perspectives in preventing CHD. Determining the level of pessimism could help in targeting preventive actions against CHD more precisely. Investigating the mechanisms of this connection may also help in clarifying the etiology and mechanism of CHD itself, and thus in identifying new ways of treating CHD.

TIIVISTELMÄ

Sepelvaltimotauti on länsimaiden yleisimpiä kuolinsyitä. Vaikka sepelvaltimotautia on tutkittu runsaasti ja sen etiologiasta, patogeneesistä ja hoidosta tiedetään jo paljon, sen ilmaantuvuus ja esiintyvyys ovat edelleen huomattavan suuria.

Sepelvaltimotautiin kohdistuva tutkimus keskittyy fysikaalisiin tekijöihin ja muuttujiin, esimerkiksi sairauden somaattisiin riskitekijöihin. On kuitenkin ilmeistä, että somaattisten muuttujien lisäksi sekä taudin syntyyn että sen kulkuun vaikuttaa myös muita tekijöitä. Näiden ei-somaattisten tekijöiden merkitys ja mekanismit ovat pitkälti tunnistamattomia.

Tämän tutkimuksen tarkoitus oli selvittää, voivatko vakaat persoonallisuuden piirteet, optimismi ja pessimismi, vaikuttaa sepelvaltimotautiin, ja miten tuo mahdollinen yhteys välittyy.

Tutkimus koostui neljästä osatyöstä. Kaikkien osatöiden tutkimusväestönä oli päijäthämäläinen väestökohortti, joka muodostui kolmesta ikäluokasta (tutkimuksen alkaessa iältään 52–56, 62–66, ja 72–76 vuotta (N=2 815)). Tutkimushenkilöiden optimismirakenteen ominaisuudet määritettiin käyttämällä Life Orientation Test – Revised (LOT-R) -kyselyä. Tutkimushenkilöt täyttivät myös useita muita kyselyitä, jotka koskivat mm. elintapoja ja terveydentilaa. Heiltä määritettiin myös muita sepelvaltimotautiin liittyviä muuttujia, mm. painoindeksi, verenpainetaso sekä verensokeri- ja -kolesterolitasot.

Ensimmäisessä osatyössä tutkittiin, onko tutkimushenkilöiden optimismilla ja pessimismillä yhteyttä sepelvaltimotaudin ilmaantuvuuteen kymmenen vuoden seuranta-aikana. Toisessa osatyössä tutkittiin optimismirakenteen yhteyttä sepelvaltimotautikuolleisuuteen ja kolmannen osatyön tavoitteena oli selvittää, toimiiko elimistön inflammaatiotaso välittäjänä optimismirakenteen ja sepelvaltimotaudin välisessä yhteydessä. Neljännessä osatyössä selvitettiin optimismin ja pessimismin vaikutusta sepelvaltimotautiriskiin vaikuttaviin ruokailutapoihin ja kykyyn parantaa niitä.

LOT-R -kyselyn perusteella optimismi ja pessimismi vaikuttavat itsenäisiltä ominaisuuksilta eli ne esiintyvät yhtäaikaisesti toisistaan riippumattomina. Tämän vuoksi optimismia ja pessimismiä käsiteltiinkin tutkimuksen kaikissa osatöissä erillisinä muuttujina.

Ensimmäisen ja toisen osatyön tulosten mukaan pessimismi on selkeä riskitekijä sekä sepelvaltimotaudin ilmaantuvuudelle että sen aiheuttamalle kuolleisuudelle. Tutkimusväestön miesten keskuudessa pessimistisimmällä neljänneksellä oli kymmenen vuoden seuranta-aikana noin nelinkertainen riski sairastua sepelvaltimotautiin verrattuna vähiten pessimistisiä ominaisuuksia omaavaan neljännekseen. Kun tutkittiin koko tutkimusväestöä, pessimistisimmällä neljänneksellä oli muiden sepelvaltimotaudin riskitekijöiden vaikutus huomioiden noin kaksinkertainen riski kuolla sepelvaltimotautiin 11 vuoden seurannan aikana verrattuna neljännekseen, jolla oli vähiten pessimistisiä piirteitä. Kolmannen osatyön tulosten mukaan pessimismin aiheuttamasta lisääntyneestä sepelvaltimotautiriskistä välittyy merkittävä osa, noin kolmannes, elimistön kohonneen inflammaatiotason kautta. Neljäs osatyö osoitti, että pessimismi on yhteydessä ruokailutottumuksiin, jotka ovat puolestaan oma erillinen riskitekijänsä sepelvaltimotaudille. Lisääntynyt pessimismi näyttää liittyvän myös heikentyneeseen kykyyn muuttaa dieettiä terveellisemmäksi.

Löydösten mukaan optimismi ei ole juurikaan yhteydessä edellä mainittuihin muuttujiin. Optimismi/pessimismi -rakenteesta vain pessimismillä on vaikutusta sepelvaltimotautiin.

Pessimismin ja sepelvaltimotaudin yhteys saattaa avata uusia näkökulmia sepelvaltimotaudin ehkäisyssä. Pessimismin määrittämisen avulla sepelvaltimotautia ehkäiseviä toimia voidaan kohdentaa aiempaa paremmin. Pessimismin ja sepelvaltimotaudin yhteyden mekanismien tutkiminen voi olla avuksi myös itse sepelvaltimotaudin syiden ja mekanismien selvittämisessä ja siten myös sepelvaltimotaudin uusien hoitokeinojen löytämisessä.

CONTENTS

ABBREVIATIONS

ACTH	Adrenocorticotropic hormone
AHA	American Heart Association
AHD	Atherosclerotic heart disease
APA	American Psychiatric Association
ASQ	Attributional Style Questionnaire
AUDIT	Alcohol Use Disorders Identification Test
AUDIT-C	Alcohol Use Disorders Identification Test – Consumption
BMI	Body mass index
BP	Blood pressure
CABS	Coronary artery bypass surgery
CAD	Coronary artery disease
CAVE	Content Analysis of Verbatim Explanations
CBT	Cognitive-behavioral therapy
CHD	Coronary heart disease
CI	Confidence interval
CRP	C-reactive protein
CVD	Cardiovascular disease
ELOT	Extended Life Orientation Test
EtOH	Ethanol
FFQ	Food Frequency Questionnaire
GOAL	Good Aging in Lahti Region
HDL	High-density lipoprotein
hs-CRP	High-sensitivity C-reactive protein
IHD	Ischemic heart disease
IL-6	Interleukin-6
LDL	Low-density lipoprotein
LOT	Life Orientation Test
LOT-R	Life Orientation Test – Revised
MCC	Morbus cordis coronarius
mRNA	messenger ribonucleic acid

NT-proBNP	N-terminal pro B-type natriuretic peptide
OR	Odds ratio
PCA	Principal component analysis
PTCA	Percutaneous transluminal coronary angioplasty
RLHT	Reformulated learned helplessness theory
SD	Standard deviation
TABP	Type A behaviour pattern
TnI	Troponin I
WHO	World Health Organization
WMA	World Medical Association

ORIGINAL PUBLICATIONS

Publication I Pänkäläinen M, Kerola T, Hintikka J: Pessimism and the risk for coronary heart disease among middle-aged and older Finnish men and women: a ten-year follow-up study. BMC Cardiovascular Disorders (2015) 15:113. doi:10.1186/s12872-015-0097-y

Publication II Pänkäläinen M, Kerola T, Kampman O, Kauppi M, Hintikka J: Pessimism and risk of death from coronary heart disease among middle-aged and older Finns: an eleven-year follow-up study. BMC Public Health (2016) 16:1124. doi:10.1186/s12889-016-3764-8

Publication III Pänkäläinen M, Kerola T, Kampman O, Kauppi M, Sarkkinen H, Lappalainen E, Hintikka J: Does inflammation mediate the effect of pessimism on coronary heart disease? A ten-year follow-up study. Submitted.

Publication IV Pänkäläinen M, Fogelholm M, Valve R, Kampman O, Kauppi M, Lappalainen E, Hintikka J: Pessimism, diet, and the ability to improve dietary habits: a three-year follow-up study among middle-aged and older Finnish men and women. Nutrition Journal (2018) 17:92. doi:10.1186/s12937-018-0400-8

1 INTRODUCTION

Despite the growth in knowledge about risk factors for coronary heart disease (CHD), and the advances made in preventing and treating them, the incidence and prevalence of CHD are still unfortunately high. For example, in the United States, the lifetime risk for some manifestation of CHD is that it will affect approximately every second man and every third woman at the age of 40 years (Lloyd-Jones et al. 1999). Furthermore, CHD is responsible for about one in every five deaths in Europe. (Townsend et al., 2015). In Finland, CHD was the primary cause of death in 10 183 occasions in Finland in 2016 (18.9% of all deaths) (Statistics Finland, 2017).

Optimism and pessimism characterize a person's attitude towards the future, and they are nowadays viewed as stable features, which develop by early adulthood similar to other personal traits. Optimism and pessimism are variables with clear individual differences, but they have a high consistency and thus they are a good target for scientific research (Scheier & Carver, 1985).

The research on CHD has tended to concentrate on the physiological factors, but there is an increasing amount of evidence for a link between mental health, personal traits and CHD. Nonetheless, data on the connection between disposition (optimism or pessimism) and CHD are relatively scarce.

The aim of this study was to explore optimistic and pessimistic properties and their connection with the incidence of CHD and CHD induced deaths in an older regional cohort population. The focus was also on the linkage between optimism/pessimism and dietary habits, since these exert a significant impact by themselves on the risk for CHD. In addition, the connection between optimism, pessimism and the ability to improve diet was investigated. If there was found to be linkage between optimism/pessimism and CHD, the intention was also to study this linkage, mainly to clarify how this linkage is mediated?

The core of this study is the revised version of the Life Orientation Test (LOT-R), which was developed to determine the disposition of individuals in order to investigate its effects on their self-regulation and later also on other variables, e.g. health related domains (Scheier et al., 1994). The study population consists of the Finnish cohort study GOAL (Good Aging in Lahti Region), which aims at

improving well-being among ageing citizens living in the region of Lahti, a city located in southern Finland.

2 REVIEW OF THE LITERATURE

2.1 Coronary heart disease

2.1.1 Definition

Coronary heart disease (CHD), also known as coronary artery disease (CAD), atherosclerotic heart disease (AHD), ischemic heart disease (IHD) or by its Latin name morbus cordis coronarius (MCC), refers to a state where the arteries supplying the heart are narrowed or even blocked due to the presence of an atherosclerotic plaque formed mainly from fatty lipids, inflammatory cells and calcium on the artery walls (AHA, 2017a). This pathological process is known as atherosclerosis and it leads to a limited blood flow to the myocardium.

The mechanism of atherosclerosis is quite complicated e.g. including lipid disturbances, platelet activation, thrombosis, endothelial dysfunction and inflammation (Faxon et al., 2004). The limitation of blood flow to the myocardium causes ischemia which can result in chest pain, arrhythmias and/or myocardial infarction and sudden death.

2.1.2 History of CHD

Even although CHD is recognized as a disease extensively linked with the modern lifestyle, it seems to have existed virtually from the very beginning of the humankind's evolution (Thompson et al., 2013). However, the discovery of CHD and the knowledge of its pathogenesis are relatively new. It is not possible to specify the exact time or era when CHD was identified, but there are some commonly recognized milestones on the road to our present understanding of this disease.

The out-of-wedlock son of a wealthy Florentine legal notary and a peasant, the celebrated genius Leonardo da Vinci (1452 – 1519), was the first scientist to introduce some kind of valid concept of the circulation. For example, he investigated why "old people fail without fever when they are of great age" and concluded that

the reason for death "without fever" could be a misfunction of the circulation. He compared circulation with the fluid mechanics of rivers and stated that "vessels in the elderly restrict the transit of blood through thickening of the tunics", like the banks of the river become clogged by the sediment transported by the river (Keele, 1973, Slijkhuis et al. 2009).

Soon after da Vinci, the English physician, William Harvey (1578 – 1657), developed and elucidated the concept of circulation. He was the first known physician to describe completely and in detail the systemic circulation. In his famous work, "'Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus" (= An Anatomical Study of the Motion of the Heart and of the Blood in Animals), he demonstrated how the heart pumps blood to the brain and body, and today he is credited as the inventor of circulation (Kilgour, 1961).

A German professor of medicine, Friedrich Hoffmann (1660–1742), noted later that the origins of CHD lie in "the reduced passage of the blood within the coronary arteries" (Sliskovic, 2013). This concept was afterwards validated and developed in 1768 by the English physician William Heberden (1710 – 1801), who brought angina pectoris to the attention of the medical profession. He wrote: "Those who are afflicted with it are seized, while they are walking, and more particularly when they walk soon after eating, with a painful and most disagreeable sensation in the breast, which seems as if it would take their life away, if it were to increase or to continue: The moment they stand still, all this uneasiness vanishes." (Heberden, 1772).

The present understanding of CHD and particularly its etiology is rather young. As mentioned, the concept of atherosclerosis and its connection with angina pectoris and CHD were known for several hundreds of years, but it was not until the mid-20th century when scientists started to understand the pathogenesis of CHD. In this task, the American Heart Association (AHA), founded in 1924, played a major role (Kritchevsky, 1998), as did the National Heart Institute (nowadays called the National Heart, Lung, and Blood Institute), which initiated the first major study to understand CHD, the Framingham Heart Study, in 1948 (Mahmood et al., 2014).

Earlier, the attempts to treat CHD aimed merely to relieve the symptoms of the disease, but with the exponentially growing knowledge concerning CHD e.g. its connection with nutrition, blood pressure, and blood cholesterol levels, it became possible to identify ways to prevent CHD.

When the imaging of coronary arteries became available in the 1950s, an accurate diagnosis of CHD was possible for the first time, and this led to possibilities to provide efficacious treatment of CHD (Bruschke et al., 2009). The first coronary artery bypass surgery (CABS) was performed in 1960 (Haller & Olearchyk, 2002),

and the first percutaneous transluminal coronary angioplasty (PTCA) was done in 1977 (Meier et al., 2003).

Recent decades have provided much new information about CHD, its etiology and pathogenesis, but we are still a long way from completely understanding CHD.

2.1.3 Epidemiology

Due to its recognizability, the epidemiology of CHD is rather well understood, e.g. the statistics of CHD have been recorded for a long time.

2.1.3.1 Prevalence

The prevalence of CHD in the Western countries has been steadily decreasing over the last four decades. CHD is still quite common, i.e. in the United States, the prevalence of CHD among individuals over 20 years of age is approximately 6.3% (7.4% for males and 5.3% for females), i.e. there is a slight male predominance in the prevalence (AHA 2017b). The reported prevalence increases considerably with age in both women and men. It has been estimated that in the United States the lifetime risk for some manifestation of CHD is as high as approximately one in two for men and one in three for women once they reach the age of 40 years (Lloyd-Jones et al. 1999).

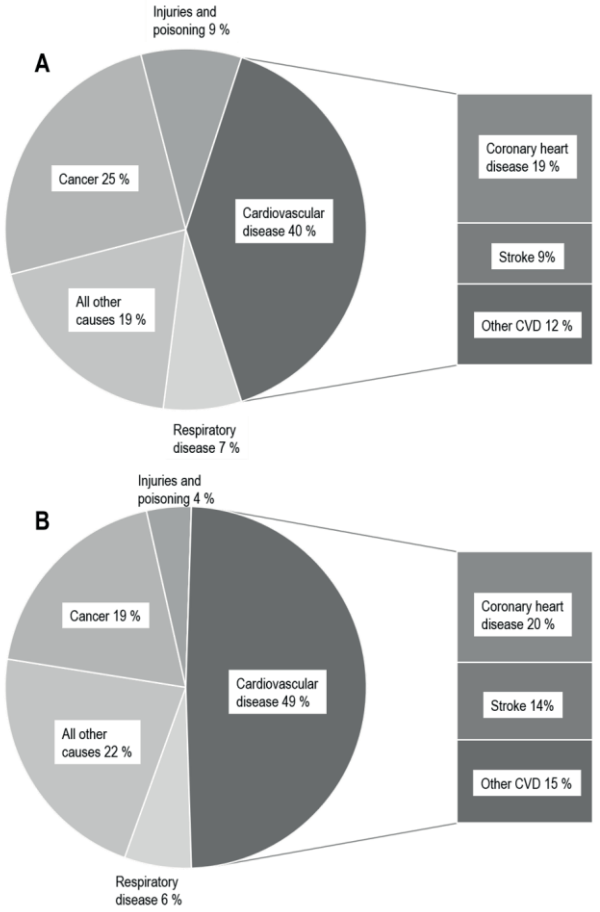
2.1.3.2 CHD-induced mortality

Cardiovascular diseases (CVD) remain the leading cause of death all around the world (Waters 2010). For example, in Europe, they are responsible for 45% of all deaths. CHD is the most prominent representative of the CVD, and despite the steady decrease in relative CHD mortality, CHD is still the cause of about every fifth death in Europe (Townsend et al., 2015, Figure 1) and every third death in the population aged over 35 years in the United States (Sanchis-Gomar et al., 2016). In 2016, in Finland, CHD was the primary cause of death on 10 183 occasions (18.9% of all deaths) (Statistics Finland, 2017). Although the age-standardized death rate is significantly declining, the absolute numbers of CHD deaths have not been reduced at the same pace, primarily due to shifting age demographics (Global Burden of Disease Study, 2015).

While there is no remarkable gender difference in the total numbers of deaths caused by CHD, men are far more likely than women to die of CHD while still at working age, e.g. Finnish men have an approximately 4-fold higher risk of dying than women before they reach retirement age (Finnish National Institute for Health and Welfare, 2018).

It is obvious that increased knowledge about the aetiology, mechanisms and treatment of CHD is urgently needed to further improve the prevention of CHD and reduce the numbers of CHD-related deaths.

Figure 1. Proportion of all deaths due to major causes among men (A) and women (B) in Europe.



Source: WHO Mortality Database (Townsend et al., 2015)

2.1.4 Aetiology

A vast amount of research has been targeted to CHD due to its significant prevalence; even if there is still much to be learned, there is indeed a substantial body of knowledge about the risk factors of CHD.

2.1.4.1 Physical risk factors

There are many well-known risk factors with the most notable being high blood cholesterol, high blood pressure, smoking and diabetes. Thus, the vast majority of those with CHD (more than 3 out of 4) seem to have at least one of these four risk factors and it is not uncommon for an individual to have more than one risk factor for CHD (Faxon et al., 2004; Khot et al, 2003; Kovanen & Pentikäinen, 2016). The effects of many of the so-called modifiable risk factors are quite dramatic. For example, smoking just one cigarette per day may increase an individual's risk for CHD by 50% while those who smoke a whole pack of cigarettes (= 20) every day have an approximately doubled risk of developing CHD (Hackshaw et al., 2018). Furthermore, a lack of exercise has been linked to approximately 6% of cases (Lee et al., 2012).

In addition to the abovementioned risk factors, there are also risk factors that cannot be changed, such as age, gender and family history; these too can have quite a remarkable effect on CHD. For example, it has been claimed that as many as 50% of CHD cases can be linked to genetics (Dai et al., 2016).

2.1.4.2 CHD and inflammation

There is convincing experimental and clinical evidence of the crucial role of chronic low-grade inflammation in the initiation and progression of atherosclerosis, and inflammatory changes are thought to lie at the core of CHD. Inflammation plays a significant role in many phases of the atherosclerotic process, from endothelial dysfunction to plaque build-up (Koenig, 2013).

There are many biomarkers reflecting the inflammation process; of these, C-reactive protein (CRP) when measured with high-sensitivity assays (hs-CRP), seems to be the most reliable and the most useful method, at least when studying the connection between inflammation and CHD (Koenig, 2013, Zakai et al., 2007). CRP is an acute-phase reactant and a non-specific marker of inflammation, produced

mainly by hepatocytes. CRP (originally named as Fraction C) was discovered in 1930 in pneumonia patients by William Tillett and Thomas Francis (Tillett & Francis, 1930), but the link between CRP and CHD was only discovered in the 1990s (Ridker et al., 1997). While older assays were able to reliably identify only the acute phase responses of CRP, during which the rise in CRP level is very significant (i.e. levels >10 mg/L), more recent high sensitivity immunoassay methods have enabled the measurement of baseline levels and the quantification of CRP throughout its normal range. This has helped in revealing the connection between low-grade inflammation and the elevated risk of cardiac morbidity, particularly CHD (Casas et al., 2008; Sarwar et al., 2009). There are several benefits associated with the use of CRP, e.g. its long plasma half-life and relative stability in a frozen sample (Yousuf et al., 2013).

It is still unclear whether CRP is 'a maker or a marker' of CHD (Yousuf et al., 2013). Some in vitro tests have indicated that CRP itself possesses pro-atherogenic properties. CRP seems to decrease the expression of endothelial nitric oxide synthase messenger ribonucleic acid (mRNA) and thus also the enzymatic protein and to increase the harmful effect of oxidized low-density lipoprotein (LDL) on endothelial function. These facts suggest that CRP could be an aetiological factor in the pathway to CHD (Koenig 2013). On the other hand, some genetic studies have indicated that CRP has no causal role in the pathogenesis of atherosclerosis; rather, it simply reveals the current risk of CHD (C Reactive Protein Coronary Heart Disease Genetics Collaboration, 2011).

Nonetheless, hs-CRP seems to perform rather well as a predictor of future cardiovascular outcomes, such as in estimating the incidence of CHD. It is sometimes an even better predictor than several traditional risk factors (Koenig 2013). In fact, CRP seems to be an independent predictor of cardiovascular events, even in the presence of 'CHD-specific biomarkers' like troponin I (TnI) and N-terminal pro B-type natriuretic peptide (NT-proBNP) (Koenig, 2013). In a study of 17,802 men and women, it was noted that among apparently healthy persons without hyperlipidaemia, an elevated level of high-sensitivity C-reactive protein (>2.0 mg/L) was an independent risk factor for developing CHD (Yousuf et al., 2013).

Thus, it seems quite clear that the level of hs-CRP is a good choice for estimating the amount of low-level inflammation when evaluating the risk of developing CHD.

2.1.4.3 Psychosocial risk factors

Even if the majority of those patients with CHD seem to have at least one of the rather well-known physiological risk factors (Khot et al., 2003), at the same time

there are also many individuals with no recognized risk factors but who still have CHD and conversely, subjects with one or more identifiable risk factors but nonetheless will never suffer from CHD. One reason for this may lie in the presence of psychosocial factors that can alter an individual's risk for CHD.

In the history of art and culture, the heart has always been described as a centre of psychosocial health and emotions. The scientific connection between psychosocial health and the heart was studied for the first time in 1937, when Benjamin Malzberg found a connection between involutional depression and an elevated rate of cardiovascular deaths (Malzberg 1937). Since the research of Malzberg, the scientific interest on psychosocial factors affecting the risk for CHD has waxed and waned.

Nowadays there is convincing evidence that psychosocial factors exert a major impact on the risk for CHD. For example, in the INTERHEART study, psychosocial factors such as depression and psychosocial stress were found to be one of the most significant risk factors for myocardial infarction (Rosengren et al., 2004; Yusuf et al., 2004), and the American Heart Association has stated that depression is an independent risk factor for a poor prognosis following an acute coronary syndrome (AHA, 2014).

The research into the connection between psychosocial variables and CHD has mainly concentrated on psychiatric illnesses, such as depression and the spectrum of psychotic disorders, which are clear risk factors for incident CHD. These diseases are also connected with worse outcomes in the treatment of CHD and linked with increased CHD-related mortality (Barth et al., 2004; Carney & Freedland, 2017; Lahti et al., 2012; Tiihonen et al., 2009). There is also evidence of other psychosocial risk factors for CHD, such as low socio-economic status (Albert et al., 2006; Stringhini et al., 2010; Tonne et al., 2005), stress at work and in family life (De Vogli et al., 2007; Eaker et al., 2007; Eller et al., 2009) as well as social isolation and low social support (Lett et al., 2005; Mookadam & Arthur, 2004). Furthermore, anger and personality "type D" (=distressed) have been linked with an elevated risk of CHD (Chida & Steptoe, 2009; Denollet et al., 2006; Veromaa, 2019).

The initial research concerning personal traits and the risk for CHD was done in 1950s, when the type A behaviour pattern (TABP), characterized by competitiveness and hostility, time urgency and impatience, first introduced by Friedman and Rosenman, was found to be a risk factor for CHD (Friedman & Rosenman, 1959). This linkage was confirmed in their later studies (Rosenman et al., 1975), but afterwards it has been argued that the connection between this personality style and CHD was not valid; instead the factors increasing the risk for CHD were some other

characteristics which had not been evaluated in that study (Karlsson, 2011; Petticrew et al., 2012; Šmigelskas, 2012).

Subsequently, the research investigating the connection between personality and cardiac health including CHD has been conducted at a growing pace in the past three decades. A recent review dealt with the connection of positive psychological constructs and cardiac health. According to the results of various studies, a positive construct of personality (i.e. hope, optimism and resiliency) was associated with reduced rates of hospitalisation or mortality due to cardiac diseases and it was stated that positive psychological constructs, i.e. optimism, appeared to be prospectively associated with health outcomes in most, but not all, studies (DuBois et al., 2015). Optimism (and pessimism) and CHD have been the focus of some research, with the results usually indicating that optimism as a personal trait is connected with good outcomes in cardiac health (= in this case less CHD and better results in treating CHD) , but the number of the publications is still quite modest (Boehm et al., 2011; Giltay et al., 2004; 2006; Hansen et al., 2010; Kubzansky et al., 2001; Scheier et al., 1989; 1999; Tindle et al., 2009; 2012). However, all of these studies assessed optimism as a single factor (meaning that optimism and pessimism are considered as opposite poles on a single continuum, which differs from the approach applied in this study, (see chapter 2.2.4)). In addition to the connection between the optimism construct and CHD found in the abovementioned studies, one study also claimed that optimism was not beneficial with respect to preventing and treating CHD (Robinson 2014).

2.1.4.3.1 Optimism construct and inflammation

How do psychosocial factors influence the risk of CHD? In the studies concerning the connection of psychiatric illnesses and CHD, a few possible mediators have been identified. The most common suggestions have involved an altered autonomic nervous system activity (e.g. elevated heart rate), elevated catecholamine levels, elevated inflammatory activity, endothelial dysfunction and platelet dysfunction (Carney et al., 2017). Naturally, there are also behavioral mechanisms linked to this connection, such as poor motivation in adopting a healthy way of living and reluctance to attend medical examinations and to adhere to recommended treatments (Carney et al., 2017). It is also possible that patients with psychiatric symptoms receive less attention from the health care system if they also have somatic illnesses as compared to those individuals with no morbid psychiatric properties (Carney et al. 2017; Lahti et al., 2012).

How is the optimism construct possibly connected to CHD? There are very few studies which have investigated the connection between any personal traits and CHD and naturally even fewer studies on the optimism construct and CHD. In most of those studies, the mediating agent between the possible connection of the optimism construct and CHD has not been evaluated. There are theories that an elevated level of inflammation might represent the possible link between the optimism construct and CHD. High pessimism and/or low optimism have been linked with elevated levels of interleukin-6 (IL-6) levels, and IL-6 is able to elevate the level of CRP (Ikeda et al., 2011; O'Donovan et al., 2009). It has also been studied whether the genome coding of CRP has an influence on the levels of dispositional optimism and pessimism; but no such link could be identified. Instead, the investigators have suggested that there might be a reverse causal association – i.e. low level optimism may cause high CRP levels (Rius-Ottenheim et al. 2012). When investigating optimism and pessimism as two different and independent variables and not as a single construct which includes both optimism and pessimism, the connection between pessimism and inflammation has seemed to be stronger than the connection between inflammation and optimism, i.e. the higher the pessimism level, the higher the level of CRP (Roy et al., 2010). It has also been stated that under stress conditions, a higher level of optimism dampens the responses of the immune system, which can lower the level and consequences of inflammation (Brydon et al., 2009).

The connection between optimism, inflammation, and CHD has not been widely studied; in fact, there seems to be only one previous study examining this topic. In that study, it was hypothesized that the prognostic value of the optimism construct over CHD might be weaker when one controlled for the inflammation status – i.e. a higher inflammation status could explain at least some of the linkage between optimism and the risk of developing CHD. Nonetheless, it proved impossible to prove that inflammation had a mediating role (Gramling et al., 2010). Unfortunately, in that study, optimism was measured by asking the test subjects what they thought about their risk of developing CHD, i.e. the question actually evaluated self-rated health rather than optimism.

2.2 Optimism and pessimism

”The optimist sees the rose and not its thorns; the pessimist stares at the thorns, oblivious to the rose”

- Kahlil Gibran (1883-1931)

2.2.1 Definitions

The terms optimism and its antonym pessimism derive from Latin words ‘optimus’ and ‘pessimus’, respectively, the first meaning ‘the best’ and the latter meaning ‘the worst’ (Lewis & Short, 1879). The words optimism and pessimism are used in describing people’s outlook and expectations concerning their future.

People differ widely from each other in how they view the world. Persons who tend to be favourable in their outlook concerning their future and expect things to go their way are called optimists and they are said to have a tendency to “make lemonade out of lemons”, and to see the “glass as half-full rather than half-empty”. Pessimists in turn generally feel that bad things are more likely to happen rather than good things or they tend to emphasize the bad part of a situation. The glass of the pessimist tends to be half-empty. (Cambridge Free English Dictionary and Thesaurus, 2019; Scheier & Carver, 1985).

2.2.2 History of optimism and pessimism

According to a Finnish saying it’s better to be pessimistic, because “a pessimist never gets disappointed.” The history of optimism and pessimism is indeed dominated by pessimism. In ancient history, pessimism was considered as more rational and a mature point of view than expecting too much from the future. For example, the writer of Ecclesiastes in the Old Testament regarded the world in a somehow pessimistic way when saying: “Vanity of vanities, saith the Preacher, vanity of vanities; all is vanity” (Ecclesiastes, ca. 940-931 BC) and so too did an ancient Mesopotamian text, “The Dialogue of pessimism” (writer unknown, ca. 950 BC). Sophocles (496-406 BC) stated that optimism only prolongs human suffering and it is better to face the unpleasant facts of human life rather than hope that better things will happen (Sophocles, ca. 430-426 BC), a view continued by Hegesias (ca. 320-280

BC), who stated that lasting happiness is impossible and all we can do is to try to keep our pain to a minimum (Hegesias, 290 BC).

Optimism and pessimism were identified as philosophical positions in the 17th century. The formulation of an optimism construct is said to have been made by Rene Descartes (1596-1650), who contributed significantly to the transition from the somehow pessimistic philosophy fostered by the Catholic Church of the Middle ages to the philosophy of modern times and who is often recognized as the father of modern philosophy (Stanford Encyclopedia of Philosophy, 2018). Descartes believed very strongly in science and believed that science would enable human beings to create an Eden of our own making and provide us with tools to maintain our health and enjoy the fruits of earth (Descartes, 1628).

Gottfried Leibniz (1646-1716), who is regarded as "the last universal genius", continued the optimistic perspective of Descartes and introduced the famous term "the best of all possible worlds", meaning that God's moral perfection caused Him to choose to create the best of all the possible universes (Stanford Encyclopedia of Philosophy, 2013). Leibniz describes this "maximum instance of an infinite class of possibilities" with the term "optimum" (Leibniz, 1710).

After the optimistic perspectives of Descartes and Leibniz, the tides reverted again towards pessimism. In the most famous book of the French author and philosopher Voltaire (real name François-Marie Arouet, 1694-1778), called "Candide, ou l'Optimisme", optimism is described as a clearly negative phenomenon. In the book, the protagonist, Candide, suffers all kind of hardships. Despite all of these misfortunes, his teacher, Dr. Pangloss maintains his idea originated from Leibniz: everything is for the best and we live in the best of all possible worlds. Towards the end of the book, Candide abandons the philosophy of his teacher and announces that he has finally learned his lesson: The optimistic perspective should be rejected, and people should just devote themselves to practical labor (Voltaire, 1759). Later, Voltaire stated that optimism seems plausible only to young aristocrats, who can live a pleasurable life. If someone disagrees, he needs only to "stick his head out the window and he will see enough unhappy people" meaning there is no space for optimism (Voltaire, 1764).

Since the time of Voltaire, optimism was viewed for a long time mainly as a negative feature. Immanuel Kant (1724-1804) and Georg Wilhelm Friedrich Hegel (1770-1831) had very pessimistic opinions of all mankind, but their pessimism pales in comparison to the pessimism of Arthur Schopenhauer (1788-1860), whose leading idea was that our world is the worst of all possible worlds. Friedrich Nietzsche (1844-1900) continued along the pathway of Schopenhauer, but in his final years, he started

to write in a more optimistic manner (Catholic Encyclopedia, 2017; Domino & Conway, 2001).

The negative attitude towards optimism was expressed also by Sigmund Freud (1856-1939), who argued that optimism was widespread but illusory (Freud, 1927). Freud stated that optimism might be compulsory in order to make civilization possible, but that it came with a cost: it made us deny reality, because reality, at least to some content, should make us think quite pessimistically. In Freud's opinion, only the educated and particularly neurologists did not need the illusion created by optimism in order to evolve and to be producing and they could handle the realistic and rational world without the foolishness and denial promoted by optimism (Peterson, 2000).

Later it was stated that the "mentally healthy" perception of reality means that the opinions and thoughts should be equal with the reality rather than be too positive, "when what the individual sees corresponds to what is actually there" (Jahoda, 1958). This kind of approach was adopted by all of the influential psychologists and psychiatrists until the 1960s (Snyder, 1989; Taylor & Brown 1988).

The opinion of Freud is expressed also in the famous term of the Pollyanna principle (also known as pollyannaism), introduced by researchers Margaret Matlin and David Stang (Matlin & Stang 1979). Pollyannaism means a subconscious and, as Freud thought about optimism, an unrealistic bias, towards the positive. This term originates from the classic children's book called Pollyanna (Porter 1913). Pollyannaism is considered as a negative property and according to it, positive thinking is regarded as naïve and unrealistic.

From the 1960s more and more evidence from various studies showed that we have always produced more positive than negative memories as in the Finnish saying, "Time makes memories golden", and most people also evaluate both themselves and their future in a positive manner (Matlin & Stang, 1978). This "more positive than negative" –way of thinking has been noticed also in the social media, where the positive emotions are used more often than negative emotions and the likelihood of adopting positive emotions from social media among other users is much greater than that of negative emotions (Ferrara & Yang, 2015).

During the past few decades the research on optimism has shown that optimism is associated with a large array of positive consequences (Carver et al., 2010; Forgeard & Seligman 2012; Seligman, 1991) and being optimistic is nowadays considered as a positive feature, with certain qualifications.

2.2.3 Present conceptions

It is somewhat surprising that even if optimism and pessimism nowadays seem to be variables with clear individual differences, high consistency and strong consequences for behaviour, the scientific community has shown little interest in researching optimism.

Optimism was defined by anthropologist Lionel Tiger as "a mood or attitude associated with an expectation about the social or material future – one which the evaluator regards as socially desirable, to his/her advantage, or for his/her pleasure" (Tiger, 1979). According to this, defining optimism in an objective way is impossible, because it depends on what the individual views as desirable. This dilemma could naturally complicate the possibility to do any research into optimism. Nonetheless, some efforts have been made in determining optimism and pessimism in a more precise way in order to adopt a scientific approach to investigating the optimism construct. Defining of these terms has enabled scientists to investigate these personal traits in recent decades.

The current view is that optimism in psychology is an affective, cognitive and motivational construct (Peterson, 2000). The psychological trait of optimism is regarded as a factor that has an influence in the way we perceive ourselves and our environment, how we process incoming information, and what kind of decisions we make based on this information. In other words, optimism does not influence only our thinking, but also modifies our feelings about the future. While optimists make a practice of trusting that their future is going to be beneficial, pessimists in the same situations, tend to believe that it is more probable that there will be negative events in their lives. Optimism and pessimism can be seen as "cognitive filters", altering an individual's perceptions of his/her surrounding environment and affecting the way how they think and behave and how they adapt to new situations, particularly in difficult and challenging times (Carver et al. 2010, Seligman, 1991).

The concept of optimism is usually considered to involve two concepts, optimism and pessimism, which are commonly seen as antonyms. In other words, a person with many optimistic properties is seen as an optimist while a person with only a small amount of optimism is regarded as a pessimist with pessimistic properties. Optimism and pessimism are assimilated with other personal traits which, according to general theories, develop during childhood and early adulthood and are influenced by both heritage and environment (Mosing et al., 2012). Like other personal traits, they account for individual differences in patterns of thinking, feeling, and behaving (American Psychological Association, 2015). The heritability of optimism is believed

to be somewhat smaller than the heritability of most other personal traits. According to twin and adoption research, the heritability is approximately 25% for both optimistic and pessimistic properties (Plomin et al., 1992; Schulman et al., 1993). For example, in contrast to mood, the construct of optimism (including both optimistic and pessimistic properties) is thought to be quite stable after it has evolved, regardless of whether the individual experiences negative or positive incidents (APA, 2013; Billingsley et al., 1993; Schou et al., 2005). This stability applies both in time and context i.e. optimists often appear to be optimistic "in general," meaning that their positive expectations are not limited to some individual aspects or to certain times in their lives. In the same fashion, pessimistic persons often give the appearance of being universally negative in their vision of their future (Scheier & Carver, 1985).

According to the scientific research from the past couple of decades, it seems that being optimistic does not mean either forced enthusiasm or denial of the realities, but it actually seems to be primarily, if not completely, a positive personal trait when considering its consequences for an individual's health. After systematic investigations and evaluations, the optimism construct has today gained respectability as a scientific topic and it has been an increasingly popular topic for investigation in recent years. (Carver, et al., 2010, Forgeard & Seligman, 2012, Peterson, 2000).

During the past few decades of the research into optimism as an individual and separate psychological variable, optimism has been conceptualized and handled in two different principal styles: namely as "optimistic explanatory style", and as "dispositional optimism".

2.2.3.1 Optimistic explanatory style

The first scientific approach towards conceptualizing and measuring optimism and pessimism was introduced by Martin Seligman. Since the 1960s, Seligman and his colleagues have studied a phenomenon they named as "learned helplessness". In their research, it was noticed that when the test subjects (at first experimental animals but later also human test subjects) were exposed to uncontrollable stressors, some of them became helpless and they continued to act in a helpless manner even if the stressors became controllable (Alloy et al., 1984; Hiroto & Seligman, 1975; Maier & Seligman, 1976; Seligman & Maier, 1967).

Later Seligman and his colleagues observed that certain reoccurring negative events, which are out of the person's control make some individuals blame

themselves for those unwanted and negative events and these persons are likely to keep on thinking negatively after those negative events have ended (Abramson et al., 1978). They often see those negative events to be connected to them (e.g. "I´m the one to blame"). This belief is quite stable ("Things will always be like this") and this kind of thinking is often believed to be large-scale ("My whole life is ruined"). People with these kinds of traits are often unable to feel that they have succeeded in something and could be credited for positive incidents ("My success was just luck"), they usually believe think that positive events will not last for long ("Maybe I did well now but nobody knows what kind of bad things will happen in the future"), and their lives are affected by possible good events only marginally ("Even if I might know how to do this, I'm still quite bad in most things") (Abramson et al., 1978, Forgeard & Seligman, 2012).

While making these observations, the researchers also noticed that in the same situations, some people would not start to think negatively, and they did not feel that they were somehow responsible for those negative events. Instead of blaming themselves, they thought that these negative events were not their fault, but they blamed the experiment for setting them up to fail (Seligman, 1991). These findings have led to terms called optimistic and pessimistic explanatory style. The habit of blaming oneself for one's problems tends to affect many aspects of life, because this belief of a tendency to fail seems to be widespread and to continue indefinitely. This phenomenon is called a pessimistic explanatory style while an optimistic explanatory style means that a person, when facing problems, blames outside forces rather than him/herself and believes that such events will end soon, and they will not affect other aspects of their lives (Maier & Seligman, 1976; Peterson et al., 1993). So according to explanatory optimism, those individuals who do recognize the presence of negative events but explain them in a circumscribed way, with unstable, external, and specific causes, are described as optimistic, whereas those who tend to think that the reasons for these negative events are internal and stable are described as pessimistic. This theory (the reformulated learned helplessness theory (RLHT)) allowed researchers to realize why some people are quite resistant to trauma i.e. in them, the effects of the negative events are quite modest while some other individuals suffer greatly and almost instantaneously after adverse events (Gillham et al., 2001; Peterson et al., 1995).

There are two main instruments for assessing the optimistic explanatory style: the Attributional Style Questionnaire (ASQ) (Peterson et al., 1982) and Content Analysis of Verbatim Explanations (CAVE) method (Schulman et al., 1989). In ASQ, the respondents are asked to explain, why some favorable and unfavorable events have

happened while the CAVE method involves researchers extracting and coding content from the conversations or writings of study subjects about their explanations about positive and negative events (Peterson et al., 1998). This processed data is then studied by researchers using tools from ASQ.

2.2.3.2 Dispositional optimism

The second scientific way to define and measure optimism and pessimism, the "dispositional optimism" approach, derives from research carried out by Scheier and Carver (Scheier & Carver, 1985). Scheier and Carver studied optimism as a disposition and their perspective was based on an expectancy-value model of goal pursuit, according to which individuals practically always pursue goals they feel confident in attaining (expectancy) and goals they see as most important to them (value) (Carver & Scheier, 1981; Scheier et al., 2001).

This model is based on several traditional theories in psychology about goal-directed behaviour (Heckhausen 1967; Norman 1981; Powers 1973). When studying dispositional optimism, researchers were interested in determining whether the participants expect events in their future to be favorable or unfavorable, instead of clarifying how participants interpret the events they are presently facing as occurs in the explanatory model. Dispositional optimism is indeed also called "expectational optimism" because instead of concentrating on the attitudes towards the past, it measures beliefs and views concerning the future. (Schueller & Seligman, 2008).

According to Carver et al., the concepts of optimism and pessimism are "broad, generalized versions of confidence and doubt and they pertain to life, rather than to only a specific context" (Carver et al., 2010). In other words, in the dispositional model of optimism, optimists are confident and persistent when facing challenges (Scheier & Carver, 1992).

Dispositional optimism resembles optimism in its "common form" more than the explanatory model. As earlier mentioned, the dictionary describes optimism as "hopefulness and confidence about **the future**" while the description of pessimism is defined as "a tendency to see the worst aspect of things or believe that the worst **will** happen" (Oxford Dictionaries). So, the traditional meaning of these words concerns the future and what is to be expected, in exactly the same way as in the concept of dispositional optimism, which means the general expectation that there will be many positive events in the future and negative events will not happen so often.

The concept of dispositional optimism is associated with the self-regulatory model of Scheier and Carver, which states that virtually all areas of human activity can be thought as goal terms, and the way that people behave, involves the identification and adoption of these goals and the regulation of actions (Carver & Scheier, 1981). Optimism has an influence in achieving the goals that have been set, i.e. when facing distress, do people still believe that they can achieve their goals and keep on working to reach them? If so, they are optimistic: if not, they are pessimistic. Optimism leads to more persistent efforts to attain the goal, while pessimism leads to giving up. It has been noticed that the importance of the goal moderates this relationship. When the goal is considered as an important one, then dispositional optimism helps to achieve it (Geers et al., 2010).

Dispositional optimism can be assessed using self-report questionnaires. The first questionnaire introduced, the Life Orientation Test (LOT) was devised by Scheier and Carver in the 1980s (Scheier & Carver, 1985) and the best-known and most used questionnaire of dispositional optimism is the re-evaluated version of that questionnaire, namely Life Orientation Test – Revised (LOT-R) (Scheier et al., 1994). The original LOT has subsequently been revised also by Chang et al. (Extended Life Orientation Test (ELOT)) (Chang et al., 1997). Another scale that assesses dispositional optimism is the Optimism & Pessimism Scale (Dember et al., 1989), which, like ELOT, provides separate scores for optimism and pessimism. This procedure of separating optimism and pessimism can be used also with LOT-R, as will be later explained.

2.2.3.3 Connection of explanatory and dispositional models

The relationship between the optimistic explanatory style and dispositional optimism has been under investigation and the results are somewhat inconsistent. There are results of both low and high correlations between these two concepts (Hjelle et al., 1996; Peterson & Vaidya, 2001; Scheier & Carver, 1992; Schueller & Seligman, 2008; Tomakowsky et al., 2001). However, these two constructs are theoretically distinct, and it has therefore been recommended that they should not be considered as interchangeable (Carver et al., 2010). From these two, dispositional optimism meets the definition of optimism (and pessimism) better than the explanatory style and it has proved to be far more popular in the studies searching for the connection of optimism and other variables, e.g. variables linked with health.

2.2.3.4 Little and big optimism

Optimism is sometimes divided also into "little or big" optimism. Little optimism is said to be oriented to small and specific goals (i.e. "I will find a parking place soon.") while big optimism deals with more abstract and larger goals (i.e. "I will do great things in my future"). It has been claimed that little optimism correlates quite well with the optimism explanatory style while the dispositional optimism is strongly connected with big optimism (Peterson, 2000).

2.2.4 Optimism and pessimism – opposites or independent variables?

People are often categorized as either optimists or pessimists. This can lead to the conclusion that optimism and pessimism are the two extremities of the same unidimensional continuum (the optimism construct). Nevertheless, the concept of optimism itself has long been controversial: there is debate over whether the optimism construct should be seen as a single bipolar dimension or if optimism and pessimism might be two separate dimensions that exist simultaneously and may be unattached to each other.

The tests used in measuring optimism have different scores for optimistic and pessimistic properties i.e. they give the answers separately to optimism and pessimism. It seems that in many cases the answers to these two subcategories do not correlate with each other, as will be described later in the text. Scores of one subcategory cannot be predicted by determining the scores in another subcategory. This could mean that optimism and pessimism should be processed as individual and independent variables.

ASQ measuring the explanatory style is mainly used as two-factor model because usually the explanatory style based on bad events does not correlate with the result of explanatory style for good events (Peterson, 1991).

Even although LOT and LOT-R which measure dispositional optimism and pessimism, were meant to be used as a single-factor test, they are often used as a test measuring two variables, optimism and pessimism, due to the weak correlation between optimism and pessimism subscales (Chang et al., 1994 & 1997; Glaesmer et al., 2012; Herzberg et al., 2006; Kubzansky et al., 2004; Marshall et al., 1992; Robinson-Whelen et al. 1997).

It has also been proposed that optimism might be a unidimensional continuum but the scales measuring it divide optimism into two independent subscales, namely optimism and pessimism. The creators of LOT – R have advised that the two-factor

model should be used if the two subsets used in a certain study design do not correlate significantly (Carver, 2006; Scheier et al., 1994). In summary, it still seems that LOT-R works at its best when two different and independent subscales of optimism and pessimism are applied.

2.2.5 The reality basis of optimism

The relationship between optimism and reality has also been a topic of investigation. Common sense says that too unrealistic optimism can have costs. When people are asked to estimate their risk for injury or illness, they usually underestimate their actual risks (Weinstein, 1989). The average individual tends to view him/herself as having a smaller risk for a variety of diseases in comparison to others, which naturally cannot be the truth. This phenomenon needs attention because it can result in the situation where people neglect the need to adhere to a healthy lifestyle. In other words, unrealistic optimism can distract people from making concrete plans about how to attain goals themselves and instead adopt a form of wishful thinking (Oettingen, 1996).

2.2.6 Related constructs

There are naturally other psychological concepts relating to optimism and pessimism. For example, the senses of control (Thompson et al., 2002) and self-efficacy (Bandura, 1997) relate to expecting positive outcomes but in addition to optimism, these variables include also how the desired outcomes are expected to happen. Self-efficacy is a concept in which the self as a doer and as a causal agent is the main influencer. If people have high self-efficacy expectancies, they presumably believe that it is their personal efforts or skills that will determine the outcome. The difference between self-efficacy and optimism is that compared to optimism, a person with a high level of self-efficacy relies on him/herself while an optimist does not count on his/her own abilities.

Another construct resembling optimism, and having its own substantial literature, is hope (Snyder, 1994; 2002). Hope is said to be created out of two different factors. One part is the individual's perception of the existence of the pathways needed to reach his/her goals. The second factor is the person's level of confidence of being able to use those pathways to reach these goals. Thus, hope reflects both the ways and the will (Snyder et al., 1991). The dimension of will and confidence is quite

similar to optimism, though it has more emphasis on the personal ability to tackle problems. Another difference between hope and optimism is that the optimism concept does not address the pathway component. Like optimism, also hope is believed to induce persistence, i.e. when a person has hope, he/she will keep on trying to achieve his/her goals despite the possible setbacks.

One further term close to optimism or in this case, actually to pessimism is neuroticism. A person with high level of neuroticism experiences the world as distressing, threatening, and unsafe (Weed & Kwon, 2019). Smith et al. found that the results of optimism and pessimism given by the original LOT were confused by neuroticism (Smith et al., 1989), a finding made also by Marshall and Lang (Marshall & Lang, 1990). They noticed that when neuroticism was controlled, the correlations between the optimism construct and several of the investigated outcome variables became notably reduced. This finding led to the development of LOT-R (Scheier et al. 1994).

2.2.7 Optimism, pessimism and health

Personality and personal traits play a role in human behaviour, so it is only natural to postulate that they also influence our health. One pathway would be their influence on health behaviour, but there is also evidence that after excluding the differences they have on health behaviour, the personal traits have also an impact on our health and that this is mediated in some other way. These findings concern also optimism and pessimism as personal traits (Rasmussen et al., 2009).

2.2.7.1 Health behaviour

As mentioned earlier, optimism and pessimism have an influence on the way we see our lives. So, it is only natural that optimism and pessimism affect the decisions we make, including the decisions concerning our health.

Contrary to popular belief, optimists seem to be less likely to deny the existence of problems. Researchers have found that optimists try to solve their problems more actively than pessimists (Nes & Segerstrom, 2006) while pessimists use strategies of avoidance (Carver et al., 1989). These actions can lead to situations, where optimists can solve their problems much more effectively than pessimists, which in turn can lead also to a healthier lifestyle, better health and subjective well-being.

Optimistic people seem also to have better adherence when it comes to treating illnesses (Brewer et al., 2013; Bruzzese et al., 2014; Godin et al., 2005; O'Brien et al., 2009; Schroder & Schwarzer, 2005; Shepperd et al., 1996; Ylöstalo et al., 2003) and they make healthier choices in their way of life (Boehm et al., 2013a; Roy et al., 2010). It has even been demonstrated that optimism seems to be positively connected with longevity (Giltay et al., 2004).

According to these studies, it seems that dispositional optimism and pessimism relate to the motivation to comply with the treatment demands and the ability to adopt an overall health behaviour and to make changes in lifestyle in order to improve well-being.

2.2.7.2 Mental health

Optimists expect good outcomes and that is why they are likely to experience more positive feelings. There is substantial research information supporting the concept of optimists enjoying higher levels of subjective mental well-being, which is endorsed also by common sense (Achat et al. 2000; Carver & Gaines, 1987; Lam et al., 2016; Orom et al., 2015; Scheier et al., 2001; Schou et al., 2004; Zenger et al, 2011). Persons with higher level of optimism seem to sleep better (Uchino et al., 2016) and adjust better to pain (Ronaldson et al., 2014). Optimism seems also to have a good predictive value in life satisfaction: those who have higher levels of optimism seem to be more satisfied with their lives as compared to those with lower levels of optimism (Daukantaite & Bergman, 2005; Daukantaite & Zukauskiene, 2011).

Pessimism by definition is related to hopelessness, which is a risk factor for depressive symptoms (Alloy et al., 2006). Optimism seems to increase resilience under stressful events, which in turn naturally diminishes the risk for mental problems (Ellicott et al., 1990; Finlay-Jones & Brown, 1981). There seems also to be a positive connection with optimism and other important variables in mental health like social integration and socioeconomic status which in turn have protective effects for mental health (House et al., 1988; Kawachi & Berkman, 2001).

All in all, there is a substantial body of data linking optimism with better mental coping including overall happiness, coping with adversities and emotional and psychological well-being (Carver et al. 2010; Carver & Scheier 2014; Strack et al., 1987).

2.2.7.3 Physical health

The well-known Latin phrase “Mens sana in corpore sano” (Juvenes, 2nd Century), translated usually as "a healthy mind in a healthy body" is widely used to express the thought that physical well-being is an important part of mental and psychological well-being and vice versa. Previously, the scientific approach towards this connection has focused on the connection between mental and physical illnesses, but recently investigators have become interest also in the connection between physical health and personal traits, including the optimism construct. In the fictive literature the theory of “physiology of optimism” was mentioned in the late 1960s (by Oleg Filimonovich Kostoglotov in the “Cancer Ward” by Alexandr Solzhenitsyn, 1968) and the scientific interest on this subject has been increasing in the past few decades. It seems that when studied objectively, in addition to higher levels of subjective psychosocial well-being, people with a higher level of optimism also have better physical health and this is related to both primary as well as secondary indicators. The results of many studies indicate that people with an abundance of optimism have fewer physical illnesses (Boehm et al., 2011; Giltay et al., 2006; Hansen et al. 2010; Kim et al. 2014; Kubzansky et al., 2001; Matthews et al., 2004; Nabi et al. 2010; Tindle et al., 2009). A high level of optimism has also been linked to good results in situations where some physical illness is already present (Matthews et al., 2004; Scheier et al., 1989; Scheier et al. 1999; Tindle et al., 2012).

There are some possible pathways to explain why optimism has this positive effect. A high level of optimism has been linked to lower level of inflammation and endothelial dysfunction (Ikeda et al., 2011), higher length of telomeres (Ikeda et al., 2014), higher level of antioxidants and lower level of lipids (Boehm et al., 2013a & 2013b). As mentioned earlier, optimistic people seem also to have better adherence when it comes to treating illnesses (Brewer et al., 2013; Bruzzese et al., 2014; Godin et al., 2005; O’Brien et al., 2009; Schroder & Schwarzer, 2005; Shepperd et al., 1996; Ylöstalo et al., 2003) and they make healthier choices in their way of life (Roy et al., 2010; Boehm et al., 2013a). It has even been demonstrated that optimism seems to be positively connected with longevity (Giltay et al., 2004).

According to these studies, it seems that dispositional optimism and pessimism relate to the motivation for treatment compliance as well as with overall health behaviour, and the ability to make changes in lifestyle to improve one’s physical well-being.

The connection between optimism construct and physical health was widely examined in a meta-analysis of 83 studies; its results confirmed the positive effect of optimism on overall health (Rasmussen et al., 2009).

In addition to the quite large body of evidence for a positive connection between optimism and physical health, there is also a smaller number of studies with results that optimism either has no effect or even negative effects on physical health (Coyne & Tennen, 2010; Robinson 2014; Schofield et al., 2016; Tomakowsky et al., 2001).

2.2.7.3.1 Optimism and the heart

Since the study made by Malzberg (Malzberg, 1937) the scientifically significant linkage between psychosocial health and the heart has been proved to be rather solid. The better an individual's psychosocial well-being, the better the health of his/her heart. It has been found that even an optimistic attitude towards one's cardiovascular health, whether justifiable or not, seems to be an independent factor that enhances the health of the cardiovascular system (Gramling et al., 2008). In the above mentioned meta-analytic review into optimism and physical health, attention was paid to the connection of optimism and cardiac health with a clear positive linkage being confirmed (Rasmussen et al., 2009). According to the results of a recent review, positive psychological constructs were associated with reduced rates of rehospitalization or mortality due to cardiovascular diseases and it was stated that positive psychological constructs, i.e. optimism, appear to be prospectively associated with cardiac health outcomes in most, but not all, studies (DuBois et al., 2015).

There have been an increasing number of studies examining the connection between optimism and cardiovascular health (Table 1). In summary, it seems that optimism and good outcomes cardiac health are connected, but the amount of the research is still rather modest.

2.2.8 Is optimism ever bad? The question of unrealistic optimism

As was mentioned earlier, there can be a discrepancy between optimism and realism, i.e. one can be too much, even unrealistically, optimistic i.e. be a Pollyanna. Are there circumstances where optimism is harmful, and it would be better to be more pessimistic? Do optimists sometimes make decisions without thinking through the

risks involved which can lead to bad outcomes? This concept of unrealistic optimism was introduced in 1980 (Weinstein, 1980).

Depending on the circumstances, it can be very reasonable to have an optimistic view of the future. But sometimes also pessimism can be justified. Alternatively, the view can also be optimistic or pessimistic but at the same time unrealistic and it can result in unwanted outcomes, if one believes that things will go well even when there are no facts to support this belief.

Several studies indicate that there seems to be only a few contexts where optimism can cause more troubles than advantages. Research on gambling has found that optimism increases positive expectations when gambling and this will lead to greater losses. When a pessimist loses while gambling, he/she starts to reduce the amounts he/she is betting while the optimist does not reduce the size of the bets (Gibson & Sanbonmatsu, 2004). In another study, lower levels of optimism among entrepreneurs seemed to correlate with the good results emerging from new ventures (Hmieleski & Baron, 2009). In that study, the authors reminded that entrepreneurs are very optimistic as a group and among them "low level of optimism" could mean normal optimism among non-entrepreneurs and this could have an effect on the results.

It is still commonly stated that there are no convincing results indicating worse outcomes for those with a higher level of optimism with respect to health. The only connections between higher optimism and bad outcomes in health have been found for the well-known health risks of smoking and alcohol. It has been stated that smokers tend to unrealistically think that their risk of developing lung cancer or some other smoking-related disease is smaller than the risk experienced by other smokers, which may explain their unwillingness to quit smoking (Dillard et al., 2006; Weinstein et al., 2005) and this unrealistic optimism will naturally have negative impact on the smoker's health (Dillard et al. 2009; Weinstein, 1989). This finding can obviously also influence the connection between optimism construct and cardiac health.

Nonetheless, those negative outcomes pale in comparison with the positive outcomes found in the numerous studies described above.

2.2.9 Is it possible to learn to be more optimistic?

Thus, it seems that optimism (or the lack of pessimism) has many positive consequences. What if you are a pessimist? Is there something you can do in order

to become more optimistic (or less pessimistic) so that you can gain the benefits of optimism? Is the optimism learned at an adult age somehow "artificial"?

As mentioned earlier, optimism and pessimism are considered to be trait-like and thus stable over time and independent of life events. Nonetheless, some kind of change in our way of thinking seems to be possible e.g. through cognitive-behavioral therapy (CBT) (Meevissen et al., 2011; Segerstrom, 2006; Seligman 1991), but many questions remain unresolved. How large can the change be and how permanent will the possible change be? It has been estimated that because optimism is a personality trait, changing it permanently would be very hard, if not impossible (Carver et al., 2010; Carver & Scheier 2014). It is also unclear whether this learned optimism will have the same beneficial effects as natural optimism. There are no studies investigating health and optimism and/or pessimism before and after trying to change the optimism construct; in fact, designing such a study would be very challenging.

Table 1. Previous studies on optimism, pessimism and cardiovascular diseases

Study	Study population	Measured variable and method	Main results
Scheier et al., 1989	51 elective CABS patients (men and women)	Dispositional optimism as a single bipolar variable (LOT)	Optimism correlated positively with better recovery and quality of life after CABS
Scheier et al., 1999	309 CABG surgery patients (men and women)	Dispositional optimism as a single bipolar variable (LOT-R)	Optimistic persons were significantly less likely to be rehospitalized after CABG surgery
Kubzansky et al., 2001	1,306 men in a cohort study	Explanatory optimism as a single bipolar variable (CAVE)	Optimism protected against the risk of coronary heart disease in a prospective study
Giltay et al., 2004	941 men and women in a cohort study	Dispositional optimism as a single bipolar variable (a questionnaire of their own)	Persons with more optimism had lower over-all mortality, mainly due to the lower cardiovascular mortality
Matthews et al., 2004	209 women in a cohort study	Dispositional optimism as a single bipolar variable (LOT)	Atherosclerosis was more likely to show progression among pessimistic women compared to optimists
Giltay et al., 2006	545 men in a cohort study	Dispositional optimism as a single bipolar variable (a questionnaire of their own)	Optimism was independently inversely associated with the risk of cardiovascular death
Tindle et al., 2009	97,253 women in a cohort study	Dispositional optimism as a single bipolar variable (LOT-R)	Optimists had a lower hazard of CHD and CHD-related mortality
Hansen et al., 2010	1,739 men and women in a cohort study	Dispositional optimism, as a single bipolar variable (LOT-R)	Optimism was independently associated with a reduced risk of incident CHD
Nabi et al., 2010	23,216 men and women in a cohort study	Dispositional optimism as a two-factor variable, only pessimism scores were used (LOT-R)	Low pessimism protected against stroke
Boehm et al., 2011	7,942 men and women in a cohort study	Dispositional optimism as a single bipolar variate (a single question)	Optimism protected against CHD
Tindle et al., 2012	430 CABG surgery patients	Dispositional optimism, as a single bipolar variate (LOT-R)	Optimism correlated with a lower risk for rehospitalization
Kim et al., 2014	6,808 men and women in a cohort study	Dispositional optimism as a single bipolar variable (LOT-R)	Optimism was associated with a lower risk of heart failure
Robinson, 2014	413 CVD patients (men and women)	Dispositional optimism as a single bipolar variable (LOT-R)	Optimism did not significantly improve the predictive ability of traditional CVD risk models

CABS = coronary artery bypass surgery, CABG = coronary artery bypass graft, LOT = Life Orientation Test, LOT-R = Life Orientation Test – Revised, CAVE = Content Analysis of Verbatim Explanations CHD = coronary heart disease, CVD = cardiovascular disease

3 AIMS OF THE STUDY

Psychosocial factors have gradually been recognized as playing a part in the aetiology and the prognosis of CHD. There is evidence that a low level of optimism is connected with an elevated risk of developing CHD and it seems to worsen the outcomes of the treatment in situations when CHD is already present. However, there is still a paucity of knowledge about this connection. There are some findings that the connection of optimism and CHD is merely based on the level of pessimism instead of optimism, supporting the theory that the construct of optimism actually consists of two independent variables, i.e. optimism and pessimism. It is unclear how these personal traits eventually influence the course of CHD.

The purpose of the present thesis was to study the construct of optimism (i.e. are optimism and pessimism two independent variables?) (I-IV), to explore the connection of optimism and/or pessimism with the incidence of coronary heart disease (I) and with the risk of CHD-induced death (II) and if this connection is detected, to examine if the level of inflammation plays any part in mediating the connection (III). The focus was also on the connection between optimism/pessimism and dietary habits and the ability to improve them as a marker of the connection between the optimism construct and the healthiness of the way of life (IV).

The specific aims were to study:

1. the incidence of coronary heart disease cases in the view of optimism and pessimism (I).
2. the mortality caused by coronary heart disease in the view of optimism and pessimism (II).
3. whether the level of pessimism induces coronary heart disease via inflammation (III).
4. if the dietary habits and the ability to change them are connected with optimism and pessimism (IV).

4 MATERIAL AND METHODS

4.1 Study subjects – the GOAL study

The birth rate in the Western countries like Finland is slowly diminishing while the life expectancy in the same areas is simultaneously growing and so the age structure is changing at a remarkable rate (Statistics Finland, 2018; United Nations, 2017). There are fewer working-age people to take care of the elderly, which means that new and better ways to organize their care must be found. Many actions have been made in order to manage this problem. One of them is a Finnish research and development project on ageing and well-being called GOAL (Good Aging in Lahti Region). The Finnish name of the project is "Ikihyvä" meaning "Forever Good".

At the end of 20th century, it was recognized in the Päijät-Häme region (a province in Southern Finland with the city of Lahti as its capital) that there were regional demands to improve health and well-being of the aging population as well as a need to find innovations to provide more efficient health care. This led to the initiation of a research and development project called GOAL. The aim of GOAL is to improve physical and psychosocial well-being as well as to improve active living among ageing citizens in the Lahti region.

This collaborative framework consists of a network including the University of Helsinki (particularly the Palmenia Centre for Continuing Education and Department of Social Policy), The National Institute for Health and Welfare, UKK Institute for Health Promotion, Lahti Polytechnic (Faculty of Social and Health Care) and Päijät-Häme hospital district with its municipalities.

The core of GOAL is a 10-year cohort follow-up study started in 2002. Stratified (age, sex, municipality) random samples of men and women born in 1926–30, 1936–40, and 1946–50 were drawn from the population register of all 14 municipalities in the province of Päijät-Häme. A total of 4,272 subjects were invited and 2,815 (66%) participated in the project (Table 2). Assessments of study subjects were made in 2002, 2005, 2008 and 2012. At baseline in 2002, the study subjects filled in questionnaires concerning their current life status and lifestyle: e.g. socio-economic background, health status, functional ability, use of health services, quality of life, lifestyle, and health-related cognitions. Life Orientation Test – Revised (LOT-R),

Food Frequency Questionnaire (FFQ), Alcohol Use Disorders Identification Test (AUDIT) as well as a variety of clinical measures and laboratory tests were carried out. In addition to laboratory tests, blood samples were also drawn and frozen for later assessments.

The subject groups of this study were formed out of the participants of the GOAL study. The comprehensive data collected by questionnaires during the 10-year follow-up, the official register of the causes of death and the results of the laboratory tests taken at the baseline of the GOAL study were available. In addition to those laboratory tests also the frozen blood samples stored during the study were examined.

Table 2. The participants of GOAL

	n	Age (Mean +/- SD)
Men	1,350	64.0 (8.0)
Women	1,465	63.6 (8.2)

4.2 Life Orientation Test – Revised

In the year 1985, Scheier and Carver published their article concerning dispositional optimism (Scheier & Carver, 1985). The article introduced also a scale for measuring this new variable. The researchers had noticed that even if optimism and pessimism seemed to be quite consistent and apparently easy to observe and the differences of those properties between individuals were clear, they had not been previously widely investigated and most of the studies dealing with such concepts treated them as outcomes rather than causes. Earlier studies had also dealt with optimism and pessimism as transient and variable states instead of considering them as stable personal traits. In their study, which derived from a general model of behavioral self-regulation, Scheier and Carver defined dispositional optimism in terms of generalized outcome expectancies. According to the researchers, the primary purpose of their study was to report "their attempt to begin the exploration of the possibility that optimism, construed as a stable personality characteristic, has important implications for the manner in which people regulate their actions". The

proposition of the article was that optimism may have a variety of consequences, of which some are health-related.

At first the scale was formed out of 16 original items in the form of propositions, and after several revisions, those seeming most reliable and most informative remained and formed the final scale of eight items. Out of those eight items, four were oriented positively (e.g. "In uncertain times, I usually expect the best") and four were keyed in a negative direction (e.g. "If something can go wrong for me, it will). The scale included also four filler items. The respondents of the scale were asked to answer to the propositions on a scale from 0 (= strongly disagree) to 4 (= strongly agree). The scale was named the Life Orientation Test (LOT) (Scheier & Carver, 1985).

LOT was promptly used in many investigations and it proved to be a valuable and consistent tool for assessing the construct of dispositional optimism (Aspinwall & Taylor, 1992; Billingsley et al., 1993; Carver & Gaines, 1987; Litt et al., 1992; Scheier et al., 1989; Scheier & Carver, 1987; Strack et al., 1987). Later it was found that even if the consistency of LOT was proven to be quite good, some other variables, particularly neuroticism, which is most likely a multi-factor variable in itself, might interfere with the results obtained from the scale (Marshall & Lang, 1990; Robbins et al., 1991; Smith et al., 1989). Therefore, the developers of LOT re-evaluated the scale and a new and slightly modified scale of optimism, Life Orientation Test – Revised (LOT-R), was introduced in 1994 (Scheier et al., 1994) (Appendix 1). Two of the positively worded propositions of LOT were found not to refer to the expectation of positive future outcomes and they were replaced with one new positively keyed proposition. In order to maintain the balance between the numbers of negatively and positively worded questions, one negatively worded proposition was eliminated. Thus, the LOT-R has six questions, three of them are worded positively and three are worded negatively. The four fillers remained in the questionnaire. The style of the answers remained also the same as compared to LOT: 0 = strongly disagree, 1 = disagree, 2 = neutral, 3 = agree, and 4 = strongly agree (Scheier et al., 1994).

When interpreting the LOT-R score, the points from the positively worded items are usually combined with the reverse scored points of the answers of the negatively worded propositions, and the result describes the amount of dispositional optimism on a unidimensional and bipolar scale, namely dispositional optimism, which has optimism at one end and pessimism at the other. LOT-R is good at measuring expectations, and the items agree very closely with the dictionary definitions of optimism and pessimism.

Later studies on the factor structure have suggested that both LOT and LOT-R may have two separate and independent dimensions, namely optimism and pessimism (Chang et al., 1994; Kubzansky et al., 2004; Marshall et al., 1992). This phenomenon was also noticed by the developers of the LOT-R in their original data, but they still decided to keep optimism and pessimism as opposite ends of one bipolar dimension (Scheier et al. 1994). Even if in some studies the unidimensional bipolar model of dispositional optimism has been at least as accurate as the bidimensional counterpart (Ribeiro et al., 2012; Segerstrom et al., 2011; Scheier & Carver, 1985), confirmatory factor analytic studies of both the LOT and LOT-R generally indicate that optimism and pessimism are two independent variables and distinguishing between optimism and pessimism has been recognized as being very useful in many other studies, leading to a better prediction of outcomes (Chang et al., 1994; 1997; Glaesmer et al., 2012; Herzberg et al., 2006; Kubzansky et al., 2004; Marshall et al., 1992; Robinson-Whelen et al., 1997). In the bipolar model, optimism and pessimism might hide some of each other's results, and some data may be lost in the process. As a compromise, it has also been suggested that while dispositional optimism might be a unidimensional continuum, the tests used to measure this variable – including the LOT and LOT-R – provide answers in two separable dimensions, i.e. optimism and pessimism (Monzani et al., 2014). It has also been debated that the questions worded negatively might be better at measuring this personal trait than the optimistically oriented questions, which could lead to a weak statistical power of the optimism subscale. This could give the impression that these two variables are probably not connected (Roy et al., 2010).

Since the introduction of LOT-R, some other scales for determining these variables have also been devised and introduced, e.g. Extended Life Orientation Test (ELOT) (Chang et al., 1997), which was intentionally meant to be used to as a bidimensional tool. Nonetheless, LOT-R still remains by far as the most widely used scale for determining dispositional optimism (and pessimism) (Schou-Bredal et al., 2017). Its consistency has been proven to be solid since it was introduced in 1994.

4.3 Food Frequency Questionnaire

Dietary habits of the participants of this study were defined by using a questionnaire developed for the GOAL study. The respondents were asked about their recent dietary habits with a food frequency questionnaire (FFQ) where different foodstuffs were divided into 24 categories. The respondents were asked how often they had

consumed the foods in each category during the last seven days. The answers were scaled from 1 (not at all) to 4 (on six or seven days) (Appendix 2).

4.4 Alcohol Use Disorders Identification Test

Alcohol consumption is strongly related to health and the use of alcohol is usually determined in studies concerning health behaviour. The most widely used test in screening the use of alcohol is the Alcohol Use Disorders Identification Test (AUDIT). AUDIT was developed as a collaborative project sponsored by World Health Organization (WHO) to determine if a person might be at risk for problems caused by the consumption of alcohol (Saunders et al., 1993). In this study, the alcohol consumption habits were determined by using an abbreviated version of the original 10-item version of AUDIT, namely the Alcohol Use Disorders Identification Test – Consumption (AUDIT-C); this utilizes the first three items about alcohol consumption (Bush et al., 1998) and it has been found to be as reliable in detecting unhealthy alcohol use as the original AUDIT (Kriston et al., 2008) (Appendix 3).

4.5 Laboratory measurements

In 2002, at the beginning of the GOAL study, the levels of blood glucose and blood total and high-density lipoprotein (HDL) cholesterol of the participants were determined with standardized methods. For the study about pessimism, low-level inflammation and the incidence of CHD (substudy III), the levels of hs-CRP were determined in 2016 using blood samples which had been taken and frozen at the beginning of the GOAL study.

4.6 Clinical measurements

At the beginning of the cohort study, the test subjects completed several questionnaires concerning their current life status (e.g. psychosocial background, socio-economic status, health and lifestyle (e.g. physical exercising, dietary habits, smoking and the use of alcohol). The use of medications was also documented. Study subjects were measured for height and weight, and their body mass indexes (BMI)

were calculated. Waist circumference was measured at a level midway between the lowest rib and the iliac crest. At the launch, the blood pressure of the study subjects was measured three times and the average value was documented.

According to laboratory and clinical measurements, a general cardiovascular disease risk score (CVD risk score) was calculated for each participant. This scoring was developed as a part of the Framingham Heart Study for use in primary care (D'Agostino et al., 2008). It is a sum of sex-specific scorings of the following general risk factors for cardiovascular diseases: age, total cholesterol, HDL cholesterol, systolic blood pressure, smoking, and diabetes. The scoring of systolic blood pressure in the CVD risk algorithm depends on whether or not the subject is being treated for hypertension. Smoking status was recorded as regular smoking or not, and diabetes was defined as fasting glucose ≥7 mmol/L, the use of insulin, the use of oral antidiabetic drugs, or a self-report of having diabetes diagnosed by a doctor.

For some calculations the study subjects were divided according to their answers into "heavy-drinkers" (= those who used five or more units of alcohol in one sitting) and "non-heavy drinkers" and into the subgroups of "regular physical exercise" (= those who exercised for 30 minutes at least twice a week) and non-regular physical exercise.

4.7 Statistical analyses

Categorical variables were handled using the Pearson's Chi-squared test (I-IV). The nonparametric Mann-Whitney U (I-IV) and Kruskal-Wallis test (II, IV) were used for continuous variables. Logistic regression models were calculated to estimate the fully adjusted odd ratios for the variables under investigation (I-IV). The dimensions of the LOT-R scale were assessed using exploratory factor analysis with varimax rotation (I). A general cardiovascular disease risk score (CVD risk score), which was developed as a part of the Framingham Heart Study for use in primary care (D'Agostino et al., 2008), was calculated for each study participant (II). Spearman´s correlation coefficient (rho) was calculated to assess the association between pessimism and hs-CRP (III). Indirect mediation effects between pessimism and incidence of CHD due to the level of hs-CRP were calculated using equations devised by MacKinnon and Dwyer (MacKinnon & Dwyer, 1993), which are based on Baron and Kenny's four steps in establishing mediation (Baron & Kenny, 1986). To assess the statistical significance of this indirect mediation effect, the Sobel test was used. Due to the skewed distribution of hs-CRP, a logarithmic transformation

was performed (III). Dietary pattern models were created by using principal component analysis (PCA) with Varimax rotation and Kaiser normalization, factor loadings with absolute values more than 0.35 were considered as significant (IV). Student´s t-test was used to study the associations between optimism, pessimism, and the different dietary patterns (IV).

The statistics were calculated with SPSS 22.0, SPSS 22.1 and SPSS 22.2 (SPSS Inc., Chicago, IL, USA).

4.8 Ethical considerations

The cohort study of GOAL was approved in 2002 by the Ethics Committee of Päijät-Häme Central Hospital, and this study into the connection of optimism, pessimism and CHD was approved in 2013 by the Ethics Committee of Pirkanmaa Hospital District (R12013). Written informed consent was requested and obtained from all cohort participants in 2002. The research was conducted in compliance with the World Medical Association Declaration of Helsinki (WMA 2013).

5 RESULTS

5.1 Results of the LOT-R (I-IV)

5.1.1 Optimism and pessimism

The results of the LOT-R were used as variables in every substudy (I-IV). When the whole study population was evaluated, there were no statistically significant differences between women and men either in terms of optimism (LOT-R subscale score mean (SD): 8.37 (2.15) vs. 8.27 (2.15), $p = 0.281$) or pessimism (LOT-R subscale scale score mean (SD): 3.89 (2.67) vs. 4.00 (2.73), $p = 0.360$, respectively). No differences were found in optimism in the various age groups (ages 52–56 vs. 62–66 vs. 72–76 years at baseline: 8.25 (2.20) vs. 8.31 (2.16) vs. 8.40 (2.15), $p = 0.521$). Nevertheless, there was a statistically significant trend that those with a higher age were more pessimistic (3.40 (2.77) vs. 3.94 (2.62) vs. 4.62 (2.61), $p < 0.001$, respectively) than their younger counterparts, a finding that has also been reported in other studies (Glaesmer et al., 2012; Schou-Bredal et al., 2017).

When the individuals who had died during the study period were excluded, those study subjects who stayed in the cohort study for the whole surveillance time were less pessimistic than those who dropped out (mean 3.54 (SD 2.58) versus 4.30 (2.87), $p < 0.001$). In terms of optimism, there was no difference between the groups (8.41 (2.10) versus 8.28 (2.21), $p = 0.378$).

5.1.2 The two-factor –model of optimism and pessimism

At the beginning of the study, it was determined whether optimism and pessimism in the research material of GOAL study fell on one bipolar continuum or if they were two different and independent factors (= two-variable model). All the questions (without the fillers) of the LOT-R and their answers were included in a factor analysis with varimax rotation and Kaiser normalization. A clear-cut two-factor solution was detected, which strongly supports the concept that optimism and pessimism are two

separate variables, at least in this study population, when assessed with the LOT-R scale (Table 3). For this reason, optimism and pessimism were handled separately in all further analyses (studies I-IV). The results from every substudy, which will be described later, confirm the validity of this separation.

Table 3. The two-factor structure of the revised Life Orientation Scale in principal component analysis with varimax rotation and Kaiser normalization.

	Optimism	Pessimism
In uncertain times, I usually expect the best.	**0.717**	-0.129
If something can go wrong for me, it will.	0.060	**0.778**
I am always optimistic about the future.	**0.764**	0.081
I hardly ever expect things to go my way.	-0.004	**0.838**
I rarely count on good things happening to me.	0.112	**0.812**
Overall, I expect more good things to happen to me than bad.	**0.667**	0.247

Absolute values higher than 0.35 are statistically significant

5.2 Optimism and pessimism, and the incidence of CHD (I)

Those who developed CHD during the ten-year follow-up had been significantly more pessimistic at baseline than the subjects in the control group, i.e. those who did not have CHD after the ten-year follow-up (LOT-R pessimism subscale score mean (SD): 4.43 (2.70) vs 3.51 (2.61), $p = 0.001$). With respect to optimism, no such difference was found (LOT-R optimism subscale score mean (SD): 8.49 (1.94) vs 8.37 (2.12), $p = 0.61$). When studied by gender, differences in pessimism scores were the same in the total sample both in men (4.39 (2.73) among those who developed CHD vs 3.52 (2.66) among those who remained healthy) and in women (4.48 (2.70) vs 3.49 (2.58)), although the differences were no longer statistically significant ($p =$

0.15 and p = 0.17, respectively). The LOT-R optimism subscale scores were similar among those who became ill and those who remained healthy both in men (8.56 (1.80) vs 8.32 (2.13), p = 0.43) and in women (8.39 (2.12) vs 8.40 (2.12), p = 0.93).

Those men who at the follow-up reported having CHD had had higher blood glucose levels and higher waist circumferences at baseline than the other men. There was also a trend that those who developed CHD had higher values of BMI and systolic blood pressure at baseline. The findings in women were the same in both groups, except that there was a difference in BMI which was not only trend, but was actually statistically significant (Table 4).

Table 4. Risk factors at baseline and incidence of CHD heart disease in the ten-year follow-up.

	Men					Women				
	Coronary heart disease				Mann-Whitney *U* Test	Coronary heart disease				Mann-Whitney *U* Test
	Yes N=57		No N=580			Yes N=44		No N=755		
	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
Body mass index (kg/m^2)	28.11	3.72	27.26	3.68	0.075	29.11	4.48	27.53	4.85	**0.011**
Blood glucose (mmol/L)	6.17	1.26	5.71	0.90	**0.023**	5.97	1.66	5.34	0.79	**<0.001**
Cholesterol (mmol/L)	5.94	0.97	5.76	1.05	0.123	5.98	1.18	5.94	0.99	0.828
Waist circum-ference (cm)	100.9	9.2	98.4	10.5	**0.044**	94.4	12.4	90.0	12.7	**0.017**
Systolic BP (mmHg)	149.7	20.6	144.6	17.3	0.083	147.5	19.0	142.6	18.3	0.098
Diastolic BP (mmHg)	87.2	8.0	88.7	9.7	0.241	84.0	9.3	85.3	9.1	0.376

BP=blood pressure

In terms of health behaviours, three not unexpected differences were found between the groups. Medication for hypertension and diabetes was more common in both genders among those who reported having CHD in the ten-year follow-up than in the others. A corresponding significant difference was found in the use of statins in women while the same difference was only a trend among men. Men who were 'heavy drinkers' seemed to have a lower risk for developing CHD (Table 5).

Table 5. Health behaviours at baseline and incidence of coronary heart disease in men and women in the ten-year follow-up.

	Men						Women					
	Coronary heart disease						Coronary heart disease					
	Yes		No				Yes		No			
	N	%	N	%	Chi-squared	*p*- value	N	%	N	%	Chi-squared	*p*-value
Heavy drinking												
No	53	10.3	461	89.7			43	5.5	733	94.5		
Yes	4	3.3	119	96.7	6.070	**0.014**	1	4.3	22	95.7	0.061	0.805
Daily smoking												
No	45	8.3	498	91.7			39	5.4	685	94.6		
Yes	12	12.8	82	87.2	1.973	0.160	5	6.7	70	93.3	0.214	0.644
Regular exercise												
No	28	8.7	293	91.3			15	4.8	295	95.2		
Yes	29	9.2	287	91.3	0.040	0.841	29	5.9	460	94.1	0.435	0.510
Use of statins												
No	46	8.2	513	91.8			36	4.9	692	95.1		
Yes	11	14.1	67	85.9	2.898	0.089	8	11.3	63	88.7	4.970	**0.026**
Medication for hypertension												
No	38	7.7	454	92.3			25	4.1	587	95.9		
Yes	19	13.1	126	86.9	3.978	**0.046**	19	10.2	168	89.8	10.160	**0.001**
Medication for diabetes												
No	51	8.3	560	91.7			40	5.1	746	94.9		
Yes	6	23.1	20	76.9	6.641	**0.010**	4	30.8	9	69.2	16.207	**<0.001**

Multivariate logistic regression models were devised separately in men and women to evaluate the risk for coronary heart disease. Variables in univariate analyses that associated with coronary heart disease ($p<0.10$) were included. Blood glucose and the use of drugs for diabetes were processed as one variable as were elevated systolic blood pressure and the use of drugs for hypertension. In men, pessimism associated statistically significantly with the risk for CHD. In women, no such association seemed to be present although there seemed to be a trend suggestive of a connection (Table 6). When comparing the highest and the lowest quartiles of

pessimism in a similar model, men who were in the highest quartile of pessimism had an over four-fold adjusted risk for CHD as compared to those in the lowest quartile (adjusted OR 4.11, 95 % CI 1.68–10.04, p = 0.002). A statistically significant difference was not found in women between the highest and lowest quartiles of pessimism (adjusted OR 1.56, 95 % CI 0.57–4.29, p = 0.386).

Table 6. Risk for coronary heart disease in men and women during ten-year follow-up.

	Risk for coronary heart disease			
	Men		Women	
	OR	95% CI	OR	95% CI
Age (years)	1.03	0.99–1.08	1.08	**1.03–1.13**
Body mass index (kg/m^2)	1.00	0.85–1.18	0.99	0.87–1.12
Blood glucose (mmol/L)	1.40	**1.09–1.79**	1.40	**1.11–1.77**
Waist circumference (cm)	1.00	0.95–1.06	1.02	0.96–1.07
Systolic blood pressure (mmHg)	1.01	0.99–1.03	1.00	0.99–1.02
Use of statins (yes vs no)	1.55	0.73–3.25	1.67	0.71–3.94
Heavy drinking (yes vs no)	0.32	**0.11–0.93**	…	…
Pessimism (score)	1.10	**1.00–1.22**	1.07	0.94–1.20

OR = fully adjusted odds ratio, 95% CI = 95% confidence interval.

Heavy drinking among women was not included, because it did not seem to associate with the risk of CHD in the univariate analysis.

5.3 Optimism and pessimism, and CHD mortality (II)

The cohort study of the GOAL project lasted for 10 years (2002-2012). In addition to that ten-year period, the official statistics of causes of death among the study subjects were followed for one more year for. Consequently, the follow-up period of this study lasted for 11 years.

Men died from CHD more often than women during the follow-up (87/1,047 (8.3%) vs 34/1,220 (2.8%), chi-squared 34.01, $p<0.001$). Furthermore, those who died from CHD were older at baseline (mean 70.0 years (SD 6.2) vs 62.5 years (SD 7.8), $p<0.001$).

Those who died from CHD during the eleven-year follow-up had been significantly more pessimistic at baseline than the subjects who were still alive (LOT-R subscale score mean (SD): 4.78 (2.41) vs 3.77 (2.64), $p<0.001$), while in terms of optimism, there was no difference (LOT-R subscale score mean (SD): 8.40 (2.17) vs 8.37 (2.09), $p = 0.98$, respectively). These findings apply to both genders.

Those men and women who had died from CHD during the follow-up had had lower baseline total and HDL cholesterol levels and higher blood glucose levels than those men and women who were still alive, and their total general CVD risk scores were higher (the higher the scores, the higher the risk). Not surprisingly, those men and women who died from CHD during the follow-up, at baseline had more often reported having CHD diagnosed by a doctor. They also used medication for hypertension and diabetes more often than the other men and women (Table 7).

When building a logistic regression model for the risk of death from CHD, instead of using separate single risk factors, the only factors included were the baseline pessimism subscale score, the presence of CHD, and the general CVD risk score, which includes the most significant physiological risk factors for CHD (age, gender, total cholesterol, HDL cholesterol, systolic blood pressure, smoking, and diabetes).

Table 7. Risk factors at baseline and death from coronary heart disease during the eleven-year follow-up in men and women.

HDL = high-density lipoprotein; CVD = cardiovascular disease; LOT-R = Life Orientation Test – Revised; CHD = coronary heart disease

	Men					Women				
	Death from coronary heart disease				Mann–Whitney *U* test	Death from coronary heart disease				Mann–Whitney *U* test
	Yes N=87		No N=975			Yes N=35		No N=1,201		
	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
Total cholesterol (mmol/L)	5.26	1.08	5.67	1.09	**0.01**	5.52	1.44	5.90	1.03	**0.03**
HDL cholesterol (mmol/L)	1.21	0.30	1.37	0.36	**<0.001**	1.47	0.41	1.65	0.45	**0.04**
Systolic BP (mmHg)	148	23	146	18	0.39	152	25	145	20	0.09
Blood glucose (mmol/L)	6.48	1.86	5.86	1.27	**0.001**	5.91	1.00	5.51	1.16	**0.001**
CVD risk score	18.2	3.5	15.9	3.7	**<0.001**	18.0	3.5	14.1	4.2	**<0.001**
LOT-R optimism score	8.37	2.15	8.34	2.11	0.97	8.45	2.31	8.40	2.07	0.87
LOT-R pessimism score	4.56	2.51	3.78	2.68	**0.008**	5.34	2.03	3.75	2.61	**<0.001**
	%		%		Chi-squared test *p*-value	%		%		Chi-squared test *p*-value
CHD at baseline	42.5		9.4		**<0.001**	51.4		5.7		**<0.001**
Use of drugs for hypertension	42.5		27.0		**0.002**	28.6		60.0		**<0.001**
Use of drugs for diabetes	19.5		5.2		**<0.001**	14.3		3.4		**0.001**
Regular smoker	20.7		15.9		0.25	2.9		9.5		0.18

Pessimism was statistically significantly and independently associated with the risk of death from CHD (Table 8; Model 1). To highlight the significance of pessimism as a risk factor for CHD-induced death, the highest and the lowest quartiles of pessimism were compared in a similar model. Those who were in the highest quartile of pessimism had nearly a 2.2-fold higher adjusted odds ratio for dying from CHD during the eleven-year follow-up period when compared to those in the lowest quartile of pessimism (Table 8; Model 2).

Table 8. Adjusted risk of death from coronary heart disease during the eleven-year follow-up.

	Risk of death from coronary heart disease					
	Model 1			Model 2		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
CHD at baseline	8.09	5.35-12-23	**<0.001**	7.41	4.38-2.53	**<0.001**
CVD risk score at baseline	1.26	1.19-1.33	**<0.001**	1.30	1.21-1.39	**<0.001**
Pessimism (score)	1.08	1.00-1.16	**0.039**	…	…	…
Pessimism quartile (highest/lowest)	…	…	…	2.18	1.21-3.89	**0.010**

OR = adjusted odds ratio; 95% CI = 95% confidence interval; CHD = coronary heart disease; CVD = cardiovascular disease.

Model 1 = the pessimism score is included as a continuous variable.

Model 2 = the pessimism score has been divided into quartiles and the highest quartile has been compared with the lowest quartile.

Both models include the presence of CHD and the CVD risk score at baseline.

5.4 Optimism, pessimism and inflammation, and incidence of CHD (III)

Those who developed CHD during the 10-year study period had some notable differences compared to those who stayed healthy, as mentioned earlier. In substudy III, the risk factors were dealt with somewhat differently, e.g. the use of alcohol was measured by using AUDIT-C, an abbreviated version of the original AUDIT. A new variable compared to the other substudies was the presence of inflammation as measured by the level of hs-CRP. Those who developed CHD during the follow up

had had higher levels of inflammation at the baseline (Table 9). The pessimism score and the C-reactive protein value correlated weakly but nonetheless statistically significantly (rho 0.119, $p < 0.01$).

Table 9. Baseline characteristics and incidence of coronary heart disease during the 10-year follow-up

Risk factors at baseline (2002)	A new case of CHD during the 10-year follow-up (2002-2012)				Mann-Whitney *U* test
	No N=1,357		Yes N=200		
	Mean	SD	Mean	SD	*p*-value
Optimism score	8.39	2.07	8.45	2.05	0.69
Pessimism score	3.47	2.55	4.56	2.53	**<0.001**
B-glucose (mmol/L)	5.51	0.88	6.11	1.47	**<0.001**
Total cholesterol (mmol/L)	5.87	1.01	5.85	1.13	0.91
HDL cholesterol (mmol/L)	1.57	0.43	1.38	0.40	**<0.001**
Age (years)	60.7	7.2	66.7	7.5	**<0.001**
Systolic BP (mmHg)	143.4	17.8	150.0	19.6	**<0.001**
Diastolic BP (mmHg)	86.7	9.4	85.5	10.0	0.09
Body mass index (kg/ m^2)	27.4	4.4	29.2	5.1	**<0.001**
hs-CRP (mg/L)	2.26	3.61	3.34	6.65	**<0.001**
AUDIT-C	2.81	2.23	2.55	2.43	**0.025**

SD = standard deviation; HDL = high density lipoprotein; BP = blood pressure; hs-CRP = high sensitivity C-reactive protein; AUDIT-C = Alcohol Use Disorders Identification Test (Consumption)

The values of variables in this table differ slightly compared to the results of substudy I because in this study also those who had died during the follow up were included.

New cases of CHD were more common among men than women and among daily smokers than non-daily smokers. Regular physical exercise activity and the incidence of CHD associated negatively during the ten-year follow-up (Table 10).

Table 10. Baseline characteristics and CHD during the ten-year study period.

	A new case of coronary heart disease during the 10-year follow-up (2002–2012)				Chi-squared value	p-value
	Yes N = 200		No N = 1,357			
	N	%	N	%		
Gender						
Men (N=715)	123	17.2	592	82.8		
Women (N=842)	77	9.1	765	90.9	23.43	**<0.001**
Regular physical exercise						
Yes (N=900)	102	11.3	798	88.7		
No (N=657)	98	14.9	559	85.1	4.36	**0.04**
Daily smoking						
Yes (N=598)	101	16.9	497	83.1		
No (N=959)	99	10.3	860	89.7	14.19	**<0.001**

Regular physical exercise = those who exercised for at least 30 minutes per session at least twice a week. Daily smoker = those who had smoked daily at least a year during their life-time.

In the fully adjusted logistic regression (Table 11) without pessimism and hs-CRP in the model, higher age, higher blood glucose, lower HDL cholesterol, daily smoking, and lack of regular physical exercise – but not gender, systolic blood pressure, alcohol use (AUDIT-C score), and body mass index – associated with the risk of developing CHD during the follow-up period (Model I). When pessimism and hs-CRP were included in the model, the result remained essentially the same (Model II). However, in this model, the risk for developing CHD was associated with male gender but no longer with a lack of regular physical exercise. Both pessimism and hs-CRP associated independently with the risk of having a new case of CHD during the follow-up.

A statistically significant indirect mediation effect was found between pessimism and developing coronary heart disease via the level of high sensitivity C-reactive protein (accounting for 28.5% of the connection between pessimism and the incidence of CHD, $Z = 3.03$, $p = 0.001$) during the 10-year study period.

Table 11. Baseline characteristics and the risk of developing coronary heart disease during the 10-year follow-up.

	Model I	Model II
	OR (95% CI)	OR (95% CI)
Gender (males/females)	1.49 (0.99-2.23)	**1.59 (1.05-2.40)**
Age (years)	**1.12 (1.09-1.14)**	**1.11 (1.08-1.14)**
Systolic blood pressure (mmHg)	**1.01 (1.00-1.02)**	1.01 (0.98-1.02)
Body mass index (kg/m^2)	**1.03 (1.00-1.07)**	1.02 (0.98-1.06)
B-glucose (mmol/L)	**1.29 (1.12-1.48)**	**1.28 (1.11-1.47)**
HDL cholesterol (mmol/L)	**0.51 (0.32-0.84)**	**0.53 (0.33-0.86)**
Daily smoking (yes/no)	**2.19 (1.51-3.17)**	**2.10 (1.46-3.05)**
AUDIT-C score	0.93 (0.86-1.02)	0.93 (0.85-1.01)
Regular physical exercise (yes/no)	**0.71 (0.51-0.99)**	0.74 (0.53-1.03)
Pessimism score	…..	**1.10 (1.04-1.17)**
High-sensitivity CRP	…..	**1.20 (1.01-1.41)**

Fully adjusted logistic regression models: Model I does not include the pessimism score and hs-CRP in the model. Model II includes the pessimism score and hs-CRP in the model.

5.5 Optimism and pessimism, and dietary habits (IV)

By using the data from the food frequency questionnaire in 2002, the study subjects were divided into different dietary pattern groups with a principal component analysis (PCA). The analysis resulted in four nearly independent dietary patterns, which we named as 'healthy', 'sweet unhealthy', 'fatty unhealthy' and 'traditional' diets (Table 12). In the further analyses, PCA scores were used as independent variables to describe the amount of each different dietary pattern in the study subjects. Only those study subjects who had adequate data from the baseline and after the three-year follow-up were included in the analyses of this substudy.

Table 12. Rotated factor matrix for dietary patterns created by using principal component analysis. Factor loadings with absolute values of >0.35 have been presented in bold. Negative loadings indicate the lack of foodstuff in question belonging to certain dietary patterns.

	Dietary pattern			
Foodstuff	Healthy	Sweet unhealthy	Fatty unhealthy	Traditional
Porridge, cereals	**0.382**	-0.001	-0.152	0.249
Fish	**0.397**	-0.109	0.060	-0.097
Lunch meats, cold cuts	**0.359**	0.214	0.055	0.142
Fresh vegetables/root vegetables	**0.664**	-0.018	-0.131	0.005
Cooked vegetables	**0.646**	-0.049	-0.032	-0.098
Berries and fruits	**0.589**	0.076	-0.171	0.181
Fruit or berry juice	**0.378**	0.081	0.189	0.037
Sweet pastries	0.109	**0.597**	-0.031	0.256
Ice cream	0.088	**0.495**	0.085	-0.131
Candies	-0.043	**0.701**	0.033	0.078
Chocolate	0.035	**0.677**	0.098	-0.032
Salty snacks	-0.024	**0.352**	0.195	-0.221
Fried potatoes, French fries	-0.005	0.026	**0.489**	-0.059
Low-fat cheese	**0.411**	0.142	**-0.368**	-0.066
Other cheese	-0.004	0.025	**0.609**	0.108
Sausages	-0.147	0.240	**0.493**	0.065
Sliced sausages	-0.111	0.139	**0.558**	0.053
Eggs	0.151	0.013	**0.475**	-0.057
Soft drinks	-0.103	0.305	**0.352**	-0.125
Meat dishes	0.028	0.132	**0.366**	**0.552**
Chicken, turkey	**0.443**	0.003	-0.048	**-0.415**
Boiled or mashed potatoes	0.230	0.002	0.101	**0.658**
Rice, pasta	0.294	0.088	0.115	**-0.409**
Pizza, hamburgers	-0.021	0.263	0.169	-0.302

The medians of the LOT-R optimism and pessimism subscale scores were used to classify the study subjects into low and high optimism and low and high pessimism groups (according to the previous substudies optimism and pessimism were processed as separate factors). PCA scores were compared between these groups. At baseline, higher optimism and lower pessimism were associated with a 'healthy' dietary pattern. Optimism and pessimism did not seem to play any role in the 'sweet unhealthy' and 'traditional' dietary patterns, but high pessimism and the 'fatty unhealthy' dietary pattern associated significantly (Table 13).

Table 13. Comparisons of principal component analysis scores of dietary patterns between groups with low or high pessimism, and low or high optimism

	Principal component analysis scores (mean)							
	Healthy dietary pattern	*p* [1]	Sweet unhealthy dietary pattern	*p* [1]	Fatty unhealthy dietary pattern	*p* [1]	Traditional dietary pattern	*p* [1]
Low pessimism (N=1,274) [2]	0.071		0.029		-0.048		-0.006	
High pessimism (N=1,351) [3]	-0.066	**<0.001**	-0.027	0.153	0.046	**0.016**	0.006	0.762
Low optimism (N=1,210) [2]	-0.085		0.000		-0.019		0.026	
High optimism (N=1,415) [3]	0.073	**<0.001**	-0.000	0.995	0.016	0.365	-0.022	0.213

[1] Student´s t-test. [2] Below the median. [3] Median or higher.

The follow-up lasted for three years and in 2005, the study subjects were examined again. Now, 93% of the original sample (2,625 subjects) had adequate responses in both 2002 and 2005 and could therefore be included in the analyses. In 2005, the study subjects were asked if they had tried to improve or were about to improve their dietary habits, and if they had tried to improve their diet, how had they managed to achieve their goals. The possible improving styles in the diet were further divided into five subgroups: reducing the consumption of fat, changing to low-fat products, reducing the consumption of sugar, increasing the consumption of vegetables, and increasing the consumption of berries and fruits.

The study subjects in these five subgroups of different improving styles were further divided into four categories according to the possible changes in their diets: 1) those who had not tried to change their eating habits to a healthier diet, even when they thought it would have been beneficial, 2) those who thought their dietary habits were healthy enough even without an improvement, 3) those who had succeeded in improving of their diet, and 4) those who had tried to improve their diet but had failed to do so.

The association between changes in dietary habits during the follow-up and pessimism was quite clear (Table 14). There was a strong trend that those who managed to change to a healthier diet were less pessimistic than the others. The differences were statistically significant in four dietary categories: reducing fat, changing to low-fat products, increasing vegetables, and increasing berries and fruits. The higher the level of pessimism, the less likely the individual was to succeed in improving her/his diet. Nevertheless, those who had tried but failed to reduce their sugar intake were not more pessimistic than others. Optimism was associated with only one dietary change; those who had tried but failed to increase consumption of berries and fruits were less optimistic than others.

Table 14. The association between optimism and pessimism, and the change in dietary habits.

	Has not changed	No need to change	Has changed	Tried to change, but failed	Kruskal-Wallis *p*
Reducing fat	N=82	N=1,059	N=1,280	N=204	
Optimism (Mean (SD))	8.60 (2.02)	8.26 (2.24)	8.39 (2.08)	8.18 (2.14)	0.385
Pessimism (SD)	4.59 (2.60)	4.19 (2.79)	3.62 (2.58)	4.44 (2.81)	**<0.001**
Changing to low-fat products	N=155	N=1,098	N=1,266	N=106	
Optimism (Mean (SD))	8.37 (2.20)	8.28 (2.21)	8.39 (2.09)	8.18 (2.15)	0.674
Pessimism (Mean (SD))	4.46 (2.74)	4.15 (2.77)	3.65 (2.60)	4.47 (2.76)	**<0.001**
Increasing vegetables	N=198	N=1,141	N=1,090	N=196	
Optimism (Mean (SD))	8.46 (2.16)	8.25 (2.28)	8.43 (2.01)	8.10 (2.06)	0.058
Pessimism (Mean (SD))	4.10 (2.69)	4.09 (2.77)	3.69 (2.59)	4.43 (2.79)	**<0.001**
Reducing sugar	N=110	N=1,287	N=986	N=242	
Optimism (Mean (SD))	8.23 (2.13)	8.29 (2.23)	8.42 (2.04)	8.17 (2.18)	0.520
Pessimism (Mean (SD))	4.16 (2.54)	4.04 (2.75)	3.78 (2.69)	3.95 (2.54)	0.145
Increasing berries and fruits	N=128	N=1,520	N=859	N=118	
Optimism (Mean (SD))	8.38 (2.05)	8.39 (2.20)	8.32 (2.05)	7.81 (2.22)	**0.041**
Pessimism (Mean (SD))	4.43 (2.77)	4.02 (2.78)	3.68 (2.51)	4.35 (2.72)	**0.002**

Multivariate logistic regression models were created including several predicting variables for the risk of failure in improving dietary habits (Table 15). Because of the relatively small subgroups, those who had failed in their dietary changes and those who had not even tried to improve their diet even when they recognized the need to do so were combined into one group. Those who saw no need to improve their diets formed another group together with those who had managed to make healthy changes. The models included different dietary patterns, age, sex, smoking and alcohol consumption habits, physical exercise, the levels of blood glucose and cholesterol, body mass index, the possible existence of CHD, and pessimism as explaining variables.

A fatty unhealthy dietary pattern associated with the risk of failure in changing to low-fat products and in increasing the consumption of vegetables. A sweet unhealthy dietary pattern associated with the risk of failures in increasing the consumption of vegetables, in reducing sugar consumption and in increasing their intake of berries and fruits. Finally, the effect of pessimism seemed clear in three out of five subgroups. Pessimism increased the probability of failures in reducing fat, changing to low-fat products, and increasing the consumption of berries and fruits.

To emphasize the association between pessimism and failures in changing dietary habits, the study subjects in the highest and the lowest quarters of pessimism were compared in logistic regression models which were fully adjusted for age, sex, smoking and alcohol consumption habits, physical exercise, the levels of glucose, cholesterol, body mass index and the possible existence of CHD. Those who belonged to the highest quarter of pessimism had a 1.4-fold risk of not succeeding in reducing their consumption of fat (adjusted OR 1.44, 95% CI 1.00–2.08, $p = 0.05$), a 1.5-fold risk of not succeeding in changing to low-fat products (adjusted OR 1.51, 95% CI 1.03–2.21, $p = 0.03$), and a 1.5-fold risk of failing to increase the consumption of berries and fruits in their diet (adjusted OR 1.46, 95% CI 1.01–2.12, $p = 0.02$) as compared to the study subjects in the lowest quarter of pessimism.

Table 15. Odds ratios of different dietary pattern groups, coronary heart disease and pessimism (rows) on the risk of failure in change to more healthy dietary habits (columns) as analysed by logistic regression models. [1]

	Dietary change				
	No change and fail in reducing fat	No change and fail in changing to low-fat products	No change and fail in increasing vegetables	No change and fail in reducing sugar	No change and fail in increasing berries and fruits
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Healthy dietary pattern	0.87(0.76-1.00)	0.88 (0.76-1.01)	**0.79 (0.70-0.89)**	0.92 (0.82-1.04)	**0.75 (0.65-0.86)**
Sweet unhealthy dietary pattern	1.13 (0.99-1.29)	1.07 (0.94-1.23)	**1.26 (1.13-1.40)**	**1.30 (1.16-1.45)**	**1.23 (1.08-1.40)**
Fatty unhealthy dietary pattern	1.10 (0.96-1.26)	**1.14 (1.00-1.31)**	**1.17 (1.05-1.32)**	1.03 (0.92-1.16)	1.13 (0.98-1.30)
Traditional dietary pattern	1.12 (0.98-1.27)	1.02 (0.90-1.17)	0.97 (0.87-1.08)	1.01 (0.90-1.14)	0.89 (0.78-1.02)
Coronary heart disease	1.07 (0.66-1.73)	0.91 (0.54-1.54)	1.20 (0.81-1.80)	**1.52 (1.00-2.31)**	1.41 (0.87-2.28)
Pessimism	**1.07 (1.02-1.12)**	**1.07 (1.02-1.13)**	1.03 (0.99-1.07)	1.02 (0.98-1.07)	**1.05 (1.00-1.11)**

OR = Odds ratio. CI = Confidence interval.

[1] Models are fully adjusted for age, sex, smoking and alcohol consumption habits, physical exercise, body mass index and the levels of blood glucose and cholesterol.

6 DISCUSSION

6.1 Results of the LOT-R

The study population (I-IV) was based on the same cohort study so the basis of the optimism construct was the same for all substudies. The results of LOT-R were in line with the results reported by other investigators. There were no significant differences between men and women in either subcategory (optimism and pessimism) and the results of optimism subscale were not connected to the age of the respondents, although those with a higher age were more pessimistic, a finding that has also been reported in other studies (Glaesmer et al., 2012; Schou-Bredal et al., 2017).

In this study population, the optimism construct seemed to be made up of two independent variables, optimism and pessimism. As mentioned earlier, this finding has been previously reported (Chang et al., 1994 & 1997; Glaesmer et al., 2012; Herzberg et al., 2006; Kubzansky et al., 2004; Marshall et al., 1992; Robinson-Whelen et al. 1997). The results of each substudy confirmed that the separation of optimism into these two factors proved to be useful. The basis of this separation was the clear-cut two-factor solution found with varimax rotation and Kaiser normalization (Table 3). Naturally optimistic and pessimistic subscale did not correlate with each other in any of the substudies, because the study populations were approximately the same (e.g. the subjects with missing data varied only marginally depending on the studied variable), but the fact that pessimism correlated clearly with the outcomes of interest in every study while the only association with optimism and studied outcomes in all the studies was found in substudy IV (the linkage between high level of optimistic subscale and the prevalence of having a healthy diet), also favours the two-factor model of optimism. These findings highlight the need to examine optimism and pessimism separately as two independent variables. Optimism is not the same as the absence of pessimism and vice versa. The fact that the optimism and pessimism subscales did not correlate also means that people should not be categorized simply as "optimists" or "pessimists" as opposites but we should consider that people may have both optimistic and pessimistic properties simultaneously.

6.2 Optimism and pessimism, and the incidence of CHD (I)

This substudy showed that pessimism is a clear and an independent risk factor for coronary heart disease, especially in men even after adjusting for classical well-known risk factors. Moreover, optimism does not seem to associate with the incidence of CHD. This finding of insignificance of optimism specifies the results of some previous studies (Boehm et al., 2011; Giltay et al., 2006; Hansen et al., 2010; Kubzansky et al., 2001; Tindle et al., 2009), because these have approached optimism and pessimism as a unidimensional mental construct, whereas a bidimensional approach was adopted in this study. If we had applied the unidimensional approach, then it would not have been possible to reveal the findings emerging from this study.

While pessimism seems to be a clear risk factor for CHD among men, this kind of a connection was not evident in the women evaluated in this substudy. Similar gender differences between psychosocial factors and overall well-being have also been observed in some other studies. For example, in a Japanese study of over 88,000 men and women, a low perceived level of life enjoyment was a risk factor for stroke and CHD among men, while among women, the level of life enjoyment was not associated with elevated risks of cardiovascular disease (Shirai et al., 2009). In addition, the connection between pessimism and depression has been claimed to be much stronger among men than among women (Sha, 2006). The mechanism of this gender difference is not fully understood. Differences between men and women in somatic responses to stress may at least partly explain this phenomenon. Cardiovascular reactivity to stressors (e.g. the rise in the levels of blood pressure and heart rate) seems to be more significant among men than among women (Lash & Eisler, 1995; Lawler et al., 1995). In addition, the neuroendocrine response to stress seems to be greater in males. Plasma ACTH and cortisol levels rise more significantly in men than in women in stress situations, evidence that men exhibit a greater activation of the hypothalamic–pituitary–adrenal axis to psychological stress (Traustadóttir et al., 2003). These findings suggest that in men, there is a stronger connection between psychosocial factors and CHD than is the case in women, as was evident in this study.

6.3 Optimism and pessimism, and CHD mortality (II)

The main finding of this component of this study was that pessimism is a strong and independent risk factor for death from CHD. The magnitude of the result seemed

to be quite similar when compared to the earlier studies examining this subject (Giltay et al. 2004 & 2006; Tindle et al. 2009). Nevertheless, the results from those other studies cannot be directly compared to these findings because in those publications, the optimism construct was determined as a bipolar single factor, whereas here optimism and pessimism were considered as separate variables. Similarly, to the connection of the optimism construct and the incidence of CHD, optimism did not associate with the mortality rates induced by CHD.

Those with higher scores on the pessimism subscale at baseline may have had more physiological risk factors of CHD already at the beginning of the eleven-year follow-up and one might think that an awareness of those risk factors could be one reason for pessimism. However, pessimism remained a clear risk factor in the logistic regression model which adjusted for concomitant risk factors and on the other hand, it has also been demonstrated that personality traits evolve at a relatively early age and subsequently, they are very stable, so it could be argued that the level of pessimism would not necessarily be connected with the present health status. For example, receiving bad news about one's health seems to have no effect on the LOT-R scores (Billingsley et al., 1993; Schou et al., 2005).

This result – pessimism being the only variable out of optimism and pessimism that mediated the effect of the optimism construct on the risk of CHD-induced death, while the optimism had no influence at all – is not unique. For example, in the review of Rasmussen et al., it was also speculated that the presence or absence of pessimism alone might determine the effect of the optimism construct on cardiac health, regardless of optimism (Rasmussen et al., 2009). This emphasizes the stance that the optimism construct should be viewed as having two separate and independent dimensions, optimism and pessimism, instead of one continuum with two poles. The protective factor against CHD is not optimism as was originally believed. Rather, this study suggests that the protective factor is a lack of pessimism; in fact, optimism exerts practically no impact as a protective factor. This theory is also supported by some other studies (Chang et al., 1994; Glaesmer et al., 2012; Herzberg et al., 2006; Marshall et al., 1992; Robinson-Whelen et al., 1997). This observation would remain obscured if optimism and pessimism were assessed as a part of the same unidimensional construct and the effect of this construct would be substantially smaller. This separation may be beneficial when studying this topic in the future.

The optimism construct seems to have a clear impact on physiological health and CHD mortality even after adjustments for the well-known classical risk factors of cardiovascular diseases. This finding suggests that our knowledge about the

connection between the optimism construct and physical health is still rather incomplete.

6.4 Optimism, pessimism and inflammation, and incidence of CHD (III)

The link between the optimism construct and the risk of CHD has been rarely scrutinized. One postulated theory is that the level of inflammation might function as a mediator between psychosocial factors and CHD and this pathway could be involved also in the connection between pessimism and CHD (Roy et al., 2010). For example, a high level of pessimism has been linked with elevated levels of inflammation markers, increased endothelial dysfunction, and shorter telomere length (Ikeda et al., 2011; 2014). Optimism has been observed to be associated with many indicators of better health, e.g. with higher fruit and vegetable consumption and carotenoid levels which might lower the level of inflammation, with a healthier overall diet and a healthy lipid profile (Boehm et al., 2013a). Furthermore a lower body mass index has been considered as a potential explanation for the association between optimism/pessimism and CHD (Boehm et al., 2013b). In general, optimists seem to have healthier lifestyles. They smoke less, are more physically active, consume more fruit, vegetables and whole-grain bread, and drink alcohol in more moderate amounts (Boehm et al., 2013a; Giltay et al., 2007). Nevertheless, pessimism seems also to be an independent risk factor for CHD even after adjustment of these well-known risk factors, as mentioned earlier.

In this substudy, it was hypothesized that low-level inflammation would correlate with the level of pessimism and that it would be an elevated level of inflammation among those with a higher level of pessimism that would mediate the effect of pessimism on CHD. The main findings of this substudy are that there are clear positive connections 1) between a higher level of pessimism and a higher incidence of CHD; 2) between an elevated level of hs-CRP (as an indicator of low-level inflammation) and a higher incidence of CHD and 3) between higher levels of pessimism and hs-CRP. The elevated level of hs-CRP among the more pessimistic study subjects seemed to mediate nearly 30% of the effect of pessimism on CHD. This is a substantial proportion when it is compared to findings of a previous study on the same research subject, the only study that could be identified (Gramling et al., 2010). In that study, the optimistic perception of one's CVD risk was associated with lower rates of the adverse effects of CVD, but this connection could not be

explained by the mediating effect of the level of inflammation. Parallel findings have also been made with depression, another psychosocial factor. In research originating from the Heart and Soul Study, the connections between depression and inflammation, between depression and CHD, and between inflammation and CHD were confirmed, but there was no evidence of inflammation operating as a mediator in the link between depression and CHD (Whooley et al., 2007). Thus, it seems that the known link between inflammation and many different psychosocial factors does not completely explain the recognized relationship between those psychosocial factors and CHD. Nevertheless, contrary to previous reports, in this study the mediating effect of elevated inflammation level in the connection between the elevated level of pessimism and CHD amounted to 28.5% of the risk for a new case of CHD. This partially confirms the working hypothesis of the study but at the same time suggests that there remain other unknown biological factors mediating the connection between pessimism and CHD.

An elevated amount of low-level inflammation has been recognized by the American Heart Association (AHA) to be an independent indicator of an increased risk of developing CHD (Koenig, 2013). If one wishes to examine this connection, measuring CRP with high sensitivity assays has been proposed to be the most reliable and most useful method (Zakai et al., 2007; Koenig 2013). Thus, it seems quite clear that the level of hs-CRP is a good choice for estimating the amount of low-level inflammation when evaluating the risk of developing CHD. The connection of hs-CRP level and the risk of developing CHD was also confirmed in this study.

6.5 Optimism and pessimism, and dietary habits (IV)

It has been noticed that pessimism is linked with an unhealthier way of life (Boehm et al., 2013a & 2013b; Giltay et al., 2007). In substudy IV, it was noticed that a higher level of pessimism was related to unhealthier diet as well as greater difficulties in improving dietary habits. Thus, while pessimism seems to be an independent risk factor for CHD, these results suggest that it may also be related to an increased risk of CHD via an unhealthier diet, which means that pessimism is an even greater risk factor for CHD. It can also be speculated that there are also other lifestyles known to elevate the risk of CHD that are connected to pessimism, in other words, an unhealthy diet is most probably not the only factor.

This part of the study strengthens the concept of considering optimism and pessimism as two different and independent variables. The statistical power of the

optimism subscale was very small, while pessimism displayed stronger associations with several outcomes.

Improving the diet has a role in both the prevention and treatment of several chronic diseases (Schwingshackl & Hoffmann, 2015). The result of this study – that pessimism was associated with difficulties in improving one's diet – is in parallel with earlier studies on psychosocial factors. Dietary habits have been linked earlier to other psychosocial factors e.g. willpower, self-efficacy, and satisfaction with life (Brownell et al., 1995; Kumanyika et al., 2000; Lappalainen et al., 1997; Steptoe et al., 2000; Strachan & Brawley, 2009; van de Rest et al., 2009). There are also some earlier studies which examined the link between dietary habits and the construct of optimism. In young adults, unipolarly measured optimism had an influence on dietary habits, and pessimism was linked to an unhealthy diet (Kelloniemi et al., 2005). In a study investigating elderly men, a low level of optimism was associated with an unhealthy lifestyle, including unhealthy dietary habits (Giltay et al., 2007). In studies with only women as test subjects, high optimism has also been related to healthier eating habits and greater levels of success in improving dietary habits (Gacek et al., 2014; Hingle et al., 2014; Tinker et al., 2007).

Nonetheless, according to these results, it is important not only to explore the classical well-known physiological risk factors for CHD when planning the prevention of CHD; it is also important to pay attention to psychosocial components like the optimism construct, particularly pessimism.

Optimism and pessimism have been linked also to adherence to various treatments (Brewer et al., 2013; Bruzzese et al., 2014; Godin et al., 2005; O'Brien 2009; Schroder & Schwarzer, 2005; Shepperd 1996; Strack et al., 1987; Ylöstalo et al., 2003). In cross-sectional analyses, optimists have been shown to choose healthier food when no preceding instructions are given (Boehm et al., 2013a; Roy et al., 2010). According to these studies, it seems that dispositional optimism and pessimism seem to be related to motivation for treatment compliance, overall health behaviour, and the ability to make changes in lifestyle in order to improve one's physical well-being. The results of this study strengthen this claim.

Even if it seems that people with high levels of pessimism have an unhealthier diet than others and they are less likely to be able to change their dietary habits, it has been found that after proper education and monitoring, the association between pessimism and the ability to improve diet disappears. This conclusion was drawn following a trial derived from the GOAL study (Hankonen et al., 2010). In that study, the subjects with higher pessimism levels had unhealthier lifestyles, including unhealthier dietary habits. However, after the pessimists had received education

about healthier lifestyles and were subjected to close monitoring, they managed to improve their lifestyles to be equivalent to that of the other subjects. Keeping this in mind, it would seem only natural that determining pessimism could be a way to pinpoint those individuals who probably would benefit most from the preventive actions concerning their health and who should be monitored more closely in order to detect as early as possible signs of illnesses, e.g. CHD. Naturally, the independent risk of pessimism in developing those illnesses – for example, CHD – is still unlikely to diminish.

6.6 Methodological considerations

6.6.1 The strengths of the study

The strength of this study lies in its design. The randomly selected study group with equal numbers of both sexes and representatives of all the age groups invited can be viewed as rather comprehensive. The follow-up periods of 3-11 years seem to be long enough to allow the statistically significant differences between study groups to emerge. The prospective nature of the studies makes the results more reliable.

The use of a well-known test pattern (LOT-R) in determining optimism and pessimism makes the results of this thesis more convincing. Separating optimism from pessimism seemed to clarify the results. Analysing optimism and pessimism as a unidimensional bipolar variable in these studies would probably have obscured some of the current results.

The fact that the official statistics could be used in some parts of the study (the causes of deaths in the substudies II and III) also makes the results more reliable.

6.6.2 Limitations of the study

There are naturally a few limitations in this study; one of these is that in many instances, the information used was collected from self-reports and there was no access to the authentic medical files of the population. It is expected that the real incidence of CHD (substudy I) might be slightly greater than the numbers reported by the study subjects and used in some of the calculations. It is also anticipated that some of those who died during the follow-up periods, had a new CHD but if it was

not the primary cause of death, they would not have been registered here as new CHD patients.

Some of the questionnaires were quite brief, which is typical of cohort studies and the variables were sometimes simplified. For example, in substudy IV concerning dietary habits, the reduction of fat intake was classified as an indication of a healthy change in the dietary habits. This may of course be debated, since more recent studies have indicated that it is the actual fat quality (the shift from saturated towards unsaturated fats) that is more important than the intake of total fat per se (Schwab & Uusitupa, 2015).

It is also probable that poorly functioning and institutionalized persons had a lower participation rate than community-dwelling subjects, which can have an effect on the results (Nummela et al., 2011). It is probable that the incidence of CHD would have been higher in those populations. It is also not known whether there are any differences in pessimism between these groups and the rest of the population.

Yet another possible form of bias in substudy III is related to the fact that the levels of hs-CRP were analysed in samples that had been frozen for more than 10 years. Consequently, there is a risk that the absolute levels of hs-CRP could have been affected when analyzed from frozen – rather than fresh – samples.

However, there is some proof that the above-mentioned limitations might not play a major role in these studies. For example, the numbers obtained by self-reports concerning the incidence and prevalence of CHD are quite similar to the incidence and prevalence rates of CHD calculated from the official statistics for the same-aged population in Finland at that time (The Social Insurance Institution, 2015; Statistics Finland, 2015).

Moreover, the problem of self-reporting does not seem to be very significant. One might think that there could be some inconsistencies between the answers and the reality in some questions, for example, those concerning consumption of alcohol and smoking habits. Nonetheless, it has been demonstrated that alcohol consumption can be estimated quite accurately from self-reports (Bell et al., 2003; Gruenewald & Johnson, 2006; Sobell & Sobell, 2003) and while self-reports concerning smoking status are usually not so reliable, they are rather accurate when the respondents are elderly (Pell et al., 2008), i.e. like the participants evaluated here.

Brief questionnaires and variables do not necessarily inevitably lead to the possibility of bias. For example, the above-mentioned simplifying of dietary changes with respect to fat intake, i.e. reduction of fat instead of shifting from saturated towards unsaturated fats might be a good way to measure the changing of dietary

habits towards a healthier direction. In the early 2000s, cutting down on the intake of dietary fat and eating less fatty food were generally - at least among many lay individuals - regarded as healthy and for that reason, a reduction in the fat intake was chosen as an indication of a choice to improve dietary quality.

Lastly, the possibility of problem with the hs-CRP analysed in samples which had been frozen for more than 10 years is rather insignificant. It has been found that CRP is relatively stable as a frozen sample (Yousuf et al., 2013). The possibility of analytical inaccuracy is reduced also by the fact that all the samples were frozen for an equally long time.

7 CLINICAL IMPLICATIONS

The history of the scientific approach towards the optimism construct and its connections with health is still in its infancy. However, it has already been quite convincingly demonstrated that optimism is linked with better overall health. This study establishes that the connection between the optimism construct and health seems to refer primarily to the connection between pessimism and health; the positive effect is linked to the lack of pessimism instead of the presence of optimism. This means that in studies which handle the optimism construct as a bipolar and single variable, the connection between optimism construct and health is possibly hidden or at least it may appear to be weaker than it really is. This finding that pessimistic properties were the main factor influencing health may also diminish the possible confounding properties of unrealistic optimism.

The construct of optimism or, according to this study, mainly the pessimism factor, is strongly connected with CHD even if one takes into account the classical and well-known risk factors. Those classical risk factors also seem themselves to be independently connected with pessimism. Bearing this in mind, it could be beneficial to determine the level of pessimism using LOT-R together with the well-known and more "traditional" risk factors of CHD to obtain more accurate predictions of an individual's actual risk of CHD. When the information concerning pessimism and the well-known risk factors, e.g. family history, smoking and the levels of cholesterol, blood glucose and blood pressure are recorded, it could be easier to target the preventive actions on CHD to those individuals most in need of help. Knowing the level of pessimism might also be helpful in detecting those people who will need more education and other forms of help in altering their lifestyle, e.g. dietary habits, to a healthier direction. Naturally, the independent risk of pessimism in developing those illnesses – for example, CHD – is still unlikely to diminish.

The level of dispositional pessimism is straightforward to assess and practically cost free, so it can be expected to be very cost-effective.

It is still too early to say if the learning of optimism, or in fact, learning to be less pessimistic, will help in preventing CHD.

8 SUGGESTIONS FOR FURTHER INVESTIGATION

The level of pessimism seems to have a clear impact on CHD. The impact is independent and furthermore pessimism can influence the risk on CHD in other ways e.g. by influencing the healthiness of dietary habits. Pessimism is presumably linked also to other variables connected with a healthy lifestyle and also in the inability to improve them.

These findings seem to be quite reliable. However, this topic has still not been widely scrutinized and the results will need confirmation from other studies in the future.

It seems that the connection between pessimism and the risk of developing CHD is partially mediated indirectly through the presence of low-grade tissue inflammation, but while the finding is significant, it also means that there are still other mechanisms mediating the effect and it must be admitted that our knowledge about the connection between the optimism construct and physical health is far from complete. That is why the whole concept of optimism should be investigated in the future. Identifying the other factors mediating the link between pessimism and CHD could help in understanding CHD, its aetiology and mechanism, which in turn could help in preventing and treating CHD.

While the connection between optimism construct and health has been studied at least to some extent, a topic which has been rarely investigated is the ability to change the optimism construct. At the moment, the leading scientists in this field state that even if optimism is considered as a personal trait, it might be possible to learn to be more optimistic and/or less pessimistic, but at the same time, they tend to be less convinced about the possible benefits of this conceivable change (Carver & Scheier 2014). Learned optimism may be short-lived and it may not have the positive connections of "natural optimism". Future studies of optimism and/or pessimism should focus also on this subject. Is it possible to learn to be more optimistic and less pessimistic and if the answer is "yes", how can this best be achieved? If optimism (or the lack of pessimism) can be learned, is the change permanent and will it have the same positive effect on health as the "congenital optimism" (or lack of pessimism)?

9 CONCLUSIONS

Study I-IV: Optimism and pessimism are two different and independent variables. Optimism is not the same as the lack of pessimism and vice versa.

Study I-II: Pessimism is an independent risk factor for CHD and for CHD-induced death. Optimism does not prevent CHD whereas the lack of pessimism has a preventive effect on the development of CHD.

Study III: An elevated level of inflammation mediates a notable amount of the effect of pessimism on the incidence of CHD.

Study IV: People with a higher level of pessimism tend to have unhealthier dietary habits and they are more likely not to succeed in improving or even trying to improve them regardless of their intent to do so.

The method of using optimism and pessimism as two different dimensions rather than one bipolar single variable may reveal much more information about the connection of the optimism construct and the studied outcomes when the opposite ends of the bipolar variable do not cancel each other.

While pessimism seems to be an independent risk factor in developing CHD, determining the level of an individual's pessimism can be helpful in finding subjects who have more need of actions to prevent CHD. Knowing the level of one's pessimism can also help in changing one's lifestyle into a more healthy direction. The greater the level of the pessimism, the greater the need for guidance and help in making the change.

The association between psychosocial factors and CHD seems to be quite robust, and this study emphasizes the need to continue the research in this area, particularly as the hypothesis of inflammation mediating the connection between pessimism and CHD was only partially confirmed. Finding the other mediating factors between pessimism and CHD could help in understanding CHD itself, its aetiology and mechanism, which in turn could help in preventing and treating CHD.

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11 APPENDICES

APPENDIX 1

Life Orientation Test – Revised (LOT-R)

Please be as honest and accurate as you can throughout. Try not to let your response to one statement influence your responses to the other statements. There are no "correct" or "incorrect" answers. Answer according to your own feelings, rather than how you think "most people" would answer.

I disagree strongly = 0
I disagree a little = 1
I neither agree nor disagree = 2
I agree a little = 3
I agree strongly = 4

1. In uncertain times, I usually expect the best.
[2. It's easy for me to relax.]
3. If something can go wrong for me, it will.
4. I'm always optimistic about my future.
[5. I enjoy my friends a lot.]
[6. It's important for me to keep busy.]
7. I hardly ever expect things to go my way.
[8. I don't get upset too easily.]
9. I rarely count on good things happening to me.
10. Overall, I expect more good things to happen to me than bad.

Note:

> Items 2, 5, 6, and 8 are fillers. Researchers who are interested in testing the potential difference between affirmation of optimism and disaffirmation of pessimism should compute separate subtotals of the relevant items.
> Scheier et al., 1994

APPENDIX 2

Food Frequency Questionnaire (FFQ)

How often have you used the following foodstuffs during the past seven days?

Not a single time = 1
On one or two days = 2
On three to five days = 3
On six to seven days = 4

Boiled or mashed potatoes
Fried potatoes, French fries
Rice, pasta
Porridge, cereals
Low-fat cheese
Other cheese
Chicken, turkey
Fish
Meat dishes
Sausages
Sliced sausages
Lunch meats, cold cuts
Eggs
Pizza, hamburgers
Fresh vegetables/root vegetables
Cooked vegetables
Berries and fruits
Sweet pastries
Ice cream
Candies
Chocolate
Soft drinks
Fruit or berry juice
Salty snacks

APPENDIX 3

Alcohol Use Disorders Identification Test – Consumption (AUDIT-C)

1) How often did you have a drink containing alcohol in the past year?

- Never (0 points)
- Monthly or less (1 point)
- Two to four times a month (2 points)
- Two to three times per week (3 points)
- Four or more times a week (4 points)

2) How many drinks containing alcohol did you have on a typical day when you were drinking in the past year?

- 0 drinks (0 points)
- 1 or 2 (0 points)
- 3 or 4 (1 point)
- 5 or 6 (2 points)
- 7 to 9 (3 points)
- 10 or more (4 points)

3) How often have you had six or more drinks on one occasion in the past year?

- Never (0 points)
- Less than monthly (1 point)
- Monthly (2 points)
- Weekly (3 points)
- Daily or almost daily (4 points)

PUBLICATIONS

PUBLICATION I

Pessimism and the risk for coronary heart disease among middle-aged and older Finnish men and women: a ten-year follow-up study

Mikko Pänkäläinen, Tuomas Kerola, Jukka Hintikka

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RESEARCH ARTICLE Open Access

Pessimism and the risk for coronary heart disease among middle-aged and older Finnish men and women: a ten-year follow-up study

Mikko T. Pänkäläinen[1*], Tuomas V. Kerola[2] and Jukka J. Hintikka[1,3]

Abstract

Background: Despite the growth in knowledge about coronary heart disease (CHD) risk factors, and the advances made in preventing and treating them, the incidence of CHD is still notably quite high. Research has concentrated on the physiological factors that present risks for CHD, but there is an increasing amount of evidence for the connection of mental health, personal traits and CHD. Data on the connection of disposition (optimism or pessimism) and CHD are relatively scarce. The aim of this study was to investigate the long-term connection between optimism, pessimism and the risk for having CHD.

Methods: This was a ten-year prospective cohort study on a regional sample of three cohorts aged 52–56, 62–66 and 72–76 years at baseline ($N = 2815$). The study groups were personally interviewed four times (in 2002, 2005, 2008 and 2012). The revised Life Orientation Test (LOT-R) was completed at the first appointment to determine the level of dispositional optimism or pessimism. During the ten-year follow-up, the incidence of new cases of coronary heart diseases was measured. The association between dispositional optimism/pessimism and the incidence of CHD during the follow-up was studied with logistic regression.

Results: Those who developed coronary heart disease during the ten-year follow-up were significantly more pessimistic at baseline than the other subjects. Using multivariate logistic regression models separately for men and women, we noticed no elevated risk for CHD in the pessimistic women compared to the non-pessimistic women. However, among men in the highest quartile of pessimism, the risk for CHD was approximately four-fold (OR 4.11, 95 % CI 1.68–11.04) that of the men in the lowest quartile. Optimism did not seem to have any role in the risk for developing CHD.

Discussion: Our main finding is that pessimism seemed to be a clear risk factor for coronary heart disease in men even after adjusting for classical well-known risk factors while optimism did not seem to be a protective factor. Connection between pessimism and coronary heart disease was not detectable among women. Similar gender differences between psychosocial factors and overall well-being have been noticed in some earlier studies, too. The mechanism of this gender difference is not fully understood. Differences between men and women in somatic responses to stress found in earlier studies may at least partly explain this phenomenon.
The impact of optimism and pessimism on cardiovascular disease has been studied earlier and several possible mechanisms have been discovered but it seems clear that they cannot fully explain the association. For example, optimists have healthier lifestyles which lowers the risk for coronary heart disease, but pessimism was established to be a risk factor for cardiovascular disease in our study even in logistic regressions including the best known classical

(Continued on next page)

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(Continued from previous page)
risk factors, e.g. smoking and high level of blood glucose. According to our study it is important to pay attention also to the psychosocial components in addition to the well-known risk factors when planning the prevention of coronary heart disease. Measuring pessimism is quite easy and it consumes very little time. Once the amount of pessimism is ascertained, it is easier to define who is in the greatest need of preventive actions concerning coronary heart disease.

Conclusions: Pessimism seems to be a substantial risk factor for CHD, and as an easily measured variable it might be a very useful tool together with the well-known physiological risk factors to determine the risk for developing CHD, at least among men.

Keywords: Pessimism, Optimism, Life Orientation Test - Revised, Coronary heart disease, Gender difference

Background

Cardiovascular events are the leading cause of mortality in industrialized countries [1]. There is a significant number of known risk factors for coronary heart disease (CHD). In a study of more than 120,000 subjects, the majority of those with CHD (75 % of women and 80 % of men) had at least one of the four most important physiological risk factors (diabetes, hypertension, smoking or elevated lipids) [2]. There were also patients with no recognized risk factors and subjects with one or more risk factors that still had no CHD. One reason for this might be psychosocial factors that can be either protective or risk factors for CHD.

The terms optimism and its antonym pessimism derive from Latin words 'optimus' and 'pessimus', respectively, the first meaning 'the best' and the latter meaning 'the worst' [3]. Optimists have 'a feeling or belief that good things will happen in the future', whereas pessimists have 'the feeling that bad things are more likely to happen than good things' [4]. People are often categorized as optimists or pessimists. This can lead to the conclusion that optimism and pessimism are the two extremities of the same unidimensional continuum (dispositional optimism). Nevertheless, the concept of optimism itself has long been controversial: there is debate over whether the optimism construct should be seen as one bipolar dimension or if optimism and pessimism should be seen as two separate dimensions that exist simultaneously and may be unattached to each other. Like other personality traits also optimism and pessimism characterize an individual in ordinary situations and they are stable and predictable once they have evolved. Unlike, e.g. mood, they seem to remain the same over situations as well as time, regardless of negative or positive incidents [5–7]. The development of optimism and pessimism appears to be influenced by both heritage and environment [8, 9].

Research on CHD has mainly been focused on physiological risk factors, so the possible psychosocial risk factors are not as well known. Psychosocial factors have nevertheless been considered in some studies. For example, in the INTERHEART study the psychosocial factors were one of the most significant risk factors for myocardial infarction [10, 11]. In most of the studies where psychosocial risk factors have been linked to CHD, the focus has mostly been on psychiatric symptoms and illnesses and not on the role of the construction of personality. Nevertheless, in some studies there has been a connection also between the personality traits, and psychiatric morbidity [12, 13], physical functioning [12, 14], overall mortality [15] and illness burden [16].

The link between physical health and optimism and pessimism as personality traits has not been widely studied. Two long-term follow-up studies on older men have suggested that an optimistic explanatory style protects against CHD [17] and unidimensionally assessed dispositional optimism protects against cardiovascular death [18]. In an extensive study on women, a lower risk for CHD was found among optimists [19]. Optimism was assessed unidimensionally i.e. the optimism and the pessimism were studied as the opposite ends of the same continuum rather than two independent variables. In two follow-up studies on both men and women, optimism reduced the risk for CHD independently of other risk factors [20, 21]. Both studies, however, have methodological shortcomings. To assess optimism, Hansen et al. [20] used only two of the six questions of the revised Life Orientation Test [22] and Boehm et al. [21] used only one self-worded question.

We found no prospective studies on general population samples where the risk for coronary heart disease was evaluated separately for optimism and pessimism in men and women. For this reason, we conducted this ten-year follow-up study on middle-aged and older Finnish men and women. We assessed whether optimism and pessimism are separately genuine protective factors or risk factors for coronary heart disease.

Methods

A stratified (age, sex, municipality) random sample of men and women born in 1926–30, 1936–40, and 1946–50 were drawn in 2002 from the population registry of all 14 municipalities of the Päijät-Häme region, Finland.

A total of 4,272 subjects were invited, and 2,815 (66 %) participated.

In 2002, the study subjects were invited to the launch of the Good Ageing in Lahti region (GOAL) study. The GOAL study primarily aimed to improve the health and well-being of the ageing population of the Päijät-Häme region. The test subjects completed several questionnaires concerning their current life status (e.g. psychosocial background, socio-economic status, health and lifestyle). The use of medications was also documented. Blood tests were taken to specify the levels of blood glucose and cholesterol. Study subjects were measured for height and weight, and their body mass indexes (BMI) were calculated. Waist circumference was measured at a level midway between the lowest rib and the iliac crest. At the launch, the blood pressure of the study subjects was measured three times and the average was documented.

Smoking habits were asked and the study subjects were divided into daily smokers (i.e. persons who smoked every day regardless of the amount) and non-daily smokers. Study subjects who used five or more units of alcohol in one sitting formed the 'heavy drinkers' group, while the rest were 'non-heavy drinkers'. The subgroup 'regular physical exercise' included those who exercised for 30 min at least twice a week. Finally, the use of drugs was asked and the following variables were created: use of statins (yes vs no), use of drugs for hypertension (yes vs no) and use of drugs for diabetes (yes vs no).

Optimism and pessimism was measured by using the revised version of the Life Orientation Test (LOT-R). The test was initially developed in the mid-1980s to assess the beneficial effects of optimism on psychological and physiological health (LOT, [23]). The scale was re-evaluated and revised (LOT-R) later by Scheier, Carver and Bridges [22] to focus its item content more closely on the subject's expectations of the future. Originally, both LOT and LOT-R were thought to be unidimensional scales, but later studies have suggested that they may have two separate independent dimensions, namely optimism and pessimism. Even if in some studies the unidimensional bipolar model of dispositional optimism has been at least as accurate as the bidimensional one [23–25], the separation of optimism and pessimism has been recognized to be very useful in many other studies, leading to the better prediction of outcomes [26–32]. In the bipolar model, optimism and pessimism seem to hide some of each other's results, and some data may be lost in the process. As a compromise, it has also been suggested that dispositional optimism might be a unidimensional continuum, while the tests used to measure this variable – including the LOT and LOT-R – give answers in two separable dimensions, i.e. optimism and pessimism [33].

LOT-R includes four fillers and six actual statements, of which three are worded positively for optimism (e.g. 'In uncertain times, I usually expect the best') and three are worded negatively to indicate pessimism (e.g. 'If something can go wrong for me, it will'). The respondents are asked to indicate how much they agree with the statements in general, as expressed on a scale from 1 ('I disagree a lot') to 5 ('I agree a lot'). A higher score refers to greater optimism or greater pessimism depending on the statement. In the final analyses, we used the independent optimism component subscale scores and the pessimism component subscale scores separately. They were named 'optimism' and 'pessimism', respectively.

In 2012, ten years after the GOAL study launch, 1697 subjects responded. They were asked whether they had coronary heart disease that had been diagnosed by a doctor. The study group consisted of those who answered 'yes' and the control group of those who answered 'no'. Those who in 2002 had not participated, had answered incompletely, or reported having coronary heart disease were excluded from the study ($n = 261$). Those who in 2002 reported having coronary heart disease and were excluded from the final sample were more pessimistic than the other participants (pessimism subscale score mean (SD): 4.45 (2.64) vs 3.88 (2.70), $p = 0.001$); for optimism there was no difference (data not shown). The final study group ($n = 101$) consisted of 57 men and 44 women, and the final control group ($n = 1335$) consisted of 580 men and 755 women. Among those who finished the study, the total incidence of coronary heart disease during the ten-year follow up was 8.9 % (57/637) in men and 5.5 % (44/799) in women.

The study protocol was approved (R12013) by the Regional Ethics Committee of Tampere University Hospital. All participants gave their informed consent prior to data collection.

In the statistical analyses, we used exploratory factor analysis with varimax rotation to assess the dimensions of the LOT-R scale. When handling categorical variables we used the Chi-squared test. For continuous variables, we used the nonparametric Mann–Whitney U test. Finally, we calculated logistic regression models to discover the fully adjusted odd ratios for those risk factors for CHD that associated ($p < 0.10$) with coronary heart disease in the univariate analyses.

Availability of supporting data

The data of this study is a part of the GOAL (Good Ageing in Lahti Region) Project. The original data was collected and is preserved by the Palmenia Centre for Continuing Education in Lahti, Finland.

Results

First, we sought to determine whether optimism and pessimism fall on a unipolar continuum or if they are two different and independent factors. All the questions (without

the fillers) of the LOT-R and their answers were included in a factor analysis with varimax rotation and Kaiser normalization. The final solution is shown in Table 1. A clear-cut two-factor solution was found, which strongly suggests that when optimism and pessimism are assessed with the LOT-R scale, they are two separate variables. We decided to handle them separately in further analyses.

There were no differences between men and women in optimism (LOT-R subscale score mean (SD): 8.35 (2.10) vs 8.40 (2.12), Mann–Whitney U test $p = 0.81$) or pessimism (LOT-R subscale score mean (SD): 3.60 (2.67) vs 3.55 (2.59), $p = 0.93$). No differences were found in optimism between age groups (ages 52–56 vs 62–66 vs 72–76 years: 8.34 (2.13) vs 8.40 (2.07) vs 8.43, Kruskal-Wallis test $p = 0.84$). Those with a higher age were more pessimistic (3.20 (2.62) vs 3.71 (2.50) vs 4.28 (2.76), $p < 0.001$).

Those who developed coronary heart disease during the ten-year follow-up had been significantly more pessimistic at baseline than the subjects of the control group (LOT-R subscale score mean (SD): 4.43 (2.70) vs 3.51 (2.61), Mann–Whitney U test $p = 0.001$). In terms of optimism, there was no difference (LOT-R subscale score mean (SD): 8.49 (1.94) vs 8.37 (2.12), $p = 0.61$). When studied by gender, differences in pessimism scores were the same in the total sample both in men (4.39 (2.73) vs 3.52 (2.66)) and women (4.48 (2.70) vs 3.49 (2.58)), and they were no more statistically significant ($p = 0.15$ and $p = 0.17$, respectively). The LOT-R optimism subscale scores were similar among those who got ill and those who remained healthy both in men (8.56 (1.80) vs 8.32 (2.13), $p = 0.43$) and in women (8.39 (2.12) vs 8.40 (2.12), $p = 0.93$).

Those men who on follow-up reported having CHD had had higher blood glucose levels and higher waist circumferences at baseline than the other men. There was also a trend towards higher BMI and higher systolic blood pressure. The findings in women were the same in both groups, except there was a statistically significant difference in BMI (Table 2).

In health behaviours, three differences were found between the groups (Table 3). Medication for hypertension and diabetes was more common in both genders among those who reported having CHD in the ten-year follow-up than in the others. A corresponding significant difference was found in the use of statins in women. In men there was a trend towards the difference in the use of statins. Men who were 'heavy drinkers' seemed to have a diminished risk for developing CHD.

Table 1 The two-factor structure of the revised Life Orientation Scale in principal component analysis with varimax rotation and Kaiser normalization

	Optimism	Pessimism
In uncertain times, I usually expect the best.	0.717	−0.129
If something can go wrong for me, it will.	0.060	0.778
I am always optimistic about the future.	0.764	0.081
I hardly ever expect things to go my way.	−0.004	0.838
I rarely count on good things happening to me.	0.112	0.812
Overall, I expect more good things to happen to me than bad.	0.667	0.247

Finally, we calculated multivariate logistic regression models separately in men and women for the risk for coronary heart disease. We only included the variables that in univariate analyses significantly associated with coronary heart disease or had a trend towards a significant association ($p < 0.10$). Blood glucose and the use of drugs for diabetes were highly correlated with each other, and we chose to use only blood glucose in these analyses. For the same reason, systolic blood pressure was included in the models, and use of drugs for hypertension was excluded.

In men, pessimism associated statistically significantly with the risk for CHD. In women, pessimism did not associate with the risk for CHD (Table 4). To highlight the significance of pessimism as a risk factor for CHD, we compared the highest and the lowest quartiles of pessimism in a similar model. Those men who were in the highest quartile of pessimism had an over four-fold adjusted risk for CHD compared to those in the lowest quartile (adjusted OR 4.11, 95 % CI 1.68–10.04, $p = 0.002$). No difference was found in women between the highest and lowest quartiles of pessimism (adjusted OR 1.56, 95 % CI 0.57–4.29, $p = 0.386$).

Discussion

Our main finding is that pessimism was a clear risk factor for coronary heart disease in men even after adjusting for classical well-known risk factors. Moreover, optimism did not associate with the incidence of CHD and it was not a protective factor. This finding contradicts some previous studies [17–21], which have approached optimism/pessimism as a unidimensional mental construct, whereas our approach was bidimensional.

Our findings highlight the need to scrutinise optimism and pessimism separately as two independent variables. Optimism is not the same as the absence of pessimism and vice versa. According to our findings, the protective factor against CHD is not optimism as previous studies have suggested [17–21]. Rather, our study suggests that the protective factor is a lack of pessimism. This observation would remain unnoticed if optimism and pessimism were seen as part of the same unidimensional construct.

While pessimism seemed to be a clear risk factor for CHD among men, such a connection was not detectable among women. Similar gender differences between psychosocial factors and overall well-being have been noticed in some other studies, too. For example, in a Japanese study

Table 2 Risk factors at baseline and incidence of coronary heart disease in the ten-year follow-up

	Men					Women				
	Coronary heart disease				Mann–Whitney *U* test	Coronary heart disease				Mann–Whitney *U* test
	Yes		No			Yes		No		
	N = 57		*N* = 580			*N* = 44		*N* = 755		
	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
Body mass index (kg/m^2)	28.11	3.72	27.26	3.68	0.075	29.11	4.48	27.53	4.85	0.011
Blood glucose (mmol/L)	6.17	1.26	5.71	0.90	0.023	5.97	1.66	5.34	0.79	<0.001
Cholesterol (mmol/L)	5.94	0.97	5.76	1.05	0.123	5.98	1.18	5.94	0.99	0.828
Waist circumference (cm)	100.9	9.2	98.4	10.5	0.044	94.4	12.4	90.0	12.7	0.017
Systolic blood pressure (mmHg)	149.7	20.6	144.6	17.3	0.083	147.5	19.0	142.6	18.3	0.098
Diastolic blood pressure (mmHg)	87.2	8.0	88.7	9.7	0.241	84.0	9.3	85.3	9.1	0.376

of over 88,000 men and women, a low perceived level of life enjoyment was a risk factor for stroke and CHD among men, while among women, the level of life enjoyment was not associated with elevated risks of cardiovascular disease incidence [34]. In another study concentrating on optimism, pessimism and depression, the connection between pessimism and depression was much stronger among men than among women [35]. The mechanism of this gender difference is not fully understood. Differences between men and women in somatic responses to stress may at least partly explain this phenomenon. Cardiovascular reactivity to stressors (e.g. the rise in the levels of blood pressure and heart rate) seems to be more significant among men than among women [36, 37]. In addition, the neuroendocrine response to stress seems to be greater among men than among women. Plasma ACTH and cortisol levels rise more significantly in men than in women in situations of stress, showing that men exhibit greater activation of the hypothalamic–pituitary–adrenal axis to psychological stress [38]. These findings suggest that men have a more remarkable connection between psychosocial factors and CHD than women, as was seen in our study.

Table 3 Health behaviours at baseline and incidence of coronary heart disease in men and women in the ten-year follow-up

	Men						Women					
	Coronary heart disease						Coronary heart disease					
	Yes		No				Yes		No			
	N	%	N	%	Chi-squared	*p*- value	N	%	N	%	Chi-squared	*p*-value
Heavy drinking												
No	53	10.3	461	89.7			43	5.5	733	94.5		
Yes	4	3.3	119	96.7	6.070	0.014	1	4.3	22	95.7	0.061	0.805
Daily smoking												
No	45	8.3	498	91.7			39	5.4	685	94.6		
Yes	12	12.8	82	87.2	1.973	0.160	5	6.7	70	93.3	0.214	0.644
Regular physical exercise												
No	28	8.7	293	91.3			15	4.8	295	95.2		
Yes	29	9.2	287	91.3	0.040	0.841	29	5.9	460	94.1	0.435	0.510
Use of statins												
No	46	8.2	513	91.8			36	4.9	692	95.1		
Yes	11	14.1	67	85.9	2.898	0.089	8	11.3	63	88.7	4.970	0.026
Medication for hypertension												
No	38	7.7	454	92.3			25	4.1	587	95.9		
Yes	19	13.1	126	86.9	3.978	0.046	19	10.2	168	89.8	10.160	0.001
Medication for diabetes												
No	51	8.3	560	91.7			40	5.1	746	94.9		
Yes	6	23.1	20	76.9	6.641	0.010	4	30.8	9	69.2	16.207	<0.001

Table 4 Risk for coronary heart disease in men and women during ten-year follow-up

	Risk for coronary heart disease			
	Men		Women	
	OR	95 % CI	OR	95 % CI
Age (years)	1.03	0.99–1.08	1.08	1.03–1.13
Body mass index (kg/m^2)	1.00	0.85–1.18	0.99	0.87–1.12
Blood glucose (mmol/L)	1.40	1.09–1.79	1.40	1.11–1.77
Waist circumference (cm)	1.00	0.95–1.06	1.02	0.96–1.07
Systolic blood pressure (mmHg)	1.01	0.99–1.03	1.00	0.99–1.02
Use of statins (yes vs no)	1.55	0.73–3.25	1.67	0.71–3.94
Heavy drinking (yes vs no)	0.32	0.11–0.93	…	…
Pessimism (score)	1.10	1.00–1.22	1.07	0.94–1.20

OR fully adjusted odds ratio, *95 % CI* 95 % confidence interval

When studying optimism and pessimism and their impact on physiological health and CHD in particular, several possible mechanisms have been discovered. Pessimism has been found to associate with inflammation and endothelial dysfunction [39] and shorter telomere length [40] in older men. Optimism is associated with higher carotenoid concentrations and fruit and vegetable consumption as well as a lower smoking rate, which are potential pathways underlying the association [41]. Furthermore, optimism is associated with a healthier diet and a healthy lipid profile, and a lower body mass index may partially explain the association [42] between optimism/pessimism and CHD. Conversely, optimism did not associate with hypertension [43]. In general, optimists have healthier lifestyles [44]. They smoke less, are more physically active, consume more fruit, vegetables and whole-grain bread, and use alcohol in more moderate amounts. Nevertheless, pessimism was established to be a risk factor for CHD in our study, even in logistic regressions including, e.g. smoking and high blood glucose and cholesterol.

According to our study, it is important not only to explore the classical well-known physiological risk factors for CHD when planning the prevention of CHD; it is also important to pay attention to psychosocial components. The degree of pessimism seems to have a substantial effect on the likelihood of developing CHD among men, regardless of the amount of optimism. Measuring pessimism is quite easy and it consumes very little time. Once the amount of pessimism – which seems to be one of the significant risk factors for CHD – is ascertained, it is easier to define who is in the greatest need of preventive actions concerning CHD.

The strength of this study lies in its design. The study was a prospective ten-year follow-up survey based on randomly selected individuals from the older population, with equal numbers of both sexes and representatives of all the age groups invited. The study group can be seen as a comprehensive one. Compared to earlier studies concerning the connection between CHD and optimism and pessimism, in our study life orientation was measured using the complete test pattern of the LOT-R, thus giving more reliable answers.

There are a few limitations in this study as well. One of them is that we could only use self-reports. We did not have access either to the authentic medical files of the population or to the cause-of-death statistics. It is expected that there were more persons with cardiovascular disease among those who died during the follow-up. However, the numbers received by self-reports are quite similar to the incidence rates of CHD that can be calculated from the official statistics for the same-aged population in Finland (8.5 % in men, 3.4 % in women) [45, 46]. Another limitation is that we had relatively small numbers of cases in the study groups due to the separate analyses of men and women. There may have resulted type 2 statistical errors, e.g. it may be possible that we missed some real differences between the groups. Separate analyses for men and women were, however, essential to find out an obvious gender difference in the association between pessimism and the incidence of CHD. Finally, it is probable that poorly functioning and institutionalized persons had a lower participation rate than community-dwelling subjects. It is probable that the incidence of CHD would have been higher in those populations, but it is not known whether there are any differences in pessimism between these groups and the rest of the population.

Conclusions

Pessimism seems to be quite a significant risk factor for coronary heart disease in men, while optimism does not provide protection. Separating optimism and pessimism improves the prognostic values of the connection between these personality traits and coronary heart disease.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Authors MP and JH designed the study. TK participated in the conception of the study. JH managed and conducted the statistical analyses and interpreted the data. MP wrote the first draft and MP, JH and TK revised it to make the final manuscript. All authors have approved the final manuscript.

Authors' information

Not applicable.

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PUBLICATION II

Pessimism and risk of death from coronary heart disease among middle-aged and older Finns: an eleven-year follow-up study

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Pessimism and risk of death from coronary heart disease among middle-aged and older Finns: an eleven-year follow-up study

Mikko Pänkäläinen[1*], Tuomas Kerola[2], Olli Kampman[3,4], Markku Kauppi[2,4] and Jukka Hintikka[1,4]

Abstract

Background: Mortality from coronary heart disease (CHD) remains at quite notable levels. Research on the risk factors and the treatment of CHD has focused on physiological factors, but there is an increasing amount of evidence connecting mental health and personality traits to CHD, too. The data concerning the connection of CHD and dispositional optimism and pessimism as personality traits is relatively scarce. The aim of this study was to investigate the connection between optimism, pessimism, and CHD mortality.

Methods: This was an 11-year prospective cohort study on a regional sample of three cohorts, aged 52–56, 62–66, and 72–76 years at baseline ($N = 2815$). The levels of dispositional optimism and pessimism of the study subjects were determined at baseline using a revised version of the Life Orientation Test (LOT-R). Eleven years later, those results and follow-up data about CHD as a cause of death were used to calculate odds. Adjustments were made for cardiovascular disease risk.

Results: Those who died because of CHD were significantly more pessimistic at baseline than the others. This finding applies to both men and women. Among the study subjects in the highest quartile of pessimism, the adjusted risk of death caused by CHD was approximately 2.2-fold (OR 2.17, 95 % CI 1.21–3.89) compared to the subjects in the lowest quartile. Optimism did not seem to have any connection with the risk of CHD-induced mortality.

Conclusions: Pessimism seems to be a substantial risk factor for death from CHD. As an easily measured variable, it might be a very useful tool together with the other known risk factors to determine the risk of CHD-induced mortality.

Keywords: Pessimism, Optimism, Cardiovascular disease risk, Coronary heart disease, Mortality, Life Orientation Test, Revised

Background

Coronary heart disease (CHD) is still the leading cause of mortality, despite growing knowledge of its risk factors and the new treatments available [1]. According to the latest statistics, CHD causes about 200 deaths per 100,000 annually in industrialized countries (e.g. in 2013 193.3/100,000 in the United States and 193.6/100,000 in Finland) [2, 3].

The majority of those with CHD have at least one of the four most important physiological risk factors (diabetes, hypertension, smoking, or elevated lipids) [4]. Some CHD patients seem to have no recognizable physiological risk factors and there are also many people with one or more physiological risk factors and still no CHD, which supports the influence of psychosocial factors in the pathogenesis of CHD.

The heart has always been described as a centre of psychosocial health and emotions in the history of art and culture. The scientific connection between psychosocial health and the heart was studied for the first time in 1937, when Benjamin Malzberg investigated the

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connection between involutional depression and the elevated rate of cardiovascular deaths [5]. Since then, there has been only limited interest in this subject. Recently, however, the scientifically significant linkage between psychosocial health and the heart has been proved. For example, in the INTERHEART study, psychosocial factors such as depression and psychosocial stress were found to be one of the most significant risk factors for myocardial infarction [6, 7], and the American Heart Association has stated that depression is an independent risk factor for a poor prognosis following an acute coronary syndrome [8].

The connection of cardiovascular health with optimism and pessimism is under increasing investigation. Links have been found between optimism/pessimism and, for example, the risk of strokes [9], the status of the major arteries [10], the risk of incident heart failure [11], the recovery of patients from coronary artery bypass surgery [12–14], and the incidence of CHD [15–18]. All of these studies have stated that optimism (or the lack of pessimism) is connected with better cardiovascular outcomes. Even an optimistic attitude towards one's cardiac health, whether justifiable or not, seems to be an independent factor that enhances the health of the cardiovascular system [19]. Recently, a large review concerning positive psychological constructs and health outcomes in patients with cardiovascular disease was published [20], and some years earlier another review was made about optimism and physical health with a notable section on the health of the heart [21]. Nevertheless, none of these studies or parts of the reviews pays any attention to the mortality caused by CHD.

The results of most of the studies concerning the connection of the optimism construct and cardiovascular health suggest that optimism or a low level of pessimism protects from cardiac problems. When searching for literature concerning the linkage between optimism, pessimism, and the risk of cardiovascular death, we could only find four studies; they had contradictory results and none of them were included in the reviews mentioned earlier. According to one prospective study, one-dimensionally assessed optimism seemed to diminish all-cause mortality, mostly by preventing cardiovascular deaths [22]. In another study, one-dimensionally assessed dispositional optimism protected men from cardiovascular death [23]. One study with only female study subjects found that optimism diminished mortality related to CHD [16]. However, in a cross-sectional study where optimism was also assessed as a single factor – with optimism and pessimism as opposites – optimism seemed to increase both cardiovascular mortality and all-cause mortality [24].

We did not find any prospective studies on general population samples where the risk of death caused by CHD was evaluated separately for optimism and pessimism. In addition, in earlier studies single-factor optimism (i.e. the one-dimensionally assessed bipolar factor with optimism and pessimism as opposites) seemed to have a controversial connection to CHD-related deaths. Therefore, we conducted this 11-year follow-up study on middle-aged and older Finnish men and women in which we assessed whether optimism and pessimism as independent variables are true protective or risk factors for CHD mortality.

Methods

The GOAL (Good Ageing in Lahti region) study was started in the district of Lahti, Finland in 2002. Its aim was to find out ways to improve the health and well-being of the local aging population in the future. Stratified (age, sex, municipality) random samples of men and women born in 1926–30, 1936–40, and 1946–50 were drawn from the population register of all 14 municipalities in the Lahti region. A total of 4272 subjects were invited and 2815 (66 %) participated. At baseline, the study subjects filled in questionnaires concerning their current status of life (e.g. socioeconomic status, psychosocial background, health, and lifestyle). Levels of blood glucose and blood total and high-density lipoprotein (HDL) cholesterol were determined with standardized methods. The blood pressure of study subjects was measured at baseline three times and the average was documented. The smoking habits were also documented, and the patients were asked about their use of drugs for hypertension and/or diabetes. Finally, the study subjects were asked at baseline whether they had CHD diagnosed by a doctor.

The study subjects filled out the revised version of the Life Orientation Test (LOT-R) to measure their optimism and pessimism. The original Life Orientation Test (LOT) was developed in the mid-1980s in order to investigate the effects of dispositional optimism on the selfregulation of behavior in a wide variety of domains, some of them health-related [25]. In 1994, the test was re-evaluated and revised (LOT-R) by Scheier, Carver, and Bridges [26] to focus its item content more closely on expectancies of the future. The questionnaire includes four fillers (which were disregarded when determining the level of optimism and pessimism) and six actual statements, of which three are worded positively to indicate optimism (e.g., "In uncertain times, I usually expect the best") and three are worded negatively for pessimism (e.g., "If something can go wrong for me, it will"). The respondents are asked to indicate how well the statements describe them in general, as expressed on a scale from 0 (not at all) to 4 (very much so). A higher score refers to greater optimism or greater pessimism depending on the statement.

Even if both LOT and LOT-R were thought to be one-dimensional scales, later studies have suggested that they may have two separate independent dimensions: optimism and pessimism. Separating optimism and pessimism, at least when they are measured by using LOT or LOT-R, has led to the better prediction of outcomes in many studies [27–31]. In our previous work, we also found that in this age-specified general population sample, LOT-R is a scale with two independent subscales [32], and the use of the bipolar model (i.e. optimism and pessimism as one variable) would have hidden some of results found in our study. Thus, in the analyses of this study, we used independent subscale scores separately for the optimism and pessimism components. They were named optimism and pessimism, respectively.

Eleven years after the baseline of the study, on 31 December 2013, we could find 2719 (97 %) of the original 2815 study subjects from official statistics of the study area. Fifty subjects had to be excluded due to severe deficiencies in baseline data, diminishing the study group to 2669 subjects. Of these, 523 had died between the baseline and 31 December 2013. Those whose underlying cause of death was other than CHD were excluded ($n = 402$). Therefore, the final study sample included 2267 study subjects, of whom 121 had died from CHD during the 11-year follow-up, meaning that 2146 were still alive.

In this study, we calculated a general cardiovascular disease risk score (CVD risk score) for each participant. This scoring has been developed as a part of the Framingham Heart Study for use in primary care [33]. It is a sum of sex-specific scorings of the following general risk factors for cardiovascular diseases: age, total cholesterol, HDL cholesterol, systolic blood pressure, smoking, and diabetes. The scoring of systolic blood pressure in the CVD risk algorithm depends on whether the subject is treated for hypertension or not. Smoking status was recorded as regular smoking or not, and this information was ascertained by self-report. Diabetes was defined as fasting glucose ≥7 mmol/L, the use of insulin, the use of oral antidiabetic drugs, or a self-report of having diabetes diagnosed by a doctor.

In statistical analyses, we used the chi-squared test for categorical variables. For comparing continuous variables, we used the nonparametric Mann–Whitney U test and Kruskal-Wallis tests. Finally, we calculated logistic regression models to determine adjusted odd ratios for the risk of death from CHD. Adjustments for age and sex were not made because the CVD risk scorings we calculated were already sex-specific and they also included age as one of the risk factors.

Results

Men died from CHD more often than women during the follow-up (87/1047 (8.3 %) vs 34/1220 (2.8 %), chi-squared 34.01, $p < 0.001$). Furthermore, those who died from CHD were older at baseline (mean 70.0 years (SD 6.2) vs 62.5 years (SD 7.8), Mann–Whitney U test $p < 0.001$).

There were no differences between men and women in optimism (LOT-R subscale score mean (SD): 8.34 (2.10) vs 8.40 (2.08), Mann–Whitney U test $p = 0.70$) or in pessimism (3.85 (2.67) vs 3.80 (2.61), $p = 0.83$, respectively). No differences were found in optimism between age groups (aged 52–56 vs 62–66 vs 72–76 years: 8.26 (2.17) vs 8.38 (2.05) vs 8.53 (2.05), Kruskal-Wallis test $p = 0.10$), but those of higher age were more pessimistic (3.34 (2.68) vs 3.86 (2.57) vs 4.42 (2.56), $p < 0.001$, respectively).

Those who died from CHD during the 11-year follow-up had been significantly more pessimistic at baseline than the subjects who were still alive (LOT-R subscale score mean (SD): 4.78 (2.41) vs 3.77 (2.64), Mann–Whitney U test $p < 0.001$), while in optimism, there was no difference (LOT-R subscale score mean (SD): 8.40 (2.17) vs 8.37 (2.09), $p = 0.98$, respectively). These findings apply to both genders (Table 1).

Those men and women who had died from CHD during the follow-up had had lower baseline total and HDL cholesterol levels and higher blood glucose levels than those men and women who were still alive, and their total general CVD risk scores were higher. Not surprisingly, those men and women who died from CHD during the follow-up had at baseline more often reported having CHD diagnosed by a doctor. They also used medication for hypertension and diabetes more often than the other men and women (Table 1).

Finally, we calculated a logistic regression model for the risk of death from CHD. Instead of using separate single risk factors, we included only the baseline pessimism subscale score, the presence of CHD, and the general CVD risk score (which includes the most significant physiological risk factors for CHD in itself) in the model. Pessimism was associated independently statistically significantly with the risk of death from CHD (Table 2; Model 1). To highlight the significance of pessimism as a risk factor for CHD-induced death, we compared the highest and the lowest quartiles of pessimism in a similar model. Those who were in the highest quartile of pessimism had nearly a 2.2-fold higher adjusted odds ratio for death from CHD during the 11-year follow-up period when compared to those in the lowest quartile of pessimism (Table 2; Model 2).

Table 1 Risk factors at baseline and death from coronary heart disease during the 11-year follow-up in men and women

	Men					Women				
	Death from coronary heart disease				Mann–Whitney	Death from coronary heart disease				Mann–Whitney
	Yes		No		*U* test	Yes		No		*U* test
	N = 87		*N* = 960			*N* = 34		*N* = 1186		
	Mean	SD	Mean	SD	*p*-value	Mean	SD	Mean	SD	*p*-value
Total cholesterol (mmol/L)	5.26	1.08	5.67	1.09	0.01	5.52	1.44	5.90	1.03	0.03
HDL cholesterol (mmol/L)	1.21	0.30	1.37	0.36	<0.001	1.47	0.41	1.65	0.45	0.04
Systolic blood pressure (mmHg)	148	23	146	18	0.39	152	25	145	20	0.09
Blood glucose (mmol/L)	6.48	1.86	5.86	1.27	0.001	5.91	1.00	5.51	1.16	0.001
CVD risk score	18.2	3.5	15.9	3.7	<0.001	18.0	3.5	14.1	4.2	<0.001
LOT-R optimism score	8.37	2.15	8.34	2.11	0.97	8.45	2.31	8.40	2.07	0.87
LOT-R pessimism score	4.56	2.51	3.78	2.68	0.008	5.34	2.03	3.75	2.61	<0.001
	%		%		Chi-squared test *p*-value	%		%		Chi-squared test *p*-value
CHD at baseline	42.5		9.4		<0.001	51.4		5.7		<0.001
Use of drugs for hypertension	42.5		27.0		0.002	28.6		60.0		<0.001
Use of drugs for diabetes	19.5		5.2		<0.001	14.3		3.4		0.001
Regular smoker	20.7		15.9		0.25	2.9		9.5		0.18

HDL high-density lipoprotein, *CVD* cardiovascular disease, *LOT-R* Life Orientation Test – Revised, *CHD* coronary heart disease

Discussion

Our main finding was that pessimism is a strong independent risk factor for death from CHD. The magnitude of the result seems to be quite similar when compared to the three earlier studies we found on this subject [16, 22, 23]. Nevertheless, results from those other studies cannot be directly compared to our findings because in those studies the optimism construct was determined as a bipolar single factor, whereas we used separate optimism and pessimism variables. In our study, optimism did not associate with the mortality rates induced by CHD.

Those with higher scores on the pessimism subscale at baseline may have had more physiological risk factors of CHD already at the beginning of the 11-year follow-up and one might think that awareness of those risk factors could be one reason for pessimism. However, it has been demonstrated that personality traits evolve at a relatively early age and after that they are very stable. For example, bad news about one's health seems to have no effect on the LOT-R scores [34, 35].

Our result – pessimism being the only variable out of optimism and pessimism that mediates the effect of the optimism construct on the risk of CHD-induced death, while the optimism has no influence at all – is not unique. For example, in the review by Rasmussen et al. it was also speculated that the presence or absence of pessimism alone might determine the effect of the optimism construct on cardiac health, regardless of optimism [21]. This emphasizes the stance that the optimism construct should be seen to include two separate and independent

Table 2 Adjusted risk of death from coronary heart disease during the 11-year follow-up

	Risk of death from coronary heart disease					
	Model 1			Model 2		
	OR	95 % CI	*p*-value	OR	95 % CI	*p*-value
CHD at baseline	8.09	5.35–12.23	<0.001	7.41	4.38–2.53	<0.001
CVD risk score at baseline	1.26	1.19–1.33	<0.001	1.30	1.21–1.39	<0.001
Pessimism (score)	1.08	1.00 –1.16	0.039	…	…	…
Pessimism (quartiles; highest/ lowest)	…	…	…	2.18	1.21–3.89	0.010

Model 1 = the pessimism score is included as a continuous variable
Model 2 = the pessimism score has been divided into quartiles and the highest quartile has been compared with the lowest
Both models include the presence of CHD and the CVD risk score at baseline
OR adjusted odds ratio, *95 % CI* 95 % confidence interval, *CHD* coronary heart disease, *CVD* cardiovascular disease

dimensions, optimism and pessimism, instead of one continuum with two poles. This means that people should not be categorized as "optimists" or "pessimists". This theory is supported by several other studies, too [27–31].

Optimism in the scientific sense focuses on expectancies of the future, which links it to expectancy-value models of motivation [36]. In other words, if a person is optimistic about something she/he wants to achieve, she/he may consider that goal achievable, which in turn may help and motivate behaviour in a way that enables reaching that goal. In pessimism, the connection is logically converse: if a person is pessimistic about something she/he wants to achieve, she/he may consider that goal as somehow impossible or at least improbable, which may diminish the efforts made to accomplish the goal. For example, when studying the optimism construct and cardiac health, a high level of optimism has been found to associate with a healthier lifestyle, for example with higher vegetable, fruit, and whole-grain bread consumption; higher physical activity; lower smoking rates; a healthier diet; a healthy lipid profile; and a lower body mass index, which all decrease the incidence of CHD [37–39]. These examples are connected with behaviour, which in turn is thought to be affected by the optimism construct. On the other hand, a high level of pessimism has been linked with several factors that have effects on cardiac health, i.e. elevated inflammation markers, endothelial dysfunction, and shorter telomere length [40, 41]. These factors cannot as clearly be seen as direct consequences of behaviour.

The optimism construct seems to have a clear impact on physiological health and CHD mortality even after adjustments for the well-known classical risk factors of cardiovascular diseases. This finding suggests that our knowledge about the connection between the optimism construct and physical health is far from complete. Separating optimism and pessimism seems to highlight that pessimism may be the variable in the optimism construct that mediates the effect, and this separation may be of benefit in studying this topic in the future.

One strength of this study is its design. The study group was selected randomly and it was constituted of equal numbers of both sexes and representatives of all the age groups invited, so the study group can be seen as comprehensive. Eleven years is a relatively long time and it seems to be enough for the detectable and statistically significant differences in CHD-induced mortality to appear. The fact that the study was prospective makes it more reliable. In our study, life orientation was measured using the well-known test pattern of the LOT-R, and optimism and the pessimism were seen as different variables, which seems to clarify the results.

There are a few limitations in this study as well. It is probable that poorly functioning and institutionalized persons had a lower participation rate than community-dwelling subjects. It is also probable that the incidence of CHD-induced death would have been higher in those populations. At the same time, it is not known whether there are any differences in pessimism between these groups and rest of the population. Much of the data used in this study is based on the questionnaires filled out by the study subjects themselves, so there might be some inconsistency between the answers and the reality in the questions concerning, for example, smoking habits and use of the medications.

Conclusions

Pessimism seems to be quite a significant risk factor for death from coronary heart disease both in men and women, while optimism does not protect from it. Assessing optimism and pessimism as separate entities improves the prognostic values of the connection between these personality traits and coronary heart disease. The level of pessimism can be measured easily and non-invasively and it might be a very useful tool together with the other known risk factors to determine the risk of CHD-induced mortality.

Abbreviations

CHD: Coronary heart disease; CVD risk score: General cardiovascular disease risk score; GOAL: Good Ageing in Lahti region study; HDL: High density lipoprotein; LOT: Life orientation test; LOT-R: Revised version of the Life Orientation Test

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Availability of data and materials

The dataset supporting the conclusions of this article is a part of the GOAL (Good Ageing in Lahti Region) Project and it was collected and is preserved by the Palmenia Centre for Continuing Education in Lahti, Finland.

Authors' contributions

Authors MP and JH designed the study. TK, OK and MK participated in the conception of the study. JH managed and conducted the statistical analyses and interpreted the data. MP wrote the first draft and MP, JH, OK, TK and MK revised it to make the final manuscript. All authors have approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate
The cohort study was approved in 2002 by the Ethics Committee of Päijät-Häme Central Hospital, which is located in the city of Lahti, and this extension study was approved in 2013 by the Ethics Committee of Pirkanmaa Hospital District (R12013). Written informed consent was requested and obtained from all cohort participants in 2002.

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PUBLICATION III

Does inflammation mediate the effect of pessimism on coronary heart disease? A ten-year follow-up study

Mikko Pänkäläinen, Tuomas Kerola, Olli Kampman, Markku Kauppi, Hannu Sarkkinen, Erja Lappalainen, Jukka Hintikka

Submitted for publication

PUBLICATION IV

Pessimism, diet, and the ability to improve dietary habits: a three-year follow-up study among middle-aged and older Finnish men and women

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Pessimism, diet, and the ability to improve dietary habits: a three-year follow-up study among middle-aged and older Finnish men and women

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Abstract

Background: Dietary habits have a great influence on physiological health. Even though this fact is generally recognized, people do not eat as healthily as they know they should. The factors that support a healthy diet, on the other hand, are not well known. It is supposed that there is a link between personal traits and dietary habits. Personal traits may also partially explain why some people manage to make healthy dietary changes while some fail to do so or are not able to try to make changes even when they desire to do so. There is some information suggesting that dispositional optimism plays a role in succeeding in improving dietary habits. The aim of this study was to determine the role of optimism and pessimism in the process of dietary changes.

Methods: Dispositional optimism and pessimism were determined using the revised Life Orientation Test in 2815 individuals (aged 52–76 years) participating in the GOAL study in the region of Lahti, Finland. The dietary habits of the study subjects were analysed. After 3 years, the subjects' dietary habits and their possible improvements were registered. The associations between dispositional optimism and pessimism, dietary habits at baseline, and possible changes in dietary habits during the follow-up were studied with logistic regression. We also studied if the dietary habits or certain lifestyle factors (e.g. physical exercising and smoking) at baseline predicted success in improving the diet.

Results: Pessimism seemed to correlate clearly negatively with the healthiness of the dietary habits at baseline – i.e. the higher the level of pessimism, the unhealthier the diet. Optimism also showed a correlation with dietary habits at baseline, although to a lesser extent. Those who managed to improve their dietary habits during follow-up or regarded their dietary habits as healthy enough even without a change were less pessimistic at baseline than those who failed in their attempts to improve their diet or did not even try, even when they recognized the need for a change.

Conclusions: Pessimistic people are more likely to eat an unhealthy diet than others. Pessimism reduces independently the possibilities to improve dietary patterns.

Keywords: Pessimism, Optimism, Life orientation test – revised, Dietary habits

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Background

Despite the well-known connection between dietary habits and health, many people do not eat what is recommended as a healthy diet [1]. Dietary habits are related e.g. to the risk of coronary heart disease (CHD) [2] and improving dietary habits has showed significant cardioprotective effects in a secondary prevention program among women with CHD [3].

While the intention to prevent diseases is usually thought to be an important reason for a healthier diet, psychosocial and lifestyle related factors seem to be one of the major causes for not eating healthily. The most common factors mentioned in preventing a healthy diet are a lack of time, a reluctance to give up favourite foods, and a lack of motivation and willpower [4–6]. A healthy diet is also thought to be more expensive than unhealthy one, even if this belief seems to be false [7, 8].

The terms optimism and its antonym pessimism derive from Latin words 'optimus' and 'pessimus', respectively (the first meaning 'the best' and the latter meaning 'the worst' [9]) and they are used in describing people's outlook and expectations concerning their future. Persons who have a feeling or belief that good things will happen in the future are called optimists and they are said to see "the glass as half-full rather than half-empty". Pessimists in turn generally feel that bad things are more likely to happen than good things [10]. Optimism is regarded in psychology as a cognitive, affective and motivational construct [11]. On other words, optimists not only think, but also feel positively about the future. Like other personal trait, also optimism and pessimism develop during the childhood and early adulthood influenced by both heritage and environment [12, 13], and unlike e.g. mood, the construct of optimism (including both optimistic and pessimistic properties) is thought to be quite stable after it has evolved, regardless of negative or positive incidents [14, 15].

People are often categorized as optimists or pessimists. This can lead to the conclusion that optimism and pessimism are the two extremities of the same unidimensional continuum (dispositional optimism). Nevertheless, the concept of optimism itself has long been controversial: there is debate over whether the optimism construct should be seen as one bipolar dimension or if optimism and pessimism should be seen as two separate dimensions that exist simultaneously and may be unattached to each other.

Optimism is sometimes confused with other concepts, e.g. features like the sense of control [16], self-efficacy [17] and hope [18]. There are still differences with these terms. Unlike the concept of optimism, these properties include also how the desired outcomes are expected to happen. For example, a person with high self-efficacy believes that his/her personal efforts or skills are what will determine the positive outcome while an optimist does not rely on his/her own abilities.

Numerous psychosocial factors have been noted to influence dietary behaviour. A connection seems to exist between psychosocial features and current diet, and also between psychosocial features and the ability to improve the diet. Psychosocial features of interest include e.g. socio-economic status, willpower, self-efficacy, and satisfaction with life. There are many studies on the associations between these psychosocial factors and healthy eating [4, 19–24], but the number of studies concerning the optimism construct and dietary habits is quite small. The findings of these few studies suggest that there might be a positive connection between optimism and the willingness and capability to eat in a healthier way [25–29]. In all of these studies on the connection between the optimism construct and dietary habits, optimism has been associated with healthier diet and/or pessimism vice versa. In a study on young Finnish adults, unipolarly measured optimism had an influence on dietary habits, and pessimism was linked to an unhealthy diet [25]. In a study on elderly men, a low level of optimism was associated with an unhealthy lifestyle, including unhealthy dietary habits [29]. In the large Women's Health Initiative study, high optimism was strongly related to healthier eating habits and greater levels of success in improving dietary habits [26, 27]. In a study on Polish menopausal women, optimism was positively correlated with a healthier diet [28]. However, we did not find any previous studies with general population samples focusing on the dietary habits and the optimism construct that would handle optimism and pessimism as independent factors. We conducted this 3-year follow-up study on middle-aged and older Finnish men and women to determine whether optimism and pessimism are factors that associate with dietary habits and predict success in improving those habits.

Methods

The GOAL study (Good Ageing in Lahti Region) started in 2002. Its aim was to determine and improve the health and well-being of the ageing population of the region of Lahti, a city in southern Finland. The entire project consisted of a cohort study and several community-based interventions and it lasted for 10 years. In the present study, data from baseline (year 2002) and 3-year follow-up (year 2005) of the cohort study were used.

The cohort study group consisted of a stratified (age, sex, municipality) random sample of men and women born in 1926–30, 1936–40, and 1946–50. The study participants were drawn from the population registry of all 14 municipalities in the Lahti region. A total of 4272 subjects were invited, and 2815 (66%) participated.

At the beginning of the GOAL study, cross-sectional data on the dietary habits, current health, and lifestyles of the study subjects were gathered by using questionnaires. The study subjects were asked about their recent dietary habits with a food frequency questionnaire (FFQ) where different foods were divided into 24 categories. The respondents were asked how often they had consumed the foods in each category during the last 7 days. The answers were scaled from 1 (not at all) to 4 (on 6 or 7 days). Study subjects were measured for height and weight and their body mass indexes (BMI) were calculated. According to their smoking habits, the study subjects were divided into two groups, 'daily smokers' (i.e. those who smoked every day, regardless of the amount) and 'non-daily smokers'. Study subjects who used five or more units of alcohol (one unit = 12 g EtOH) in one sitting formed the 'heavy drinkers' group, while the rest were 'non-heavy drinkers'. The study subjects were asked if they had been diagnosed with CHD by a doctor. Finally, the subgroup 'regular physical exercise' was formed to include those who exercised for 30 min at least twice a week. In addition to the questionnaires, several blood tests were taken. The samples were measured for the levels of blood glucose and cholesterol, among other things.

Levels of dispositional optimism and pessimism were measured by using the revised version of the Life Orientation Test (LOT-R). The test was initially developed in the mid-1980s to assess the beneficial effects of optimism on psychological and physiological health (Life Orientation Test (LOT)) [30]. The scale was re-evaluated and revised (LOT-R) later to focus its item content more closely on the subject's expectations of the future [31].

LOT-R includes six statements, three worded positively for optimism (e.g. 'In uncertain times, I usually expect the best') and three worded negatively to indicate pessimism (e.g. 'If something can go wrong for me, it will'). The respondents are asked to indicate how much they agree with the statements in general, as expressed on a scale from 0 ('I disagree a lot') to 4 ('I agree a lot'). A higher score refers to greater optimism or greater pessimism depending on the statement. Originally, both LOT and LOT-R were thought to be unidimensional scales, but later studies have suggested that they may have two separate independent dimensions, namely optimism and pessimism [32–36]. In the one-dimensional bipolar model with optimism and pessimism as opposites, the optimism scores and pessimism scores are calculated together and they might cancel out and hide each other's results. Our previous study showed clearly that in this study sample, LOT-R has two separate subscales: optimism and pessimism [37]. Thus, in the final analyses, we used the independent scores separately for optimism and pessimism.

After 3 years, in 2005, the study subjects were examined again. A total of 2625 subjects (93% of the original sample) had adequate responses in both 2002 and 2005, and could therefore be included in the final analyses. In 2005, the study subjects were asked if they had tried to improve or were about to improve their dietary habits, and if they had tried to improve their diet, how had they managed to achieve their goals. The possible improving styles in the diet were divided into five subgroups: reducing the consumption of fat, changing to low-fat products, reducing the consumption of sugar, increasing the consumption of vegetables, and increasing the consumption of berries and fruits.

We divided the study subjects in these five subgroups of different improving styles into four categories according to the possible changes in their diets: 1) those who had not tried to change their eating habits to a healthier diet, even when they thought it would have been beneficial, 2) those who thought their dietary habits were healthy enough even without an improvement, 3) those who had succeeded in improving of their diet, and 4) those who had tried to improve their diet but had failed to do so.

In the statistical analyses, we created dietary pattern models for grouping of the sample by using principal component analysis (PCA) with Varimax rotation and Kaiser normalization. Factor loadings with > 0.35 were considered as significant. Student's t-test was used to study the associations between optimism, pessimism, and the different dietary patterns. When studying the differences in levels of optimism and pessimism, according to the success in the improvement of dietary habits in four categories, we used the Kruskal–Wallis test due to skewed distributions.

Finally, we calculated logistic regression models to discover the fully adjusted odds ratios for different variables for the risk of not succeeding in improving dietary habits.

Results

Using the data from the food frequency questionnaire in 2002, we divided the study subjects into different dietary pattern groups by using principal component analysis. The analysis resulted in four nearly independent dietary patterns, which we named as 'healthy', 'sweet unhealthy', 'fatty unhealthy' and 'traditional' diets (Table 1). In further analyses, principal component analysis scores were used as independent variables to describe the amount of each different dietary pattern in the study subjects. We used the medians of the LOT-R optimism and pessimism subscale scores to classify the study subjects into low and high optimism and pessimism groups. Principal component analysis scores were compared between these groups (Table 2).

At baseline, higher optimism and lower pessimism were associated with a 'healthy' dietary pattern. Optimism and pessimism did not seem to play any role in

Table 1 Rotated factor matrix for dietary patterns created by using principal component analysis. Factor loadings with absolute values of > 0.35 have been presented in bold. Negative loadings indicate the lack of foodstuff in question belonging to certain dietary patterns

Foodstuff	Dietary pattern			
	Healthy	Sweet unhealthy	Fatty unhealthy	Traditional
Porridge, cereals	**0.382**	−0.001	−0.152	0.249
Fish	**0.397**	−0.109	0.060	−0.097
Lunch meats, cold cuts	**0.359**	0.214	0.055	0.142
Fresh vegetables/root vegetables	**0.664**	−0.018	−0.131	0.005
Cooked vegetables	**0.646**	−0.049	−0.032	− 0.098
Berries and fruits	**0.589**	0.076	−0.171	0.181
Fruit or berry juice	**0.378**	0.081	0.189	0.037
Sweet pastries	0.109	**0.597**	−0.031	0.256
Ice cream	0.088	**0.495**	0.085	−0.131
Candies	−0.043	**0.701**	0.033	0.078
Chocolate	0.035	**0.677**	0.098	−0.032
Salty snacks	−0.024	**0.352**	0.195	−0.221
Fried potatoes, French fries	−0.005	0.026	**0.489**	−0.059
Low-fat cheese	**0.411**	0.142	**−0.368**	−0.066
Other cheese	−0.004	0.025	**0.609**	0.108
Sausages	−0.147	0.240	**0.493**	0.065
Sliced sausages	−0.111	0.139	**0.558**	0.053
Eggs	0.151	0.013	**0.475**	−0.057
Soft drinks	−0.103	0.305	**0.352**	−0.125
Meat dishes	0.028	0.132	**0.366**	**0.552**
Chicken, turkey	**0.443**	0.003	−0.048	**−0.415**
Boiled or mashed potatoes	0.230	0.002	0.101	**0.658**
Rice, pasta	0.294	0.088	0.115	**−0.409**
Pizza, hamburgers	−0.021	0.263	0.169	−0.302

the 'sweet unhealthy' and 'traditional' dietary patterns, but high pessimism and the 'fatty unhealthy' dietary pattern associated significantly (Table 2).

The association between changes in dietary habits during the 3-year follow-up and pessimism was quite clear (Table 3). There was a strong trend that those who managed to change to a healthier diet were less pessimistic compared to others. The differences were statistically significant in four dietary categories: reducing fat, changing to low-fat products, increasing vegetables, and increasing berries and fruits. The higher the level of pessimism, the less likely was the improvement of diet. Nevertheless, those who had tried but failed reducing sugar were not more pessimistic than others. Optimism was associated with only one dietary change; those who had tried but failed to increase consumption of berries and fruits were less optimistic than others.

Table 2 Comparisons of principal component analysis scores of dietary patterns between groups with low or high pessimism, and low or high optimism

	Principal component analysis scores (mean)							
	Healthy dietary pattern	p [1]	Sweet unhealthy dietary pattern	p [1]	Fatty unhealthy dietary pattern	p [1]	Traditional dietary pattern	p [1]
Low pessimism ($N = 1274$) [2]	0.071		0.029		−0.048		−0.006	
High pessimism ($N = 1351$) [3]	−0.066	**< 0.001**	− 0.027	0.153	0.046	**0.016**	0.006	0.762
Low optimism ($N = 1210$) [2]	−0.085		0.000		−0.019		0.026	
High optimism ($N = 1415$) [3]	0.073	**< 0.001**	−0.000	0.995	0.016	0.365	−0.022	0.213

[1] Student's t-test; [2] Below the median; [3] Median or higher
p[1]-scores indicating statistical significance are bolded

Table 3 The association between optimism and pessimism, and the change in dietary habits

	Has not changed	No need to change	Has changed	Tried to change, but failed	p[1]
Reducing fat	*N* = 82	*N* = 1059	*N* = 1280	*N* = 204	
Optimism (Mean (SD))	8.60 (2.02)	8.26 (2.24)	8.39 (2.08)	8.18 (2.14)	0.385
Pessimism (SD)	4.59 (2.60)	4.19 (2.79)	3.62 (2.58)	4.44 (2.81)	**< 0.001**
Changing to low-fat products	*N* = 155	*N* = 1098	*N* = 1266	*N* = 106	
Optimism (Mean (SD))	8.37 (2.20)	8.28 (2.21)	8.39 (2.09)	8.18 (2.15)	0.674
Pessimism (Mean (SD))	4.46 (2.74)	4.15 (2.77)	3.65 (2.60)	4.47 (2.76)	**< 0.001**
Increasing vegetables	*N* = 198	*N* = 1141	*N* = 1090	*N* = 196	
Optimism (Mean (SD))	8.46 (2.16)	8.25 (2.28)	8.43 (2.01)	8.10 (2.06)	0.058
Pessimism (Mean (SD))	4.10 (2.69)	4.09 (2.77)	3.69 (2.59)	4.43 (2.79)	**< 0.001**
Reducing sugar	*N* = 110	*N* = 1287	*N* = 986	*N* = 242	
Optimism (Mean (SD))	8.23 (2.13)	8.29 (2.23)	8.42 (2.04)	8.17 (2.18)	0.520
Pessimism (Mean (SD))	4.16 (2.54)	4.04 (2.75)	3.78 (2.69)	3.95 (2.54)	0.145
Increasing berries and fruits	*N* = 128	*N* = 1520	*N* = 859	*N* = 118	
Optimism (Mean (SD))	8.38 (2.05)	8.39 (2.20)	8.32 (2.05)	7.81 (2.22)	**0.041**
Pessimism (Mean (SD))	4.43 (2.77)	4.02 (2.78)	3.68 (2.51)	4.35 (2.72)	**0.002**

[1] Kruskal–Wallis test
p[1]-scores indicating statistical significance are bolded

Finally, we calculated multivariate logistic regression models including several predicting variables for the risk of failure in improving dietary habits (Table 4). Because of the relatively small subgroups, we combined those who had failed in their dietary changes with those who had not even tried to improve their diet even when they recognized the need to do so into one group. We also combined those who saw no need to improve their diets with those who had managed to make healthy changes into another group.

The models included different dietary patterns, age, sex smoking and alcohol consumption habits, physical exercise, the levels of blood glucose and cholesterol, body mass index, the possible existence of CHD, and pessimism as explaining variables. A fatty unhealthy dietary pattern associated with the risk of failure in changing to low-fat products and in increasing vegetables. Sweet unhealthy dietary pattern associated with the risk of failure in increasing vegetables, in reducing sugar and in increasing berries and fruits. Finally, the effect of pessimism seemed clear in three out of five subgroups. Pessimism increased the probability of failure in reducing fat, changing to low-fat products, and increasing the consumption of berries and fruits.

To emphasize the association between pessimism and failures in changing dietary habits, we compared the highest and the lowest quarters of pessimism in logistic regression models which were fully adjusted for age, sex,

Table 4 Odds ratios of different dietary pattern groups, coronary heart disease and pessimism (rows) on the risk of failure in change to more healthy dietary habits (columns) analysed by logistic regression models[a]

	Dietary change									
	No change and fail in reducing fat		No change and fail in changing to low-fat products		No change and fail in increasing vegetables		No change and fail in reducing sugar		No change and fail in increasing berries and fruits	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Healthy dietary pattern	0.87	0.76–1.00	0.88	0.76–1.01	0.79	0.70–0.89	0.92	0.82–1.04	0.75	0.65–0.86
Sweet unhealthy dietary pattern	1.13	0.99–1.29	1.07	0.94–1.23	**1.26**	**1.13–1.40**	**1.30**	**1.16–1.45**	**1.23**	**1.08–1.40**
Fatty unhealthy dietary pattern	1.10	0.96–1.26	**1.14**	**1.00–1.31**	**1.17**	**1.05–1.32**	1.03	0.92–1.16	1.13	0.98–1.30
Traditional dietary pattern	1.12	0.98–1.27	1.02	0.90–1.17	0.97	0.87–1.08	1.01	0.90–1.14	0.89	0.78–1.02
Coronary heart disease	1.07	0.66–1.73	0.91	0.54–1.54	1.20	0.81–1.80	**1.52**	**1.00–2.31**	1.41	0.87–2.28
Pessimism	**1.07**	**1.02–1.12**	**1.07**	**1.02–1.13**	1.03	0.99–1.07	1.02	0.98–1.07	**1.05**	**1.00–1.11**

OR Odds ratio, *CI* Confidence interval
[a]Models are fully adjusted for age, sex, smoking and alcohol consumption habits, physical exercise, the levels of glucose, cholesterol and body mass index
p[1]-scores indicating statistical significance are bolded

smoking and alcohol consumption habits, physical exercise, the levels of glucose, cholesterol, body mass index and the possible existence of CHD. Those who belonged to the highest quarter of pessimism had a 1.4-fold risk of not succeeding in reducing their consumption of fat (adjusted OR 1.44, 95% CI 1.00–2.08, $p = 0.05$), a 1.5-fold risk of not succeeding in changing to low-fat products (adjusted OR 1.51, 95% CI 1.03–2.21, $p = 0.03$), and a 1.5-fold risk of failing to increase the consumption of berries and fruits in their diet (adjusted OR 1.46, 95% CI 1.01–2.12, $p = 0.02$) compared to the study subjects in the lowest quarter of pessimism.

Discussion

Our main findings were that the dietary habits of study subjects with a higher level of pessimism were unhealthier compared to the dietary habits of others, and that the high level of pessimism was associated with greater difficulties in improving dietary habits. High levels of pessimism have been linked independently with an elevated risk of CHD [37–39]. While pessimism seems to be an independent risk factor for CHD, our results suggest that it may also be related to increased risk of CHD via an unhealthier diet.

There seemed to be no association between sweet unhealthy dietary pattern as well as fail in reducing sugar and optimism/pessimism. It has been speculated that the physiological and psychological mechanisms concerning sugar consumption might be different compared to the mechanism of other dietary habits. For example, when trying to eat healthily, the lack of sweet foods is often seen as the most difficult task [40] and when treating binge eating with baclofen, the medication seems to suppress binge eating of pure fat but not a sugar-rich diet [41].

It can be discussed whether the test subjects had proper information about good dietary habits, but it has been stated that the factor preventing people from eating healthy is not a lack of knowledge but rather the fact that people do not eat as healthily they know they should [1, 42, 43]. While there are many different recommendations about healthy diets which can make it challenging to know how to eat healthily it also seems that the correlation between nutrition knowledge and healthy dietary intake is quite weak [44].

Our study also strengthens the idea of optimism and pessimism as two different and independent variables. The statistical power of the optimism subscale was very small, while pessimism had stronger associations with several outcomes.

Improving the diet has a role in both prevention and treatment of several chronic diseases. The result of our study – pessimism being associated with difficulties in improving one's diet – is parallel with earlier studies on psychosocial factors and adherence to various treatments. For example, adherence to treatment of asthma patients, hypertensive patients, cardiac patients, and rehabilitation patients after surgery seemed to relate to psychosocial factors, including dispositional optimism [45–48]. A higher level of optimism has also been associated, for example, with greater success in achieving good results in health changes among cardiac patients [49, 50] and in dental health [51]. Optimism and good compliance to treatment might also be connected in HIV patients [52].

An earlier study suggested that optimistic people exert greater efforts at goal attainment than pessimists do, for example, in alcoholism treatment [53]. In cross-sectional analyses, optimists have been shown to choose healthier foods when no preceding instructions are given [54, 55]. According to these studies, it seems that dispositional optimism and pessimism relate to the motivation in the treatment compliance, overall health behaviour, and the ability to make changes in lifestyle in order to improve physical well-being. The results of our study strengthen this claim.

As mentioned, there are some previous studies on associations between optimism/pessimism and dietary patterns [25–29]. However, there are some shortcomings in these studies. In these studies optimism and pessimism were dealt as a bipolar, single variable, and except for one study, the study participants were all of the same gender. It has been recognized in many other studies that optimism and pessimism are probably two independent variables that are present at same the time – i.e. one has both pessimistic and optimistic traits simultaneously [35]. The method of using optimism and pessimism as two different dimensions rather than one bipolar single variable may reveal much more information when the opposite ends of the bipolar variable do not cancel each other [32–36]. Separating optimism from pessimism turned out to be beneficial also in our study; optimism and pessimism seemed to be two different and independent factors as optimism seemed to have a connection with only one type of change in diet, while pessimism was associated much more strongly with many dietary behaviour changes. This endorses the need to separate optimism and pessimism to achieve more accurate results. Analysing optimism and pessimism as a unidimensional variable in this study would probably have covered some of the current results.

It has also been suggested that dispositional optimism might be a unidimensional continuum, but questions oriented pessimistically are better in determining this variable [54], thus diminishing the statistical power of optimistically oriented questions.

Even if it seems that people with high levels of pessimism have an unhealthier diet than others do and they are less likely to be able to change their dietary habits, it has been found that after proper education and monitoring, the association between pessimism and the ability to improve diet disappears. This conclusion was drawn

following a trial derived from the GOAL study [56]. In the study, the subjects with higher pessimism levels had unhealthier lifestyles, including unhealthier dietary habits. However, after the pessimists had received education concerning healthier lifestyles and were subjected to close monitoring, they managed to improve their lifestyles equally to other subjects. Keeping this in mind, it would seem only natural that determining pessimism could help in finding those who probably have unhealthier diets and are in greater risk in failing to improve them. Those subjects could then be targeted with proper education about healthy diets, and the monitoring of dietary changes could lower the risk of various diseases. Naturally, the independent risk of pessimism in developing those illnesses – for example, CHD – is still unlikely to diminish. Determining the level of dispositional pessimism is quick to assess and practically cost free, so it can be expected to be very cost-effective.

There are some strengths and weaknesses in our study and methods. The population was drawn as a random sample and it is representative of Lahti Region with 200,000 inhabitants. However, it seems that poorly functioning and institutionalized persons had a lower participation rate than community-dwelling subjects [57]. The design is longitudinal and observational, but it can obviously not detect any causality between the assessed variables. We have measured a great number of variables, hence the possibility to adjust for a number of confounders was good. However, and typical of cohort studies, the methods were mostly simple and we were unable to describe the diet by, e.g., an extensive food-frequency questionnaire. In the analyses, we classified reduction of fat as an indication of a healthy change. This may of course be debated, since more recent studies indicate that fat quality (shift from saturated towards unsaturated fats) is more important than the intake of total fat per se [58]. In early 2000's, reductions in dietary fat and in fatty foods were generally - at least among many lay individuals - regarded as healthy. Hence, we chose to use fat reduction as an indication of a choice to improve dietary quality.

Much of the data used in this study is based on self-rated questionnaires, so there might be some inconsistency between the answers and the reality in the questions concerning, for example, smoking habits and use of alcohol.

Conclusions

Dietary habits play an important role in the development of many diseases, and improving the diet reduces the risk for developing many severe illnesses. Pessimism and to some extent optimism seem to play a role in current dietary habits and in the ability to change these habits. By determining optimism and particularly pessimism, it is possible to detect individuals in greater need of guidance and support in ameliorating their dietary habits. Separating optimism and pessimism seems to make a clearer connection between the optimism construct and dietary habits as well as between the optimism construct and the ability to make healthy dietary changes.

Abbreviations

BMI: Body mass index; CHD: Coronary heart disease; FFQ: Food frequency questionnaire; GOAL: Good Ageing in Lahti Region study; LOT: Life orientation test; LOT-R: Revised version of the life orientation test; PCA: Principal component analysis

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Availability of data and materials

The dataset supporting the conclusions of this article is a part of the GOAL (Good Ageing in Lahti Region) Project and it was collected and is preserved by the Palmenia Centre for Continuing Education in Lahti, Finland.

Authors' contributions

Authors MP and JH designed the study. RV, MF, OK, MK and EL participated in the conception of the study. JH managed and conducted the statistical analyses and interpreted the data. MP wrote the first draft and MP, JH, RV, MF, OK, MK and EL revised it to make the final manuscript. All authors have approved the final manuscript.

Ethics approval and consent to participate

The cohort study was approved in 2002 by the Ethics Committee of Päijät-Häme Central Hospital, which is located in the city of Lahti, and this extension study was approved in 2013 by the Ethics Committee of Pirkanmaa Hospital District (R12013). Written informed consent was requested and obtained from all cohort participants in 2002.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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