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Special Features of Coronary Heart Disease among Working-aged Patients

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ACADEMIC DISSERTATION

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for public discussion in the small auditorium of Building K,
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1 SUMMARY

The aim of this study was to assess special features of coronary heart disease (CHD) among working-aged patients. First a study was made of the diagnostics of CHD in primary health care, focusing on exercise tests made by trained general practitioners. This section was based on all exercise tests carried out at Kangasala health care centre during the years 1998–2000. To assess the clinical outcome of the test in the working-aged population, all patients under the age of 60 years were followed up for two years after the test.

The other part of the study was based on The Health and Social Support study (HeSSup), a prospective etiological follow-up on the psychosocial health of the Finnish working-aged population involving a random sample of 52 739 individuals drawn from the Finnish Population Register in four age groups: 20–24, 30–34, 40–44, and 50–54. The survey was carried out by postal questionnaire in autumn 1998. Forms were returned by 21 101 individuals, a response rate of 40.0%. Since coronary heart disease is nowadays rare among young age groups, only the age groups 30–34, 40–44, and 50–54 (N=15 477, a response rate of 38.9%) were included in the analyses. Four age- and sex-matched controls for comparison were selected for every patient.

The exercise test is a useful diagnostic tool in general practice. Throughout the two years 348 patients were followed after the exercise test. Of patients with equivocal findings, 4.0% in the test were diagnosed as suffering from CHD during the follow-up period. One person with a negative finding died of a heart infarction. The specificity of the test was 87% and sensitivity 81%, when the diagnosis of CHD after the two years' follow-up period was used as gold standard. The positive predictive value was 38% and the negative 98%. A negative finding in an exercise test conducted by trained GPs for working-aged people in primary health care appears to be quite valid. Among working-aged patients suspected of coronary heart disease the exercise test may predict the clinical outcome quite well in general practice.

The HeSSup data covered 319 patients who reported that a doctor had told them they were suffering from CHD: 185 patients who had not experienced heart infarction (55.1% men) and 134 who had (78.4% men). CHD patients, despite having survived a life-threatening clinical event, appear to have maintained adverse behaviours such as smoking and being obese more often than the control population, which would imply that secondary prevention of the disease is disappointing. One in six CHD patients neglected to collect their medicines from pharmacies and neglected to visit doctors due to high prices. Neglect of treatment was most frequent among those not working. Working-aged coronary heart disease patients seem to be depressed, sleep poorly, and suffer from

daytime sleepiness more than the control population. CHD patients have also experienced significantly more childhood adversities than other people, and many of the adversities appear to be associated with coronary heart disease. Among working-aged CHD patients both the importance of sex life and interest in sex tended to decrease as a result of infarction in both genders.

Coronary heart disease among working-aged patients is a complex problem. Many aspects of the subject warrant attention in primary health care in order to improve the diagnostics of CHD, the well-being of patients and secondary prevention of the disease, and to ensure good commitment to the treatment of working-aged patients.

2 TIIVISTELMÄ

Tutkimuksen tarkoituksena oli arvioida sepelvaltimotaudin erityispiirteitä työikäisessä väestössä. Aluksi tutkittiin sepelvaltimotaudin diagnostiikkaa perusterveydenhuollossa keskittyen erityisesti koulutettujen yleislääkärien tekemiin kliinisiin rasituskokeisiin. Tämä osa perustui kaikkiin Kangasalan terveyskeskuksessa vuosina 1998–2000 tehtyihin kliinisiin rasituskokeisiin. Rasituskokeen kliinistä merkitystä arvioitaessa kaikkia alle 60-vuotiaita potilaita seurattiin kahden vuoden ajan kokeen jälkeen.

Toinen osa tutkimuksesta keskittyi HeSSup -aineistoon (The Health and Social Support study). HeSSup on suomalaisen työikäisen väestön psykososiaalista terveydentilaa ja selviytymistä koskeva seurantatutkimus. Tutkimukseen valittiin iän mukaan ositetulla satunnaisotannalla 52 739 suomalaista. Tutkittavat sijoittuivat tasaisesti ikäluokkiin 20–24, 30–34, 40–44 ja 50–54. Tutkimusprojektin ensimmäinen postikysely tehtiin syksyllä 1998. Kysymyslomakkeen palautti 21 101 henkilöä. Vastausosuus oli 40 %. Koska sepelvaltimotauti on nykyisin harvinainen nuorissa ikäluokissa, analyyseihin otettiin mukaan vain ikäluokat 30–34, 40–44 ja 50–54 (N=15 477, vastausosuus 39 %). Jokaiselle sepelvaltimotautipotilaalle valittiin neljä iän ja sukupuolen suhteen kaltaistettua verrokkia.

Terveyskeskuksessa tehty kliininen rasituskoe osoittautui hyödylliseksi diagnostiseksi tutkimukseksi. Yhteensä 348 potilasta seurattiin koko kahden vuoden ajan kliinisen rasituskokeen jälkeen. Vain 1,8 %:lla niistä, joilla koe oli tulkittu negatiiviseksi ja 4,0 %:lla niistä, joiden koetulos oli epävarma, diagnosoitiin sepelvaltimotauti seuranta-aikana. Yksi negatiivisen koetuloksen saanut kuoli sydäninfarktiin seuranta-aikana. Kliinisen rasituskokeen spesifisyys oli 87 % ja sensitiivisyys 81 %, kun kultaisena standardina pidettiin sepelvaltimotautidiagnoosia kahden vuoden seuranta-ajan jälkeen. Kokeen positiivinen ennustearvo oli 38 % ja negatiivinen 98 %. Negatiivinen löydös kliinisessä rasituskokeessa vaikuttaa olevan luotettava tässä pienen sepelvaltimotautiprevalenssin aineistossa. Kliinisellä rasituskokeella voi ennustaa sepelvaltimotaudin ilmentymistä työikäisessä väestössä.

HeSSup -aineistossa oli 319 potilasta, jotka kertoivat lääkärin sanoneen heidän sairastavan sepelvaltimotautia: 185 potilasta (miehiä 55,1 %), jotka eivät olleet sairastaneet sydäninfarktia ja 134, jotka olivat sairastaneet sydäninfarktin (miehiä 78,4 %). Siitä huolimatta, että heillä oli todettu henkeä uhkaava sairaus, he olivat jatkaneet haitallisia elämäntapoja, kuten tupakointia ja olivat ylipainoisia useammin kuin kontrolliväestö, mikä kuvasti sitä, että sepelvaltimotaudin sekundaaripreventio on epäonnistunut. Joka kuudes sepelvaltimotautipotilas oli viimeksi kuluneen vuoden aikana laiminlyönyt reseptilääkkeiden

hakemista apteekista ja lääkärissäkäyntejä korkeiden hintojen vuoksi. Suurinta laiminlyönti oli työelämän ulkopuolella olevilla. Työikäiset sepelvaltimotautipotilaat ovat usein masentuneita, nukkuvat huonosti ja potevat päiväaikaista väsymystä enemmän kuin kontrolliväestö. Sepelvaltimotautipotilaat olivat myös kokeneet enemmän lapsuudenaikaisia epämiellyttäviä tapahtumia kuin muu väestö, ja monet näistä tapahtumista liittyivät tilastollisesti merkitsevästi sepelvaltimotautiin. Työikäisillä sepelvaltimotautipotilailla sukupuolielämän merkitys näytti vähenevän sydäninfarktin seurauksena molemmilla sukupuolilla.

Työikäisten sepelvaltimotauti on monimuotoinen ongelma. Perusterveydenhuollossa on kiinnitettävä huomiota taudin primaaripreventioon ja varhaisdiagnostiikkaan ja sekundaaripreventioon sekä potilaiden hyvinvointiin ja hyvään hoitoon sitoutumiseen.

CONTENTS

3 ABBREVIATIONS

AMI	acute myocardial infarction
AP	angina pectoris
BMI	body mass index
BP	blood pressure
CAD	coronary artery disease
CHD	coronary heart disease
CSS	Canadian Cardiovascular Society
CVD	cardiovascular disease
CI	confidence intervals
DM	diabetes mellitus
ECG	electrocardiography
GP	general practitioner
HbA1C	glycosylated hemoglobin
HDL	high-density lipoprotein
HeSSup	Health and Social Support
LDL	low-density lipoprotein
MET	metabolic equivalent unit
OR	odds ratio

4 LIST OF ORIGINAL PAPERS

This dissertation is based on the following seven original studies, which are referred to in the text by their Roman numerals I-VII.

I Sumanen M. Kliininen rasituskoe terveyskeskuksen omana toimintana. Kunnallislääkäri 2000;15(7):39–44.

II Sumanen M, Jussila M, Mattila K. Exercise treadmill test may predict clinical outcome among working-aged patients suspected of coronary heart disease in general practice. Scandinavian Journal of Primary Health Care 2005;23(1):47–51.

III Sumanen M, Koskenvuo M, Immonen-Räihä P, Suominen S, Sundell J, Mattila K. Secondary prevention of coronary heart disease is disappointing among patients of working age. Family Practice 2004;21(3):303–305.

IV Sumanen M, Suominen S, Koskenvuo M, Sillanmäki L, Mattila K. Occurrence of symptoms and depressive mood among working-aged coronary heart disease patients. Health and Quality of Life Outcomes 2004; 2:60.

V Sumanen M, Koskenvuo M, Sillanmäki L, Mattila K. Childhood adversities experienced by working-aged coronary heart disease patients. Journal of Psychosomatic Research (In press).

VI Sumanen M, Ojanlatva A, Koskenvuo M, Mattila K. GPs should discuss sex life issues with coronary heart patients. Submitted for publication.

VII Sumanen M, Koskenvuo M, Rautava P, Suominen S, Sundell J, Mattila K. Työikäisten sepelvaltimotautipotilaiden terveyspalvelujen käyttö. Sosiaali-lääketieteellinen Aikakauslehti 2004;41(2):108–117.

In addition, this thesis contains unpublished data.

5 INTRODUCTION

Atherosclerotic diseases constitute an increasing health problem worldwide, and the evolution of this disease is obviously a legacy of changes in our lifestyle, even though heredity has a role to play, and our environment seriously influences the impact of heredity upon the problem (Shepherd 1997). Coronary heart disease (CHD) is the major cause of death world-wide (Murray and Lopez 1997, The World Health Report 1999). Patients with established CHD are at increased risk of subsequent vascular events such as death, myocardial infarction and stroke (Moher et al. 1997). In a study concerning heart failure in eastern Finland, CHD or hypertension was evident in 80% of cases (Remes et al. 1992). The long-term care of patients with coronary disease should be attributed the same status as that of patients with asthma and diabetes (Bethell 1998). The secondary prevention of all cardiovascular disease merits the same systematic approach as we adopt to other chronic diseases such as diabetes (Jolly et al. 1999).

CHD also represents a significant socio-economic burden for all populations (Foxton 2003). In Finland CHD it accounted for 42.7% of all deaths in 2001. Among working-aged people during the same year CHD was the leading cause of death among men, comprising 18% of all cases, whereas among women it was number five in the same list (7% of cases) (Statistics Finland 2001). We also know that of those working-aged patients not pensioned at the time of their first AMI, slightly more than half among both genders were available to the labour market two years later (Hämäläinen et al. 2004).

To the question 'Has a doctor ever stated that you have had a heart infarction?' 2.8% of working-aged men and 0.5% of working-aged women answered yes (Reunanen et al. 2002). According to the same interview the corresponding figures for angina pectoris were 3.1% and 1.1%. The differences are statistically significant ($p<0.001$).

At the end of the year 2003 a total of 192 570 Finns, were receiving special reimbursement for CHD medicines (The Social Insurance Institution 2004). Special reimbursement must be based on examinations by a specialist for internal diseases. In clear cases a statement by another physician can also be accepted if it is based on a long-term patient-doctor relationship. It is required that the patient's distinct angina pectoris symptom be according to a clinical examination considered to be chronic and respond to medical treatment. If the ECG does not give sufficient proof of CHD such as a sign of a myocardial infarction, the diagnosis has to be proved by an exercise test. Another alternative criterion is that the patient has suffered a heart infarction or has undergone coronary by-pass surgery or angioplasty. It is also possible that, in addition to the chest pain

symptom, a significant stenosis has been shown in coronary angiography (http://193.209.217.5/in/internet/suomi.nsf/alias/laake206).

In the diagnostics of the condition symptoms, chest pain and breathlessness during physical distress are important. In addition, mapping of risk factors is considered significant, especially in planning treatment. If the symptoms and risk factors suggest that CHD is probable, the diagnosis is usually verified with an exercise test. Nowadays, these tests are also widely used in primary health care. The patient material in primary health care is, however, different from patients examined at hospital outpatient clinics. If further measures are needed, patients are referred to coronary angiography, which is the gold standard for the exercise test.

In previous studies the diagnosis of CHD has been based on epidemiological data, and findings in the ECG have comprised important measurements. In primary health care, however, GPs meet patients who have the conception of suffering from angina pectoris or having had an acute myocardial infarction. Whether or not this conception is true they lead their own lives in this belief and make their decisions accordingly. It is therefore not always self-evident how the notion of a serious illness has affected their lives and well-being. Moreover, we do not know what kind of commitment they have to treatment. These aspects are examined in this study.

6 REVIEW OF THE LITERATURE ON CORONARY HEART DISEASE AMONG THE WORKING-AGED POPULATION

6.1 Epidemiology

In most industrialised countries mortality from cardiovascular diseases has shown steadily decreasing trends in working-aged people since around 1970 (Uemura and Pisa 1988, Levi et al. 2002). In Finland in the age group 35–64 years the average annual decline of CHD mortality in the 1970s was 1.8% for men and 3.4% for women (Pyörälä et al. 1985). The decline in CHD mortality was also accompanied by a decline in the incidence of non-fatal myocardial infarction. Both of these trends appear to have been due to changes in life-styles and risk factors as well as changes in the management of patients with CHD. The changes in risk factors observed from 1972 to 1992 predicted a decline in mortality from ischemic heart disease of 44% in men and 49% in women, while the decline observed was 55% and 68% respectively (Vartiainen et al. 1994). This suggests that most of the decline in mortality from ischemic heart disease can be explained by changes in the three main coronary risk factors.

A prominent example of the long-term consequences of successful CVD prevention and its influence on premature mortality in Finland was that from 1969-71 to 1995 the age-standardised CHD mortality decreased nationwide by 65% and in North Karelia by as much as 73% (Puska et al. 1998). During the 11-year period 1991-2001 the annual average decline in the age-standardised CHD mortality rate was 5.2% among men and 6.1% among women (Pajunen et al. 2004).

The community-based cardiovascular disease prevention strategy adopted and implemented in eastern Finland during the past 25 years has resulted in a drastic reduction in serum cholesterol levels among the entire population, including subjects with the highest cholesterol levels (Jousilahti et al. 1998). During the last two decades the CHD mortality in the Finnish working-aged population has declined by about 77% (Vehviläinen et al. 2004).

During The FINAMI study period from the years 1983-1997, 6501 CHD events were recorded among men and 1778 among women aged 35-64 years (Salomaa et al. 2003 A). The CHD mortality was found to have declined on an average 6.4%/year among men and 9.3%/year among women. The proportion of recurrences of all CHD events also declined significantly in both sexes. The same authors also state that the decline in out-of-hospital CHD deaths has contributed the main part to the overall decline in CHD mortality rates among persons 35 to years of age in Finland (Salomaa et al 2003 B).

The Mini-Finland survey from the years 1979-80 revealed that the angina pectoris symptom (i.e. reported chest pain under physical strain) may already appear in both sexes at the age of 30, though it was not until the age of 65 that it becomes more common among men compared to women (Aromaa et al. 1989). A large Finnish study in the 1980s also indicated that ten per cent of all heart infarctions were silent, revealed only by ECG changes (Reunanen et al. 1985).

During recent years CHD has clearly moved to old age groups, while it was previously commonly manifested among working-aged men. Among the working-aged population a decrease in risk factors has contributed to this favourable progress. In fact, CVD risk factors have declined markedly in Finland in the past two decades, suggesting that the national preventive cardiovascular strategy has been successful (Vartiainen et al. 2000). On the other hand, while the decreasing trend in smoking among men is encouraging, the increase in smoking among hypertensive women taking antihypertensive medication warrants concern (Kastarinen et al. 2002). Also the prevalence of obesity has increased significantly in normotensive and particularly in hypertensive Finns during the past 15 years (Kastarinen et al. 2000).

There is a difference between the genders in the incidence of CHD among working-aged people. The Framingham Study of cardiovascular disease over five decades indicated that women outlived men and experienced fewer atherosclerotic events, lagging behind men in incidence by 10-20 years (Kannel 2002).

6.2 Risk factors

In the Framingham Offspring Study men aged 35 to 54 years were studied, and in multivariate logistic regression analysis age, smoking and HDL and LDL cholesterol showed a significant association with coronary heart disease (Wilson et al. 1980). In a prospective study of 7735 men aged 40-59 years drawn from general practices in 24 British towns, univariate estimates of the risk of ischemic heart disease show that serum total cholesterol, HDL-cholesterol and triglyceride concentrations, systolic and diastolic blood pressures, cigarette smoking and body mass index are all associated with an increased risk of ischemic heart disease (Shaper et al. 1985). In a Finnish study of 3589 men aged 40-59 years smoking and high serum cholesterol were significant risk factors for sudden coronary death in men with manifestations of coronary heart disease (Suhonen et

al. 1988). The prevalence of risk factors among CHD patients may be considered high, since according to an analysis of 14 international randomized clinical trials 80% to 90% of patients with CHD had at least one of the four conventional risk factors (cigarette smoking, diabetes, hyperlipidemia, and hypertension) (Khot et al. 2003).

In order to assess the risk of the development of CVD the SCORE Model and Risk Charts have recently been developed (De Backer et al. 2003). A core element of the model is that risk is now defined in terms of the absolute 10-year probability of sustaining a fatal cardiovascular event.

6.2.1 High cholesterol

The lifetime risk of CHD increases sharply with higher total cholesterol levels for men and women at all ages (Lloyd-Jones et al. 2003). In men over 40 years of age cholesterol levels predict subsequent mortality, especially among those with preexisting cardiovascular disease (Pekkanen et al. 1990). However, changes in LDL/HDL ratios are better predictors of successful CHD risk reduction than changes in levels (Natarajan et al, 2003). Although the LDL/HDL ratio is a strong risk factor for CHD, it has also been found that LDL, HDL and an interaction between the two are all independent risk factors (Grover et al 2003). The lipid risk profile may, however, be different in men and women, since the serum triglyceride concentration emerged as an independent risk factor for CHD in a large follow-up study of women aged 38-60 (Bengtsson et al. 1993).

6.2.2 Hypertension

Hypertension is one of the most prevalent and powerful contributors to cardiovascular diseases, and CHD, the most lethal and common sequela, deserves highest priority (Kannel 1996). In uncomplicated mild hypertension (systolic blood pressure 140-159) among persons aged 35-64 the CHD risk has been identified 15% over 10 years with acceptable accuracy (Yikona et al. 2002). In hypertensive men treated in clinical practice systolic BP is a good predictor of CHD risk, whereas diastolic BP appears to be of little value in this respect (Benetos et al. 2002). Diastolic BP is also a weaker indicator than systolic BP of long-term cardiovascular events (Borghi et al. 2002). With increasing age, a gradual shift has been found from diastolic BP to systolic BP and then to pulse pressure as predictors of CHD risk, and in patients <50 years of age, diastolic BP was the strongest predictor (Franklin et al. 2001). Of the BP measures available from clinical sphygmomanometry, pulse pressure is a strong cardiac risk factor but is difficult to distinguish in this respect from systolic BP (Millar and Lever 2000).

6.2.3 Smoking

A number of studies report smoking as a risk factor for CHD (Wilhelmsson et al. 1975, Doll and Peto 1976, Rosenberg et al. 1985a, Willett et al. 1987, Kaufman et al. 1987). Quitting smoking is associated with a substantial reduction in the risk of all-cause mortality among patients with CHD, and this reduction appears to be consistent regardless of age and sex (Critchley and Capewell 2003). In a case-control study of 1873 men under the age of 55 with first episodes of myocardial infarction and 2775 controls the risk of myocardial infarction in cigarette smokers decreased within a few years of quitting to a level similar to that in men who have never smoked (Rosenberg et al. 1985b).

6.2.4 High blood glucose

Nondiabetic hyperglycemia is an indicator of cardiovascular risk (Balkau et al. 1998). Individuals with glucose intolerance or diagnosed diabetes are at increased risk in terms of total mortality, CHD incidence and CHD mortality, and these associations remain significant when the risk factors of age, smoking, alcohol use, hypertension, cholesterol, triglycerides and BMI are taken into account in multivariate analysis (Rodriguez et al. 1999). In the Whitehall Study of 18,403 male civil servants aged 40-64 years, the 7,5-year CHD mortality was approximately doubled for subjects with impaired glucose tolerance (Fuller et al. 1980).

Mortality and morbidity rates in CHD are 2 to 4 times higher among patients with type 1 diabetes than in age-matched nondiabetic subjects (Pyörälä et al. 1987, Krolewski et al. 1987). Poor metabolic control is also a strong predictor of CHD events in patients with late-onset type 1 diabetes without nephropathy, independent of other cardiovascular risk factors (Lehto et al. 1999). Postchallenge hyperglycemia may predict CVD mortality independently of other CVD risk factors (Saydah et al. 2001). In subjects with type 1 diabetes CAD occurs earlier in life and is more often fatal, and suboptimal glycemic control (HbA1C >7.5%) is a strong risk factor for progression of coronary artery calcification (Snell-Bergeon et al. 2003). A large study covering different European countries observed an average prevalence of approximately 10 per cent for CVD (a past history or electrocardiogram abnormalities) among insulin-dependent DM patients under the age of 60 (Koivisto et al. 1996).

Type 2 (non-insulin-dependent) DM is also a disease associated with a high vascular risk, where the majority of patients need, and are likely to benefit from, pharmacological treatment of several cardiovascular risk factors (Yki-Järvinen 2000). In the Helsinki Heart Study patients with non-insulin-dependent DM ran a markedly increased risk of CHD (Koskinen et al. 1992). In a study concerning over 116,000 US middle-aged women type 2 DM was a strong determinant of CHD, ischemic stroke and cardiovascular mortality (Manson et al. 1991).

6.2.5 Obesity

The body mass index has long been recognised as a significant predictor of ischemic heart disease (Rabkin et al. 1977). In middle-aged women measures of abdominal adiposity are associated with a risk of CHD (Rexrode et al. 1998). Among women 30 to 55 years of age and free of known cardiovascular disease with a body-mass index of 32.0 or higher who had never smoked, the relative risk of death from cardiovascular disease was 4.1, as compared with the risk among women with a body-mass index below 19.0 (Manson et al. 1995). In middle-aged women the influence of BMI on cardiovascular disease may be greater than previously thought, and although to a great extent explained by the influence of obesity on other risk factors, it is already associated with adverse outcomes at moderately increased body weight (Rosengren et al. 2003). In middle-aged men abdominal obesity is an independent risk factor for CHD, even more markedly than overall obesity (Lakka et al. 2002a). The same authors also found that metabolic syndrome increased cardiovascular and overall mortality, and was independent of other important and potentially confounding factors such as smoking, alcohol consumption and serum LDL cholesterol levels (Lakka et al. 2002b). It has also been stated that being overweight and obese promotes clusters of CHD risk factors which greatly influence their impact (Kannel et al. 2002). The overweight category has also said to be associated with increased relative and population-attributable risk of hypertension and cardiovascular sequelae (Wilson et al. 2002).

6.2.6 Alcohol

The role of alcohol as a risk factor for CHD remains unclear. In a large prospective material on 123,840 persons with 600 CAD deaths, alcohol had disparate relations to cardiovascular conditions, and the findings indirectly supported a protective effect of lighter drinking against CAD (Klatsky et al. 1990). Findings from a study in New Zealand also support the hypothesis that light and moderate alcohol consumption reduces the risk of coronary heart disease (Jackson et al. 1991). Lifelong teetotallers and ex-drinkers have shown a significantly increased risk ratio of major CHD events compared with regular drinkers, although in absolute terms this risk is small (Wannamethee and Shaper 1997). Five years later in a study concerning middle-aged men the same authors found that teetotallers with diagnosed CHD carried an increased risk of coronary heart disease and cardiovascular disease mortality compared with stable occasional drinkers, whereas teetotallers with no diagnosed coronary heart disease were not at increased risk (Wannamethee and Shaper 2002). In a large Scottish cohort study with 21 years of follow-up involving 5766 men aged 35-64 no relation was found between mortality from coronary heart disease and alcohol consumption once adjustments were made for potential confounding factors (Hart et al. 1999). On the other hand, moderate/heavy drinking in men with a history of previous myocardial infarction is associated with a marginally

significant increase in the risk of cardiovascular death and a significant increase in all-cause mortality (Shaper and Wannamethee 2000). In a Finnish study of 2 160 non-abstinent middle-aged men, again, a hangover at least monthly increased the risk of cardiovascular death over 2-fold in a follow-up time of 6.7 years compared with men with fewer hangovers, with adjustment for age and total alcohol consumption (Kauhanen et al. 1997).

6.2.7 Poor sleep

A subjective complaint of insomnia appears to increase the risk of a future coronary event, and this increase cannot be explained by age or classic coronary risk factors (Schwartz et al. 1999). In middle-aged women poor sleep and sleep without a restorative function are associated with poor prognosis, and the association is not explained by depressive symptoms or by standard coronary risk factors (Leineweber et al. 2003). In middle-aged males an association has been found between difficulties in getting to sleep and CHD mortality (Mallon et al. 2002). Also short and long self-reported sleep durations are independently associated with a modestly increased risk of coronary events in women (Ayas et al. 2003).

6.2.8 Life events

Indicators of impaired quality of life are related to high levels of cardiovascular risk factors and a high prevalence of overt cardiovascular disease (Siegrist 1987). In addition, emotional disturbance has been found to be a significant risk factor for coronary heart disease (Tennant and McLean 2001). The risk of premature death from cardiovascular disease is also particularly sensitive to socioeconomic influences acting in early life (Smith et al. 1997). However, in a review article based on 15 longitudinal and four case-control studies no consistent dose-response relationship was found between the index of early life experience and adult cardiovascular disease (Elford et al. 1991).

6.2.9 Depression and other psychological factors

Psychological risk factors for CHD have also been investigated. Depressive symptoms and clinical depression have an unfavorable impact on mortality in CHD patients (Barth et al. 2004). Type A behavior has been associated with a twofold risk of angina, myocardial infarction and CHD in general, as compared to Type B behavior (Haynes et al. 1980). Proneness to anger places normotensive middle-aged men and women at a significant risk of CHD morbidity and death independent of the established biological risk factors (Williams et al. 2000), and episodes of anger are capable of triggering the onset of acute myocardial infarction (Mittleman et al. 1995). Women appear to be

more sensitive than men with respect to psychosocial risk factors for CHD involving work content, workload and control, physical and emotional stress reactions and burnout (Hallman et al. 2001). On the other hand, in a prospective occupational 5-year follow-up cohort study of London-based civil service employees psychological distress emerged as a risk factor for CHD in men, which was not explained by health behaviors, social isolation or work characteristics (Stansfeld et al. 2002). Among men depression has been found to be an independent risk factor for ischemic heart disease, and this risk persisted regardless of smoking status, deprivation score and presence of diabetes or hypertension (Hippisley-Cox et al. 1998). It is also noteworthy that patients with CHD and low emotional social support who express anger outwardly are at a highly increased risk of disease progression, independent of medication or other risk factors (Angerer et al. 2000).

6.3 Symptoms

The typical symptoms of CHD, chest pain and breathlessness, are well known. They are considered quite dramatic, and can thus be fairly reliably mapped by a survey (Rose and Blackburn 1968). The chest pain may be classified as typical, atypical and non-anginal, and the degree of its difficulty is nowadays classified as CCS (Canadian Cardiovascular Society classification) I-IV (Kettunen 2000). Among patients with symptoms, the presence of typical chest pain is associated with an increased risk of mortality as compared with patients with atypical or non-anginal chest pain (Jones et al. 2004).

6.3.1 Palpitations

As early as 1987 it was stated that palpitations are not an independent risk factor for increased cardiac morbidity or mortality (Knudson 1987). However, in a prospective cohort study of 190 consecutive patients presenting with a complaint of palpitations at a university medical centre the etiology of the palpitations was cardiac in 43% of cases (Weber and Kapoor 1996). In another study of patients with palpitations consulting GPs it appeared that those experiencing palpitations at work and those experiencing palpitations affected by sleeping were significantly more likely to have a cardiac cause for their palpitations (Summerton et al. 2001). Gender differences in non-chest pain symptoms among CHD patients have also been found, women being more likely than men to report palpitations (Milner et al. 1999). We should, however, keep in mind that palpitation is a very common presenting symptom in primary care, and among most patients referred to secondary care for this complaint the cause of the palpitations is benign (Zimetbaum and Josephson 1998, Mayou et al. 2003).

6.3.2 Depression

Depression is a common sequel to CHD events such as bypass grafting, coronary angioplasty, myocardial infarction and myocardial ischemia (Lehto et al. 2000). At least a small, transient increase in the number of patients with depression shortly after bypass surgery has been established (Timberlake et al. 1997). On the other hand, there is evidence that the majority of patients who were depressed after bypass surgery were also depressed beforehand (McKhann et al. 1997). In a sample of 144 symptomatic patients with CHD, twenty-four per cent had a probable depressive disorder, but none had been previously identified as suffering from depression, or been treated for depression (Valkamo et al. 2001). The presence of depressive symptoms has an adverse impact on the prognosis of patients with established CHD (Frasure-Smith et al. 1995, Barefoot et al. 1996, Connerney et al. 2001). In fact, having symptoms of major depression following an AMI multiplies the risk of mortality over the first 6 months by a factor of 3 to 4 (Frasure-Smith et al. 1993). Depression is also a strong predictor of the degree of work resumption among CHD patients (Söderman et al. 2003). Patients with depression following an AMI are less likely to adhere to recommended behavior and lifestyle changes intended to reduce the risk of subsequent cardiac events, which could explain why depression in the hospital is related to long-term prognosis in patients recovering from an AMI (Ziegelstein et al. 2000). The co-occurrence of depression and cardiac disease thus represents a great challenge (Lesperance and Frasure-Smith 2000).

6.3.3 Sleep disorders

In a cross-sectional study of 5419 Finnish adult men, a higher prevalence of diagnosed myocardial infarction was found among those who slept more than 9 hours, whilst those sleeping less than 6 hours per night had more symptomatic CHD (Partinen et al. 1982). Among working-aged women poor sleep has been found to be associated with an increase in spasmodic chest pain as well as irregular heart beats (Asplund and Åberg 1998). After a coronary event fatigue and sleep problems are frequently reported complaints over a period of weeks (Denollet 1994).

6.3.4 Sexual problems

Screening for cardiovascular risk factors and adoption of preventive measures is recommended in men with erectile dysfunction, and men with cavernous arterial insufficiency aged 50 to 59 years are especially prone to develop coronary artery disease (Speel et al. 2003). It is known that cardiovascular diseases share risk factors with erectile dysfunction (Jackson et al. 2002, Seftel et al. 2004), and men with CHD have an increased risk of developing the condition (Mickley H 2002, Shiri et al. 2003). Coronary risk factors have also been confirmed to exert

an influence on erectile dysfunction apart from that of the known determinants of the dysfunction such as age, diabetes and medication (Feldman et al. 2000). For example, every mmol/liter of increase in total cholesterol was associated with a 1.32 times risk of erectile dysfunction, while every mmol/liter of increase in HDL cholesterol was associated with 0.38 times the risk (Wei et al. 1994). Erectile dysfunction is also a clinically important complication of cardiovascular disease and should be asked about and treated accordingly (Jackson 1999). However, the sex act is considered a relatively weak precipitant of an acute coronary event (DeBusk 2000). Even cardiologists consider it important that CHD patients be encouraged to continue their sexual activities (Moller et al. 2001). In any case, after a cardiac event one important issue concerns with the time to resume sexual activity (Timmins and Kalizer 2003).

Cardiovascular issues associated with sexual functions are as yet not well known in the case of women. Myocardial infarction does have a negative impact on sexuality issues in a female patient, but demands are not being met despite the fact that many patients having had a myocardial infarction desire sexual counselling (Papadopoulos et al. 1983). Women more than men have reported a decrease in the frequency of sexual interaction, a less satisfactory relationship, and an increased frequency of reports of chest pain during sexual activity after a myocardial infarction (Hamilton and Seidman 1993).

6.4 Quality of life

Quality of life is considerably affected in patients following a cardiac event, especially during the initial recovery phase (Westin et al. 1997). In a Finnish study of symptomatic CHD patients with chest pain life dissatisfaction was not primarily determined by the severity of CHD but by the existence of depressive symptoms (Valkamo et al. 2003). It is noteworthy that according to a British cohort study the greatest impact on quality of life after myocardial infarction has been seen in patients of working age (Brown et al. 2000).

6.5 Diagnostics

6.5.1 Screening

Screening for CHD is focused on the risk factors underlying it. For the most part screening concerns elevated serum lipid levels. Serum cholesterol levels are directly associated with CHD risk, and there is no threshold level below which there is no risk (Montague et al. 1994). However, universal screening is neither cost-effective nor the best use of the patient's and physician's time (Garber

1997). On the basis of the effectiveness of treatment, the availability of accurate and reliable tests, and the likelihood of identifying people with abnormal lipids and increased CHD risk, screening appears to be effective in middle-aged and older adults and in young adults with additional cardiovascular risk factors (Pignone et al. 2001). In a Norwegian study cardiovascular risk factor screening of 40-year-old men and women yielded a substantial number of people with lipid abnormalities, especially those associated with the metabolic syndrome and hypertension, indicating that monitoring of this age group in the population continues to be worthwhile (Tonstad and Hjermann 2003). Screening is most likely useful in populations at high short-time risk of dying of CHD, for example survivors of myocardial infarction and middle-aged men with multiple cardiac risk factors (Garber et al. 1996). In young adults cholesterol screening and treatment should be limited to individuals with known coronary disease or other unusual factors which place them at high short-term risk of CHD death (Hulley et al. 1993). On the other hand, since cholesterol levels in young adults predict CHD risk 30-40 years later, waiting until mid-life to find elevated cholesterol loses a significant portion of the benefit (Cleeman 1997).

6.5.2 Exercise test

Although the exercise test has a long history in cardiovascular medicine, it was not until 1932 that exercise ECG was proposed as a diagnostic tool for angina (Goldhammer and Scherf 1932). Nowadays the exercise stress test is a useful screening tool for the detection of significant CAD (Darrow 1999). Exercise ECG is invaluable in the initial assessment of CHD and yields a great deal of prognostic information (Myers and Froelicher 1993, White and Evans 2001). It can also be used in the assessment of therapeutic intervention in cardiac patients (Younis and Chaitman 1993). Routine exercise testing in asymptomatic individuals has, however, low clinical yield and is not a cost-effective strategy (Pilote et al. 1998), although in 25,927 healthy men 20 to 82 years of age at baseline (mean 42.9 years) with no history of cardiovascular disease and no risk factors, an abnormal test was associated with a 20-fold increased risk of CHD death compared with men yielding normal test results (Gibbons et al. 2000). The test requires minimum equipment and in most cases can be done safely (Ashley et al. 2000). For primary care physicians, exercise testing is a cost-effective tool to evaluate patients presenting with symptoms and helps to stratify those with probable coronary artery disease into a high-risk group needing referral and a low-risk group which can be observed (Evans and Ellested 1994). In a Swedish primary health care study involving 577 patients suffering chest pain, an exercise test led to a diagnostic decision in 77% of cases (Nilsson et al. 2003). In that study most of the findings were negative. We should, however, bear in mind that among high-risk patients, for example those over 50 years of age suffering from a typical angina pectoris syndrome, CHD cannot be ruled out with a negative finding, even if the finding can be of some predictive value (Hill and Timmis 2002). Nonetheless, the findings in coronary angiography cannot be for certain

predicted with the test (Froelicher et al. 1988). After a myocardial infarction ventricular arrhythmias have emerged as the most important prognostic factor measured during the exercise test (Hämäläinen et al. 1989).

Meta-analysis of trials has shown that the exercise test has a specificity of around 80% and a sensitivity of around 70% for obstructive coronary disease confirmed by angiography (Gianrossi et al. 1989). In one Finnish textbook of cardiology the corresponding figures are estimated at 80% and 65%, respectively (Helin and Heikkilä 1994). Such low sensitivity has been considered to reduce the utility of the test (Froelicher et al. 1989). It is also well known that many positive findings in the test are false, especially among women (Pratt et al. 1989). The lower prevalence of severe coronary artery disease and the fact that more women than men fail to reach maximum aerobic capacity during exercise testing lead to lower sensitivity for ST changes overall (Hlatky et al. 1989). The predictive value of test depends after all on the degree of ST-segment depression, and the pretest probability of CHD is an important determinant of the predictive value of any test result in the individual patient (Rifkin and Hood 1977). To improve the value of the test a prognostic score has been devised to help clinicians determine the prognosis and decide whether to refer outpatients with suspected coronary disease for cardiac catheterization (Mark et al. 1991).

In Finland during recent years the test has also come to be more commonly applied by trained GPs in primary health care. The patient material is, however, different compared with the materials in outpatient departments of internal medicine. The good availability of the test has been found to be a problem, since it may create a demand and thus the threshold for referring patients for the test becomes lower. In this case the number of false positive findings may increase, which may contribute to unnecessary further measures and incur extra costs (Länsimies 1994). In addition, the interpretation of the test requires specialized knowledge (Yleislääkärin käsikirja 1998). It has nevertheless been found possible to increase the number of diagnostic exercise tests in primary care when the indications for referral are sensibly outlined (Jauhiainen et al. 2001).

6.6 Primary prevention

Extensive epidemiologic, clinical and laboratory data accumulated over the past 3 decades provide a convincing rationale for primary prevention of CHD beginning early in life with emphasis placed on healthful lifestyle training and behavioral change interventions (Hayman and Reineke 2003). Retaining traditional balanced dietary habits and limiting salt intake together with avoiding smoking are important measures in the prevention of cardiovascular disease in developing countries (Li et al. 1994). All patients seen by a physician should have a periodic nutritional and smoking assessment and blood pressure measurement, and those patients who have less than optimal risk factor behaviors should be a target of further intervention (Kottke 1985). Individual goals should be set and worked towards through lifestyle changes and

medication (Keevil et al. 2002). One good possibility is the applicability of familial premature CHD in screening for early prevention in primary health care (Koski et al. 2000). In primary prevention, control of the major risks mainly in patients with clustered factors will substantially reduce the threat of ischemic events (Gensini et al. 1998). Unfortunately, health checks have little role in preventing coronary heart disease, but they may help to promote healthy lifestyles (Hanlon et al. 1996).

Because, however, many patients in primary prevention fail to achieve target lipid levels, simplicity of treatment can be considered to be of great importance (Gaw 2002). Although there is strong evidence to support the treatment of abnormal blood lipid levels among people with cardiovascular disease, it must be admitted that primary prevention is problematic in that many individuals with lipid abnormalities may never actually develop cardiovascular disease (Grover et al. 2000). In point of fact guidelines for assessing CHD risk and lipid-lowering therapy differ greatly (Broedl et al. 2003). On the other hand, in subjects without evidence of prior myocardial infarction but suffering from hypercholesterolemia, the use of lipid-lowering medicine yields substantial health benefits, as shown in The West of Scotland coronary prevention study with the use of pravastatin (Caro et al. 1997). In Finland it has also been found that there is still room for improvement in the use of lipid-lowering drugs, since only half of those who according to recommendations really had reason actually used the drugs (Saaristo et al. 2000). In addition, according to a risk factor survey in 2002 the marked decline previously seen in cholesterol levels in the Finnish population had levelled off (Vartiainen et al. 2003).

Control of elevated blood pressure is also important. In an American study concerning subjects 30 to 74 years of age and without prior CHD, modification of hypertension to high normal levels could prevent approximately one fifth of CHD events in men and one third in women, whereas control to optimal levels might prevent 37% and 56% of CHD events (Wong et al. 2003 A). In the same study control of LDL, HDL and blood pressure to optimal levels resulted in the prevention of 80.5% of CHD events in men and 82.1% in women (Wong et al. 2003 B). It has also been stated that strategies to reduce coronary heart disease risk in primary care are most cost-effective if they are limited to patients with raised blood pressure or a history of coronary heart disease (Field et al. 1995).

Evidence for an independent role of increased physical activity in the primary prevention of coronary heart disease has also been suggested. In a meta-analysis summary, relative risk of death from coronary heart disease was 1.9 (95% confidence interval 1.6-2.2) for sedentary compared with active occupations (Berlin and Colditz 1990).

In conclusion, in individuals with favorable levels of cholesterol and blood pressure who do not smoke and do not have diabetes, MI or ECG abnormalities, long-term mortality is much lower and longevity much greater (Stamler et al. 1999). It is also worth mentioning that subjects with favorable cardiovascular risk profiles in middle age have been found to incur lower average annual Medicare charges in older age (Daviglus et al. 1998).

6.7 Secondary prevention and treatment

A large European survey has demonstrated a high prevalence of modifiable risk factors in CHD patients, indicating that there is considerable potential to reduce morbidity and mortality (EUROASPIRE 1997). Several studies have shown that lipid-lowering therapy reduces mortality in patients with established CHD (Lewis et al. 1999**,** Pedersen et al. 2000**,** Aronow et al. 2001**,** Simes et al. 2002). The use of statins has in fact increased throughout the West since the 1990s (EUROASPIRE I and II 2001). In Finland acute coronary events were reduced already in the 1990s with another lipid-lowering medicine, gemfibrozil (Heinonen et al. 1994). Lipid-lowering therapy is also cost-effective in patients with coronary heart disease, as found in The Scandinavian Simvastatin Survival Study (4S) (Johannesson et al. 1997).

Secondary prevention should not, however, be based on medication only. There are numerous possibilities for improvements in the secondary prevention and medical management of CHD (Sigurdsson et al. 2002). Comprehensive lifestyle changes may bring about regression of even severe coronary atherosclerosis after only one year, without the use of lipid-lowering drugs (Ornish et al. 1990). In order to gain maximum benefit, lifestyle measures need to be adopted (McLeod et al. 2004). It is noteworthy that diet guidance is profitable since it increases among other things patients' commitment to treatment (Tuominen et al. 1998). With modern drug treatments for secondary cardiovascular disease prevention it remains possible through a favorable diet, exercise and smoking cessation to achieve an additional reduction in the risk for CHD (The Vestfold Heartcare Study Group 2003).

Quitting smoking is associated with a substantial reduction in risk of all-cause mortality among patients with CHD, and the reduction seems consistent regardless of differences in age, sex, country and time period (Critchley et al. 2003). In the EUROASPIRE I cohort study the results of the mortality follow-up of patients underlined the prominence of smoking and diabetes for the secondary prevention of CHD (De Bacquer et al. 2003). In addition, there is strong evidence to indicate that after coronary artery bypass graft surgery patients who do not stop smoking have a markedly elevated risk of premature death and a higher rate of repeat revascularization procedures compared with those who give up the habit (van Domburg et al. 2000). However, despite awareness that smoking cessation contributes substantially to a decrease in cardiovascular events, evidence of effective cessation strategies in cardiovascular patient populations is very limited (Wiggers et al. 2003). In Finland 22% of patients continue smoking after a coronary event (Järvi 2001).

It should ultimately be borne in mind that people also expect doctors to pay attention to the life habits of their patients and the prevention of CHD (Danielsson et al. 2000), and it is worth mentioning that the doctor-patient relationship may act as a barrier to the delivery of secondary prevention in primary care (Summerskill and Pope 2002). There would in any case appear to be ample opportunity for improving the secondary prevention of CHD in general

practice (Campbell et al. 1998a). Preventive care in patients with proven ischemic heart disease in general practice remains haphazard (Bradley et al. 1997). One means of improvement here may be the nurse-led secondary prevention clinics, which have improved CHD patients' health, the most benefit being in functional status, but there have also been improvements in the context of chest pain and less need for hospital admissions (Campbell et al. 1998b). In Scotland nurse-led secondary prevention clinics have succeeded in improving secondary prevention and reducing mortality (Murchie et al. 2003). There is in any case considerable potential to reduce the risk of a further major ischemic event in patients with established coronary disease, which can be achieved by effective lifestyle intervention, rigorous management of blood pressure and cholesterol, and the appropriate use of prophylactic drugs (Bowker et al. 1996). In one British study every measure of modifiable risk studied was found to be managed suboptimally (Flanagan et al. 1999).

6.8 Use of health services

Among adults during the year 1996 11.4% of visits to doctors concerned cardiovascular disorders (Arinen et al. 1998). It has been found that CHD patients may comply well with follow-up visits but less well with lifestyle changes (Bergman and Berterö 2001). Most studies on the use of health services by CHD patients deal with the use of medicines, especially lipid-lowering drugs. The risks of treatment discontinuation has been shown to increase continuously during treatment and totaled from 6 to 30% after 5 years (Insull 1977). However, the rate of discontinuation of statins is lower than that for other LLM, as shown in a large American cohort study (Andrade et al. 1995). In Finland the most frequent reasons for discontinuation were 'drug costs' and 'normal cholesterol values' (Strandberg et al. 1997). In general, the patients most likely to comply with lipid-lowering medications are those who have experience in being compliant with other medications and those who perceive their health as poor (Sung et al. 1998). Noncompliance must undoubtedly be of vital importance, since good adherence to statin treatment is associated with a lower risk of recurrent MI (Wei et al. 2002). In conclusion, clinicians need to recognize the widespread prevalence of noncompliance and realize that many, if not all, of their patients will not take their prescribed medications as directed (LaRosa H. and Larosa C. 2000).

7 AIMS OF THE STUDY

CHD is a common disorder, and GPs often meet patients suffering from it. When the suspicion of CHD arises, an exercise test is needed to verify the diagnosis.

In primary health care, GPs also meet CHD patients presenting with other symptoms and complaints than the well-known ones, e.g. mood disorders and sex life issues. GPs also have to take an overall view of their patients. With regard to CHD patients this consists in patients' previous history, including life events as well as secondary prevention and commitment to treatment. In this study these special aspects were studied concerning working-aged patients who have the conception of suffering from CHD.

Specific aims:

1. To evaluate the feasibility of exercise tests applied by trained GPs in primary health care.

2. To assess the significance and the predictive values of exercise tests used for working-aged patients in primary health care.

3. To evaluate risk factors related to secondary prevention in working-aged coronary heart disease patients.

4. To establish the spectrum of symptoms and complaints among working-aged people with self-reported coronary heart disease, and how they perceive their state of health.

5. To assess how childhood adversities are related to coronary heart disease among working-aged coronary heart disease patients.

6. To analyse the importance of, the satisfaction with, and the ease in talking about sex life with an important other as well as interest in sex among working-aged coronary heart disease patients.

7. To determine how working-aged coronary heart disease patients use health services with special focus on whether or not they neglect health care.

8 MATERIAL AND METHODS

The study involved two different materials:

8.1 Health centre patients at Kangasala

This cohort comprised all patients (N=246) examined by exercise test by four trained GPs at Kangasala health centre in Finland during the year 1998 (Table 1). The proportion of men was 44%, and the proportion of examined patients under the age of 60 was 55%. (I)

All patients less than 60 years of age were examined by the exercise test (N=393) carried out by the same trained GPs at Kangasala health centre during the years 1998-2000 (Table 2). Compared to the material used in the first analysis patients from the two following years were included, but patients at least 60 years of age were excluded, since they were not regarded as of working-age. Of this total 34 had previously diagnosed CHD, leaving 359 to be followed. Eleven of these, again, had moved to another area and two had died, both of an acute myocardial infarction during the follow-up. Throughout the two years 346 patients were followed. The material comprised 174 men (50.3%) and 172 women. (II)

Table 1. *Age distribution (%) of patients examined by exercise test at Kangasala health centre during the year 1998.*

	Men		Women		Total	
Age	N	%	N	%	N	%
<40	4	4	8	6	12	5
40–49	20	18	23	17	43	17
50–59	43	40	37	27	80	33
60–69	35	32	37	27	72	29
70–79	7	6	31	22	38	16
>80	0	0	1	1	1	0
Total	109	100	137	100	246	100

Table 2. *Age distribution (%) of working-aged patients followed up two years after the exercise test.*

	Men		Women		Total	
Age	N	%	N	%	N	%
<30	4	3	2	1	6	2
30–34	6	3	2	1	8	2
35–39	10	6	12	7	22	6
40–44	13	7	20	12	33	10
45–49	32	18	25	14	57	17
50–54	53	31	55	32	108	31
55–59	56	32	56	33	112	32
Total	174	100	172	100	346	100

8.2 The Health and Social Support Study

8.2.1 Study design

The Health and Social Support study (The HeSSup Study) is a prospective follow-up on the psychosocial health of the Finnish working-aged population conducted by the universities of Turku and Tampere and The Finnish Institute of Occupational Health. The general aim is to establish whether poor social support predicts morbidity and mortality outcomes (Korkeila 2005). The follow-up will include three repeated questionnaires: at baseline (in 1998) and after 5 and 10 years (in 2003 and 2008). The present study (III-VII) is based on data derived from the baseline questionnaire in 1998. In one of the original articles (V) data from the first follow-up questionnaire in 2003 was also used.

The language of the survey was originally Finnish, but it was translated for Swedish-speaking respondents. The questionnaire comprised 110 questions, many of which have been used successfully in previous studies. The survey was carried out between September 1998 and February 1999. A second postal round took place ten weeks after the first. The mailings consisted of the questionnaire, a personal invitation letter assuring confidentiality, a consent form and a pre-paid return envelope.

8.2.2 Study population

The HeSSup population consisted of a random sample of 52 739 individuals drawn from the Finnish Population Register, stratified according to gender and four age groups: 20-24, 30-34, 40-44, and 50-54 (Korkeila 2005). Two additional samples, one from the Swedish-speaking population, the other from the population of Turku and neighbouring communities, were included in the total sample. The total was 64 797 individuals. Forms were returned by 26 518 individuals, a response rate of 40.8%. Altogether 620 were discarded. The reason for this was that the respondent did not belong to the original sample (e.g. a family member had filled in the questionnaire). Moreover, 245 individuals could not be contacted due to an incorrect address. There were also 2 071 forms that were not signed. A total of 20 662 (79.8%) of those included were collected from the first and 4 604 (17.8%) from the second postal round. The postal code could not be identified in 632 (2.4%) questionnaires, because the identification code had been removed. After exclusion of the over-represented Swedish-speaking and Turku samples the total number of respondents matched for general population comparisons was 21 101 out of 52 739 mailed questionnaires. The total response rate was 40.0% (Table 3, Korkeila et al. 2001).

In order to enable linkage of the questionnaire data with hospital medical registers, the Social Insurance Institution, the Finnish cancer registry and retirement registers, respondents were asked for personal consent by signature. Identification codes were used for this linkage purpose.

Since coronary heart disease is nowadays rare among young age groups, only the age groups 30-34, 40-44, and 50-54 (N=15 372, a response rate of 38.9%) were included in the analyses (IV–VII).

The data contained 319 patients: 185 coronary heart disease patients who had not experienced heart infarction (55.1% were men) and 134 patients who had (78.4% were men) (Table 4).

Table 3. *Response rates in the HeSSup Study by gender and age (52 739 mailed questionnaires)*

	Response rates, % (No of responses/No of mailed questionnaires)		
Age group	All	Women	Men
20–24	42.7 (5 624/13 177)	54.6 (3 534/6 471)	31.2 (2 090/6 706)
30–34	37.6 (4 976/13 222)	45.5 (2 944/6 469)	30.1 (2 032/6 753)
40–44	37.9 (5 120/13 248)	45.5 (3 013/6 616)	30.3 (2 107/6 632)
50–54	41.1 (5 376/13 093)	45.3 (2 948/6 502)	36.8 (2 428/6 591)
Total	40.0 (21 096/52 739)	47.7 (12 439/26 058)	32.1 (8 657/26 681)

The age group or gender could not be identified in 5 cases.

Table 4. *Coronary heart disease patients studied according to age and gender.*

	CHD, no heart infarction (angina pectoris only)				CHD, with heart infarction (past MI)			
	Women	Men	Total		Women	Men	Total	
	N=83	N=102	N=185	%	N=29	N=105	N=134	%
Age group								
30–34	16	14	30	16	4	3	7	5
40–44	20	28	48	26	3	9	12	9
50–54	47	60	107	58	22	93	115	86

8.3 Analyses of the exercise test

The tests were performed according to a protocol, the workload increasing continuously. ST changes were measured with the Mason-Likar ECG (Myers and Froelicher 1993). The test outcome was concidered positive if the ST-depression in the chest leads (V4-6) was at least 1 mm, and was not rapidly ascending. The occurrence of chest pain was also noted.

In the case of patients tested more than once during the period only the first test was included. The classification of findings concerning CHD was four-step, positive, equivocal, negative or uninterpretable. In analysing the case history it was ascertained what the treatment decision had been in each case. The usefulness of the test was evaluated according to how the diagnostics of CHD was matched. (I)

The material included only those without a diagnosis of CHD at time of testing. Two years after the test, check was made how many of the patients concerned were still resident in the district and how many of them were still alive. All patients were checked as to whether or not they had a diagnosis of CHD after the two years' follow-up period. (II)

The specificity and sensitivity as well as the positive and negative predictive values of the test were calculated in respect to whether or not participants had a diagnosis of CHD by the end of the follow-up period. In the calculation positive and equivocal findings were combined and uninterpretable findings were excluded. The analyses were made using the SPSS System for Windows, release 11.5.

8.4 Analyses of the Health and Social Support Study

There were 110 items in the questionnaire covering the most central areas of life, including health habits, medication and diagnosed illnesses. Subjects were asked whether or not a doctor had told them that they have or have had angina pectoris or myocardial infarction. In interpretation of results CHD patients were divided into two groups. The first comprised coronary patients not having suffered a myocardial infarction (angina pectoris group) and the second patients who had had myocardial infarction (infarction group). Four age-, and sex-matched controls were selected for every patient for comparison. Stroke was ruled out in the control groups, but otherwise there were no differences between the CHD groups and their respective controls. The diagnosis of CHD was thus based solely on the subjects' own conception; no other knowledge of the diagnosis was available.

Risk factors were mapped by asking whether or not a doctor had ever said that the study participant had a high cholesterol level, diabetes or high blood pressure. Smoking was examined by asking whether the participant had ever smoked regularly, and whether he or she still smoked regularly. The height, current weight, maximal weight during lifetime and weight at the age of twenty were also established. The corresponding body mass indices (BMI) were calculated. Consumption of alcohol was mapped by asking the frequency of hangovers during the last twelve months. A hangover at least once a month was considered frequent. It was also asked whether or not the participant had been sober throughout life. It was asked how much and how exhausting exercise participants took, and the exercise variable was then calculated according to how strenuous the exercise has been. For volume of activity, an activity metabolic equivalent (MET) index was used (Kujala et al. 1998). Finally the index was divided into two classes, the limit being two MET hours of exercise daily. (III)

The appearance of dyspnea was categorised into four degrees of difficulty. Participants were also asked whether or not they had experienced daily or weekly chest pain during anger or other kinds of emotion, palpitation and perspiration without physical exercise, flushing, trembling of hands and voice and jerking of muscles. Irregular heartbeats daily or weekly were also asked. Depression was estimated by Beck's depression scale (Beck and Ward 1961) ranging from 0 to 63. The normal score on this scale is below 10. In mild depression the scores are between 10 and 19 (Varjonen et al. 1997). Respondents were also asked how well and how many hours a day they had usually slept and how often they had felt day-time sleepiness, which when occurring daily or almost daily has been proved to be associated with depression, insomnia and breath interruptions during sleep (Hublin et al. 1996). The associations, odds ratio (OR) with 95% confidence intervals (CI), between symptoms and coronary heart disease with and without heart infarction were computed by conditional logistic regression analysis. (IV)

The subjects were in terms of the following questions asked to think about their childhood adversities. Did your parents divorce? Did your family have

long-lasting financial difficulties? Did serious conflicts arise in your family? Were you often afraid of some member of your family? Was someone in the family seriously or chronically ill? Had someone in the family problems with alcohol? The alternative answers were yes, no or I do not know. Only the first two alternatives were included in statistical analyses. Finally odds ratios (OR) were calculated in the conditional logistic regression analysis for matched pairs data for every childhood adversity as factor (Model 1). The same figures were calculated adjusting with education (Model 2), with conventional risk factors such as smoking, obesity (BMI $\geq$ 27) and self-reported hypertension (Model 3), and with both (Model 4). These analyses were made for the material as a whole, but also separately for both genders. (V)

Perceptions of importance of, satisfaction with and ease in talking about sex life with an important other were asked with a Likert-type 7-point scale, but only 3 categories were used in order to avoid small frequencies (Ojanlatva et al. 2003). The item of interest in sex was drawn from Beck's Depression Inventory (Beck et al. 1961). It used 4 response alternatives (no recent change in interest in sex, less interested, much less interested, lost interest completely). (VI)

Respondents were also asked whether or not they neglected to collect their prescription-only medicines from pharmacies, neglected to visit doctors, and neglected to attend for examinations ordered by a doctor due to high prices. Other reasons for neglect were not asked. The background of neglect due to high prices was surveyed by logistic regression analysis in which both CHD groups were combined. The analysis included gender, age group, being at work, basic education, felt state of health, the degree of difficulty of depression, the amount of social support (Sarason et al. 1987), the number of visits to doctors, and chronic diseases such as hypertension, diabetes, hypercholesterolemia and asthma. (VII)

Statistical significance was tested by χ^2-test using the SPSS System for Windows, release 11.5 (III-VII). Conditional logistic regression analyses were made using the SAS System for Windows, release 8.2 (IV-V, VII).

9 RESULTS

9.1 Feasibility of exercise tests in primary health care (I)

Exercise tests were easily and safely conducted by trained GPs in primary health care. In most cases diagnostic help was obtained from the test. The suspicion of CHD was strengthened in 24% of cases, and the disease was ruled out in 49%. The tests also gave valuable information concerning the need for further examinations.

9.2 Diagnostic value of the exercise test in primary health care (II)

Of the test results 11.6% were considered positive and 78.6% negative. The finding was equivocal in 7.2% and the test uninterpretable in 2.6% of cases. The most common reason for an equivocal or uninterpretable test result was an interruption of the exercise test at too low a pulse level.

During the two years' follow-up period two patients had died, both of AMI. One was a 55-year-old woman with an uninterpretable finding in ECG who died one year after the test , the other a 46-year-old man with a negative test finding.

During the follow-up period CHD was diagnosed in six of the patients who did not yield a positive finding in the test (Table 5). Of those with equivocal findings 4.0% were diagnosed as suffering from CHD. The specificity of the test was 87% and sensitivity 81%, when the diagnosis of CHD after the two years' follow-up period is used as gold standard. The positive predictive value was 38% and the negative predictive value 98%. There were altogether 32 CHD patients. Their mean age was 53.6 years (SD 5.0), that of other patients 49.8 years (SD 7.7).

Table 5. *Diagnosis of coronary heart disease after two years' follow-up in different groups of findings in the exercise test.*

	Coronary heart disease		
Test finding	yes	no	total
Positive	24	16	40
Equivocal	1	24	25
Negative	6	267	273
Uninterpretable	1	9	10
Total	32	316	348

* The two patients who died during the two years' follow-up are included

9.3 Occurrence of risk factors (III)

In the angina group one third of subjects and in the infarction group two thirds had elevated cholesterol (Table 6). Half of the angina group and two thirds of the infarction group had elevated blood pressure. Diabetes was not common in the angina group, but concerned one in five in the infarction group. None of these risk factors was so common among controls. In the angina group every third and in the infarction group almost every second was obese. In the angina group more than half and in the infarction group two thirds had had a BMI of at least 27 kg/m^2. Among controls about one in three was obese. In both coronary heart disease groups the current average BMI and the average maximal BMI were higher than in the control groups, but only the differences in the average maximal BMI were statistically significant.

More than half in the angina group and almost three fourths in the infarction group had smoked (Table 6). In both groups half had stopped smoking. In this respect they did not differ from the controls. In both coronary heart disease groups one in five reported frequent hangovers, as against about one in six among controls. In both coronary heart disease groups one in twenty reported lifelong sobriety, while in the controls this was rarer. Lack of exercise was also more common among CHD patients than among controls. The difference, however, was statistically significant only between the infarction group and their controls.

Table 6. *Reported prevalence (%) with statistical significance of risk factors among coronary heart disease (CHD) patients and the control population.*

	CHD, no heart infarction n = 193-203 %	Controls n = 775-812 %	p-value	CHD, with heart infarction n = 133-139 %	Controls n = 523-556 %	p-value
High cholesterol	38.7	20.4	<0.001	64.9	24.9	<0.001
High blood pressure	52.0	34.1	<0.001	65.2	39.8	<0.001
Diabetes	7.0	3.1	0.010	18.0	4.9	<0.001
Obesity *						
– Maximal	60.4	47.2	0.001	69.1	59.5	0.038
Smoking						
– Ever regularly	63.0	52.9	0.010	73.9	58.6	0.001
– Still	32.5	24.6	0.022	37.4	23.9	0.001
Lack of exercise **	29.1	26.1	NS	38.1	29.3	0.045

* BMI ≥ 27 kg/m^2

** ≤ 2 MET hours daily

9.4 Symptoms and complaints (IV)

At least mild breathlessness occurred in two thirds of the angina group and in three fourths of the infarction group (Table 7). Severe or extremely serious breathlessness was reported by 20.2% in the angina group and by 27.8% in the infarction group. The corresponding figures in the control groups were 1.4% and 4.0%, the differences also being statistically significant ($p<0.001$). Chest pain during anger or any kind of emotion, palpitation and perspiration without physical exercise, irregular heart beats and jerking of muscles were all both daily and weekly statistically significantly more common among CHD patients than among controls. CHD patients reported more daytime sleepiness and trembling of hands and voice than controls. CHD patients also slept more poorly than controls, and sleeping hours ≤ 6 in 24 hours were more common among them than among controls.

CHD patients scored higher on the depression scale than the controls, the average being 10.2 (95% CI 9.0-11.4) in the angina group and 5.8 (95% CI 5.4-6.2) in the control group. In the infarction group the average score was 9.7 (95% CI 8.4-11.0). The corresponding figure in the control group was 5.9 (95% CI 5.4-6.5). In both coronary heart disease groups at least mild depression was twice as common as among controls.

In the conditional logistic regression analysis chest pain during anger or other emotions and dyspnea were the symptoms most markedly associated with CHD. Irregular heart beats and perspiration without physical exercise were also strongly associated with heart infarction, but not with CHD without heart infarction. On the other hand, jerking of muscles was strongly associated with CHD without heart infarction, but not with heart infarction.

Table 7. *Occurrence (%) of symptoms and complaints in coronary heart disease (CHD) patients and the control population.*

	CHD no heart infarction n = 177-185 %	Controls n = 729-736 %	p	CHD with heart infarction n = 129-134 %	Controls n = 516-525 %	p
At least mild dyspnea	66.5	33.2	<0.001	75.4	35.3	<0.001
Chest pain during anger or emotion						
Almost daily	12.2	1.0	<0.001	16.3	0.8	<0.001
Weekly	12.8	2.5	<0.001	16.3	3.3	<0.001
Palpitation without physical exercise						
Almost daily	14.1	3.4	<0.001	20.8	3.5	<0.001
Weekly	15.3	5.2	<0.001	16.9	5.4	<0.001
Perspiration without physical exercise						
Almost daily	22.7	9.7	<0.001	26.0	11.0	<0.001
Weekly	18.2	10.2	0.003	16.8	8.3	0.001
Irregular heart beats						
Almost daily	15.7	3.5	<0.001	24.0	3.7	<0.001
Weekly	12.4	6.1	0.004	14.0	4.4	<0.001
Depression (Beck ≥ 10)	41.6	20.4	<0.001	43.3	21.0	<0.001
Sleeping hours ≤ 6 in a day	16.8	10.3	0.015	9.4	10.1	0.003
Poor sleep	25.0	15.4	0.002	32.1	13.0	<0.001
Daytime sleepiness						
Almost daily	33.2	11.2	<0.001	32.1	14.9	<0.001
Trembling of hands						
Almost daily	13.8	2.3	<0.001	9.2	3.3	0.004
Weekly	8.3	4.7	0.053	10.7	4.0	0.003
Trembling of voice						
Almost daily	3.3	1.1	0.030	5.3	1.2	0.002
Weekly	3.3	1.2	0.049	3.8	2.3	0.341
Jerking of muscles						
Almost daily	13.7	2.7	<0.001	12.3	4.4	0.001
Weekly	11.5	2.7	<0.001	9.2	3.8	0.011

9.5 Childhood adversities (V)

The most common childhood adversities were long-lasting financial difficulties in the family and someone in the family having been seriously or chronically ill. Almost half of the CHD patients reported these, whereas among controls over 10 percentage points fewer reported the same. One in three had experienced serious conflicts and someone in the family had problems with alcohol. Among controls 7 to 8 percentage points fewer reported this. One in five had often been afraid of some member in the family, this against 6 percentage points fewer among controls. Parents' divorce had been only slightly more common among CHD patients than among controls, the difference being statistically not significant.

When looking at the material as a whole, odds ratios for coronary heart disease were statistically significant except in parental divorce, indicating that subjects with childhood adversities suffered a higher proportion of CHD (Table 8). Odds ratios for having often been afraid of some family member, serious conflicts in the family, and someone having had problems with alcohol were higher among women than among men. In contrast, long-lasting financial difficulties in the family were statistically significant only among men.

Adjustment with education (Model 2) had no influence among women, whereas among men only someone in the family having been seriously or chronically ill was statistically significant. Adjusting with conventional risk factors for CHD (Model 3) someone in the family having been seriously or chronically ill was statistically significant in both genders. In addition, long-lasting financial difficulties in the family were a statistically significant factor among men. With adjustment for both education and conventional risk factors (Model 4) only someone in the family having been seriously or chronically ill remained statistically significant in both genders.

Table 8. *ORs with 95% CI of childhood adversities in the conditional logistic analysis for coronary heart disease without and with adjustment for conventional risk factors [smoking, obesity (MBI ≥ 27), and hypertension], education, and both of them. Statistically significant differences are bolded.*

	ORs (95% CI)			
	Model 1	Model 2	Model 3	Model 4
Parents divorced	1.32 (0.89 – 1.98)	1.27 (0.85 – 1.90)	1.35 (0.88 – 2.09)	1.32 (0.85 – 2.04)
Long-lasting financial difficulties in the family	**1.52 (1.15 – 2.02)**	**1.39 (1.04 – 1.85)**	**1.44 (1.05 – 1.97)**	1.33 (0.96 – 1.84)
Serious conflicts in the family	**1.46 (1.08 – 1.97)**	**1.45 (1.07 – 1.97)**	1.22 (0.87 – 1.71)	1.20 (0.85 – 1.70)
Often afraid of some member of the family	**2.04 (1.43 – 2.92)**	**1.87 (1.30 – 2.70)**	**1.60 (1.08 – 2.37)**	1.46 (0.98 – 2.18)
Someone in the family seriously or chronically ill	**1.70 (1.31 – 2.20)**	**1.64 (1.26 – 2.13)**	**1.79 (1.34 – 2.38)**	**1.76 (1.32 – 2.35)**
Someone in the family had problems with alcohol	**1.55 (1.15 – 2.09)**	**1.48 (1.01 – 2.01)**	1.39 (0.998 – 1.93)	1.34 (0.96 – 1.88)

Model 1: Age- and sex-adjusted

Model 2: Age- and sex-adjusted and adjusted also for education

Model 3: Age- and sex-adjusted and adjusted also for conventional risk factors (smoking, obesity and hypertension)

Model 4: Age- and sex-adjusted and adjusted also for both conventional risk factors and education

9.6 Sex life issues (VI)

More than 50% of the male angina patients and their controls perceived sex life as important. In the heart infarction groups one in three among women and almost 50% among men felt the same. Among controls the proportions were higher, the differences being statistically significant. Satisfaction with sex life was only slightly less evident in the CHD groups than among their respective controls (non-significant). A half of the patients in the CHD groups and their control groups found it easy and one in three fairly easy to talk about sex life.

The proportions of men and women who had expressed no recent change in interest in sex were significantly lower in the heart infarction groups than in the control groups (Table 9). In the angina group, on the other hand, the proportion was significantly lower only among men. Among women, one in five of the heart infarction group lost interest in sex completely. In this respect there was no statistical difference between women in the angina group and controls. It was quite rare for men to lose interest in sex entirely.

Table 9. *Proportions (%) of responses to questions on interest in sex (libido) by coronary heart disease patients and their respective controls. Statistical significance was tested by χ^2-test. Statistically significant differences in bold.*

	CHD, no heart infarction				CHD, with heart infarction			
	Women		Men		Women		Men	
	Patients n=82	Controls n=329	Patients n=102	Controls n=405	Patients n=29	Controls n=113	Patients n=104	Controls n=410
No recent change in interest in sex	51.2	54.1	61.8	71.1	38.0	61.9	54.8	68.7
Less interested in sex	32.9	35.5	25.5	25.7	31.0	29.2	32.7	26.6
Much less interested in sex	7.3	6.4	12.7	2.5	10.3	8.0	10.6	3.2
Lost interest in sex completely	8.6	4.0	0.0	0.7	20.7	0.9	1.9	1.5
	p=0.368		**p<0.001**		**p<0.001**		**p=0.004**	

9.7 Commitment to treatment (VII)

One in six CHD patients had neglected to visit a doctor due to high prices during the previous year. Among controls this decision was made by less than one in ten (Table 10). High prices were likewise the reason for neglect to collect prescription-only medicines (also other than heart medication) from pharmacies among one in six CHD patients. Among controls this figure was clearly smaller. Approximately one in ten CHD patients had neglected to attend for examinations prescribed by a doctor due to high prices. Among controls this was rare.

A low level of education was clearly associated with neglect of care due to high prices among both CHD groups. In the angina group the less educated neglected visits to doctors more than controls (18% vs. 9%, $p=0.002$) likewise, collecting prescription-only medicines from pharmacies (15% vs. 5%, $p<0.001$), and attending for examinations ordered by a doctor (7% vs. 2%, $p=0.005$). In the infarction group, correspondingly, less educated neglected more than controls collecting prescription-only medicines (18% vs. 4%, $p<0.001$), and attending for examinations ordered by a doctor (11% vs. 2%, $p<0.001$), but with respect to neglect of visits to doctors there was no statistically significant difference (16% vs. 10%, $p=0.067$). Among those who had passed the matriculation examination none of the above-mentioned differences was statistically significant in either of the CHD groups.

Not being employed was a significant underlying factor in neglect of care. Depression also increased the tendency to neglect care. The impact was, however, statistically significant among those who suffered from serious depression with respect to attending for examinations ordered by a doctor. The age group 30–34 years was also associated with neglect of examinations ordered by a doctor. In contrast, estimation of state of health, the amount of social support and the number of visits to doctors did not make any difference. Of chronic diseases hypertension was statistically significantly associated with neglect of examinations ordered by a doctor due to high prices. Asthma was associated with neglect of both attendance for examinations ordered by a doctor and collection of prescription-only medicines from pharmacies due to high prices.

Table 10. *Proportion (%) of patients with coronary heart disease and controls who during the previous year had neglected to visit a doctor due to high prices, to collect prescribed medicines from pharmacies, and to attend for examinations ordered by a doctor.*

	CHD, No infarction n = 182	Controls n = 731-736	p	CHD, With heart infarction n = 132-133	Controls n = 520-523	p
Visit to doctors	17.6	8.6	<0.001	14.4	9.2	0.077
Collect prescription-only medicines from pharmacies	14.3	4.9	<0.001	17.4	3.8	<0.001
Attend for examinations ordered by a doctor	6.6	2.1	<0.001	10.5	2.1	<0.001

10 DISCUSSION

10.1 Exercise tests

10.1.1 Feasibility of exercise tests

The rationale for exercise testings by GPs in primary health care is well grounded. The equipment is available and personnel can be trained. There are also many patients suitable for the test. Well-functioning co-operation with hospital clinics creates the bases. In most cases the exercise test has proved its usefulness in the diagnosis of CHD.

The exercise tests can be carried out by health care centres themselves serving a defined population of more than 30 000 at fairly quite low costs. Conducted by trained GPs in cases where CHD is suspected it may also predict clinical outcome.

10.1.2 Strengths and weaknesses

The exercise test study material can be considered representative for examining the diagnostic value of the tests carried out in primary health care. It consisted of all working-aged patients examined by exercise test at the same health centre during three years. The two years' follow-up period was also reasonably long enough to reveal possible false interpretations in the evaluation of test results. There were excellent opportunities in the health centre for follow-up, since an electronic record of case history was available for all patients. In addition to this, all summary reports on patients sent to hospital and to private cardiologists were found in the archives of the health centre. The fact that interpretation of findings was based on a personal conception may be considered a limitation, although changes in ST-segments in the ECG and the occurrence of chest pain during testing were the basis.

The gold standard for the exercise test is coronary angiography, at least in patients without clinically diagnosed myocardial infarction. For practical reasons (because it was not possible to refer all examined patients to this invasive and expensive examination), we had to use the two years' follow-up as a reference

examination. In the GPs' work the precept 'wait and see' is a commonly used tool in the treatment of patients. We must bear in mind that we did not know whether or not the patients examined had the disease at the moment of the exercise test.

10.1.3 Comparison with previous studies

The justification for exercise testing in primary health care has been observed in another Finnish study (Jauhiainen et al. 2001). Especially in excluding coronary heart disease among the working-aged population it provides valuable information. The principal finding in the present study was that a negative finding in an exercise test conducted by trained GPs for working-aged people in primary health care appeared to be valid. Only 2% of patients yielding a negative finding suffered from coronary heart disease after two years. Even taking into consideration the man who yielded a negative finding and subsequently died of a myocardial infarction, the negative predictive value of the test was as high as 98%. This fits well with the recent observation that the test had led to a diagnostic finding in 77% of cases, most of the findings having been negative (Nilsson et al. 2003). In contrast, the positive predictive value of the test is not good. After the follow-up period a diagnosis of CHD was reached in only slightly over half of those yielding a positive finding.

Even though the exercise test is a good tool in diagnosing CHD, the Bayes theorem should be kept in mind when assessing the effectiveness of the test (Diamond and Forrester 1979, Detrano et al. 1984). If the pre-test probability of coronary disease is small, as in most cases in working aged people with atypical chest pain, the diagnostic value of a non-invasive test is negligible (Kettunen 2000). According to this theorem the number of false positive findings correlates negatively, and that of false negative findings positively to the prevalence of CHD in the population the person examined belongs to. When calculating predictive values as well as specificity and sensitivity it was reasonable to combine positive and equivocal findings, since in respect of further measures and treatment they were approached in more or less the same way.

10.2 The HeSSup data

10.2.1 Data collection

The HeSSup data were collected by mailed survey. The lack of full participation in such inquires threatens the value of the survey method (Groves et al. 1992). There is in fact no safe level of response rates below 100% (Sheikh and

Mattingly 1981). It has been stated that low rates of response to mailed health surveys may result in overestimating the utilisation of the health services (Etter and Perneger 1997). However, the HeSSup study material may be considered representative of the Finnish working-aged population, eventhough the response rate was only 39%. According to a careful non-response analysis of the HeSSup study material respondents and non-respondents were comparable in respect of most important demographic variables (Korkeila et al. 2001). Divorced, widowed, unemployed and those with less education, as well as men in general, were less likely to respond than expected from general population data. These features have also been reported in earlier studies (Barton et al. 1980, Cottler et al. 1987, van den Akker et al. 1998). In spite of the careful non-response analysis it has to be admitted that the response rate was rather low. Since on the other hand it is very common for response rates to postal questionnaires to remain low, in this respect our rate may be considered as expected.

10.2.2 Strengths and weaknesses

The findings reflect the respondents' own conception of their symptoms. This must be considered important, since according to findings from a 3 years' follow-up of 4,000 men, self-reported coronary heart disease predicts a new coronary event (Koskenvuo et al. 1988). In addition, the presence of anginal symptoms may be an important independent correlate of prognosis in patients with CHD (Cohn et al. 1981). Among outpatients with CAD, self-reported anginal symptoms consistently predict mortality irrespective of differences in age, race, education or clinical comorbidities (Mozaffarian et al. 2003). On the other hand, one American study found no association between self-reported angina pectoris and objective evidence of inducible ischemia (Gehi et al. 2003).

It is possible that CHD patients will respond to a questionnaire more actively than others. On the other hand, there are those CHD patients who neglect their disease and will not be willing to respond. It may be assumed that these two factors compensate each other and that the proportions are reliable. The findings between CHD patients and individuals in the controls groups were in this respect considered to be realistic.

It is obvious that there are those among the CHD patients of the present material who in fact do not have the disease. It is also probable that some of the findings, e.g. some complaints, concern especially these persons. The appearance of so-called false-positive CHD patients thus reduces the reliability of the findings. However, subjects who have answered yes to the questions concerning angina pectoris or heart infarction have the impression of suffering from CHD. They may have misunderstood what their doctor has said to them, or perhaps the very suspicion of the disease has given them a false impression. Very likely they act as if they were CHD patients and make their decisions accordingly. It is thus possible that they make arrangements concerning their jobs or free time, e.g. reduce their physical exercise for fear of chest pain.

In any case, GPs are the first-line physicians who meet patients with their health problems. GPs undoubtedly know that there are false-positive cases among patients having the conception of suffering from CHD. Nevertheless, in primary health care patients' notions must be taken seriously. This was also the approach of the HeSSup study in the matter. It emphasises the subjects' own conceptions.

The HeSSup study patients had given written consent for the use of register data. Unfortunately the data were not yet available. The sample is in any case to be followed-up for several years, and it will thus be possible to combine our material with data from the Social Insurance Institution. Thereafter we will know how many medically considered false positive-findings our sample comprised. This actually provides a new challenge for further research.

10.2.3 Special features of CHD among working-aged population

10.2.3.1 Risk factors and secondary prevention

There are European consensus and national guidelines on ideal risk factor levels and treatment procedures. According to our findings, however, secondary prevention of the disease has been disappointing, a circumstance also recognised in other studies (Boersma et al. 2003, Wright et al. 2003, Mayer et al. 2004). Coronary heart patients, despite having survived a life-threatening clinical event, also appear to have maintained adverse behaviors such as smoking, being obese and having frequent hangovers more than the control population. Our study also confirms previous finding that a large proportion of Finnish patients having had a coronary event continue smoking (Järvi 2001). Clearly the health care system has not succeeded in the secondary prevention of coronary heart disease when the issue is considered from the population standpoint.

10.2.3.2 Symptoms and complaints

According to the present findings many working-aged coronary heart disease patients are depressed and sleep poorly. They also suffer from day-time sleepiness. These findings fit well with those in other studies (Partinen et al. 1982, Denollet 1994, Lehto et al. 2000, Rudisch and Nemeroff 2003). In addition, working-aged CHD patients suffer from palpitation and perspiration without physical exercise, trembling of hands and voice, as well as jerking of muscles. The wide spectrum of symptoms and complaints may be considered an interesting new finding.

Working-aged CHD patients may be regarded as a special group compared with the main body of CHD patients, who are already by age entitled to a pension. Working-aged CHD patients have often experienced the hardest and

most widespread exposure to risk factors, which has caused them coronary heart disease among the first within their age group. Being of working age they are expected, however, to return to normal life and work as soon as possible. According to our study they still have abundant symptoms limiting their every day life and hampering their recovery and rehabilitation. Although we have not used validated instruments to assess quality of life (Hunt and McEwan 1980, Ware and Sherbourne 1992, Spertus et al. 1995), we can say that the quality of life of many working-aged CHD patients is not very good. Instead we used questions such as those concerning dyspnea, which have been successfully used in cardiovascular surveys (Rose and Blackburn 1968) and in the Finnish Twin Cohort Study (Hublin et al. 2001). In addition, mood was estimated according Beck's depression scale (Beck et al. 1961). It is noteworthy that many of these symptoms are not only irritating, but constitute a threat to health. The follow-up of the HeSSup cohort will show to what extent the symptoms we found are indicators of increased risk of CHD among working-aged people and to what extent the symptoms are a result of CHD and its care.

10.2.3.3 Childhood adversities

CHD patients have experienced significantly more childhood adversities than other people. Life events during childhood include not only family problems but also financial problems as well as matters of personal safety. It is also noteworthy that many of the adversities in question seem to be associated with coronary heart disease, since they are quite independent of traditional risk factors such as smoking, hypertension and obesity. This matter has not been widely studied, but there are some papers reporting parallel findings. In Finland socio-economic state in childhood has been found to be significantly associated with ischemic heart disease in middle-aged men (Kaplan and Salonen 1990). In one recent study a dose-response relation of adverse childhood events such as abuse, neglect and household dysfunction to ischemic heart disease has been found (Dong et al. 2004).

Special attention should be paid to the accumulation of these risk factors in the primary prevention of CHD. This cannot, however, be solved at doctors' offices. At the most GPs can focus their suspicion of CHD on patients reporting childhood adversities. In order to increase the welfare of the community, to prevent people from marginalisation, to avoid children's sense of insecurity, and to minimise problems caused by alcohol, a health-promoting social policy is of vital importance.

10.2.3.4 Sex life issues

Both the importance of sex life and interest in sex tended to decrease as a result of a myocardial infarction among both men and women. Our findings support those in an Israeli study where the decrease in frequency of and satisfaction with

sexual activity after a myocardial infarction was similar among women and men (Drory et al. 2000). In agreement with a finding of previously published research (Ojanlatva et al. 2003), the men in the present study perceived sex life as more important than did women, whereas women were generally more satisfied with it than men were. Regardless of a life-threatening disease, most CHD patients in the present study held on to their interest in sex. They should further be encouraged to pursue sex life and general practitioners should be proactive in bringing up the topic. Professional skills should be used to exploit the opportunities, discuss the issue and lead these patients back to normal life.

10.2.3.5 Commitment to treatment

Coronary heart disease is considered a life-threatening illness which impairs functional capacity. Poor compliance with therapy must be regarded as a serious threat to the wellbeing of CHD patients. It is possible that the level of income of subjects who neglect care is lower than the average. Incomes were not, however, inquired after, and it may be understandable that high prices constitute a more important consideration for them in neglect of treatment. It has namely been found that low level of education is associated with health behavior and a greater number of risk factors (Salomaa et al. 2003). Nonetheless, use of expensive prescription-only medicines should not be a problem for a normal citizen, since the Social Insurance Institution reimburses costs exceeding a specific sum in a year. In addition, medicines against CHD are reimbursed by 75%. For some CHD patients the prices are nevertheless a real problem, which should be taken into consideration when planning treatment. In any case CHD patients in Finland are within their own group in an unequal position: the need for care is greatest among workers and the less educated, whereas clerical workers and the well educated get treatment more easily (Keskimäki et al 2004). In addition, although the overall rate of coronary revascularisations has increased during the last few decades, socioeconomic and gender inequalities have persisted in the use of cardiac operations relative to need (Hetemaa et al. 2003).

Because only a few of the CHD patients neglecting medication used antidepressants, which are quite expensive, it may be assumed that the medicines they considered expensive are those against hypertension and hyper-cholesterolemia. In this respect our results fit well with a finding in a previous study that statin therapy for CHD patients should be intensified (Saaristo et al. 2000). In our study the use of lipid-lowering drugs was not asked. The study material thus gives no possibilities to assess what medicines against other diseases had been neglected.

The findings of poor commitment to treatment may in general be considered new. It has been difficult to find other studies on this matter. The poor commitment to treatment among working-aged CHD patients constitutes a substantial challenge to Finnish health care.

10.3 Implications for clinical practice

There are no studies in Finland concerning the outcome of exercise tests carried out on patients with a low pre-test probability of CHD. In primary health care it is of vital importance to make the diagnostics of CHD effective. Here the exercise test is a useful tool, and it should be easily available in primary health care. In addition, the test is cost-effective and particularly safe. Motivated GPs can take special training for the tests and perform them in addition to their normal duties. Health centres in Finland may also co-operate in testing and may thus serve a large population and comply with minimum safety and performance guidelines for exercise stress testing.

Coronary heart disease among working-aged patients is a complex problem. Although this life-threatening disease has moved to older age groups, working-aged CHD patients may be regarded as a group of special interest and prognostic significance. Their conception of suffering from the disease has to be taken seriously, especially when associated with one or more risk factors. Individual GPs should learn to treat CHD patients as a whole. Many aspects of the subject must be taken into consideration in primary health care in order to make the diagnostics and secondary prevention of CHD more effective, to improve the well-being and ability to act of the patients, and to achieve good commitment to treatment. It is therefore essential for GPs to support these patients and protect them from making wrong decisions in their lives. The problems cannot, however, always be solved in doctors' offices. In primary health care it is desirable that GPs take the initiative when co-operation with society is needed. All of these aspects must be considered in order to improve the quality of life of working-aged coronary heart disease patients.

11 CONCLUSIONS

1. Exercise tests can be sensibly carried out by trained GPs in general practice, and the test is a useful diagnostic tool.

2. The predictive value of a negative finding in an exercise test carried out by GPs in primary health care is very high among the working-aged population. With a negative finding in this test GPs can predict clinical outcome in general practice.

3. The health care system has not succeeded satisfactorily in secondary prevention of coronary heart disease among the working-aged population.

4. Working-aged people with self-reported coronary heart disease evince a number of symptoms limiting their everyday life, and almost one in three of them perceive their health as poor or rather poor.

5. Working-aged coronary heart disease patients will have experienced significantly more childhood adversities than other people.

6. The importance of sex life and interest in sex tend to decrease as a result of a myocardial infarction among working-aged coronary heart disease patients.

7. Many working-aged coronary heart disease patients, especially those not working, neglect to collect their medicines from pharmacies and to visit doctors due to high prices.

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14 APPENDICES

Translated by the author

14.1 I Kliinisiä rasituskokeita koskevat tiedot

Information concerning the exercise tests

Henkilötiedot *Personal data*

1. Syntymäaika *date of birth*
2. Ikä *age*
3. Sukupuoli *gender*
    1. Mies *man*
    2. Nainen *woman*
4. Siviilisääty *marital status*
    1. Naimaton *single*
    2. Avoliitossa *live together*
    3. Avioliitossa *married*
    4. Leski *widow*
    5. Eronnut *divorced*
5. Ammatti *occupation*
6. Eläkkeellä *retired*
    1. Ei *no*
    2. Kyllä *yes*
7. Kotikunta *place of residence*
    1. Kangasala
    2. Pälkäne
    3. Luopioinen
    4. Sahalahti
    5. Kuhmalahti

Päivämäärät *Dates*

8. Lähete tehty *referral done*
9. Rasituskoe tehty *exercise test done*
10. Aiemmat rasituskokeet *previous exercise tests*

Anamneesi *Anamnesis*

11. Todettu sepelvaltimotauti *diagnosed CHD*
    1. Ei *no*
    2. Kyllä, vuonna: *yes, in the year:*
12. Sairastettu sydäninfarkti *myocardial infarction*
    1. Ei *no*
    2. Kyllä, vuonna: *yes, in the year:*
13. Verenpainetauti *hypertension*
    1. Ei *no*
    2. Kyllä, vuonna: *yes, in the year:*
14. Sokeritauti *diabetes*
    1. Ei *no*
    2. Kyllä, vuonna: *yes, in the year:*
15. Rasitusrintakipuja *chest pain during distress*
    1. Ei *no*
    2. Kyllä *yes*
16. Hengenahdistusta *dyspnea*
    1. Ei *no*
    2. Kyllä *yes*
17. Muuta *something else*
    1. Ei *no*
    2. Kyllä, mitä: *yes, what:*
18. Tupakointi *smoking*
    1. Ei *no*
    2. Kyllä, määrä: *yes, amount:*

Lääkitys *Medication*

19. Beetasalpaaja *beta blocker*
    1. Ei *no*
    2. Kyllä, lääke ja annos: *yes, medicine and dose:*
20. Kalsiumsalpaaja *calcium antagonist*
    1. Ei *no*
    2. Kyllä, lääke ja annos: *yes, medicine and dose:*
21. Pitkävaikutteinen nitraatti *long-acting nitrate*
    1. Ei *no*
    2. Kyllä, lääke ja annos: *yes, medicine and dose:*
22. Digoksiini *digoxin*
    1. Ei *no*
    2. Kyllä, lääke ja annos: *yes, medicine and dose:*
23. Muuta *something else*
    1. Ei *no*
    2. Kyllä, lääke ja annos: *yes, medicine and dose:*

Potilaan koko *Size of the patient*

24. Pituus *height*
25. Paino *weight*
26. Body-mass index *BMI*

Laboratoriokokeet (ennen koetta) *Laboratory findings (before the test)*

27. Totaali kolesteroli *Total cholesterol*
28. HDL-kolesteroli *HDL cholesterol*
29. Triglyseridit *triglycerides*
30. LDL-kolesteroli *LDL cholesterol*

31. Hemoglobiini *hemoglobin*

32. Lepo-EKG *ECG at rest*
    1. Normaali *normal*
    2. Poikkeava, miten*: abnormal, how:*

Lähettävän lääkärin kysymyksenasettelu *Question setting of the referring doctor*

33. Sepelvaltimotauti? *CHD?*
    1. Ei *no*
    2. Kyllä *yes*
34. Rytmihäiriöt? *cardiac arrhythmia?*
    1. Ei *no*
    2. Kyllä *yes*
35. Rasitusastma? *asthma during physical distress?*
    1. Ei *no*
    2. Kyllä *yes*
36. Muut rintakivut? *other chest pains?*
    1. Ei *no*
    2. Kyllä *yes*
37. Suorituskyky? *performance?*
    1. Ei *no*
    2. Kyllä *yes*
38. Muuta *something else*
    1. Ei *no*
    2. Kyllä, mitä: *yes, what:*
39. Työkyvyn arviointi? estimation of working ability?
    1. Ei *no*
    2. Kyllä *yes*

Lääkäreitä koskevat tiedot *Information concerning doctors*

40. Lähettävä lääkäri *referring doctor*
41. Rasituskokeen suorittaja *doctor performing the exercise test*

Rasituskokeeseen liittyvät tiedot *Information concerning the exercise test*

42. Rasituskoe onnistui *the exercise test succeeded*
    1. Kyllä *yes*
    2. Ei, miksi? *no, why not?*
43. Saavutettu maksimisyke *maximal heart rate achieved*
44. Ikää vastaava maksimisyke *maximal heart rate responding age*
45. Maksimi ST-lasku (mm ja kytkentä) *maximal ST-depression (mm and lead)*
46. ST-vajoaman suunta *direction of the ST-depression*
    1. Nopeasti ylös viettävä *rapidly ascending*
    2. Hitaasti ylös viettävä *slowly ascending*
    3. Vaakasuora *horizontal*
    4. Alas viettävä *descending*
47. Rintakipuja kokeen aikana *chest pain during the test*
    1. Ei *no*
    2. Kyllä *yes*
48. Suorituskyky *performance*
    1. Normaali *normal*
    2. Lievästi alentunut *slightly decreased*
    3. Kohtalaisesti alentunut *moderately decreased*
    4. Voimakkaasti alentunut *severely decreased*
49. Muuta *something else*
    1. Ei *no*
    2. Kyllä, mitä: *yes, what:*
50. Löydöksen luokittelu (suorittava lääkäri) *classification of the finding (the performing doctor)*
    1. Positiivinen *positive*
    2. Epävarma *equivocal*
    3. Negatiivinen *negative*
    4. Muuta *something else*

51. Lähettävän lääkärin hoidollinen päätös *treatment decision of the referring doctor*
    1. Lähete TaYS *referral to Tampere University Hospital*
    2. Lähete konsultaatioon, mihin: *referral to consultation, where:*
    3. Lääkehoito, mikä: *medicine, what:*
    4. Seuranta *follow-up*
    5. Ei hoitoa *no treatment*
    6. Muuta, mitä: *something else, what:*

52. Kokeesta saatu hyöty *benefit gained by the test*
    1. Sepelvaltimoepäilytauti vahvistui *suspicion of CHD was strengthened*
    2. Sepelvaltimotauti poissuljettiin *CHD was ruled out*
    3. Epävarma löydös sepelvaltimotaudin suhteen *uncertain finging concerning CHD*
    4. Muuta, mitä: *something else, what:*
    5. Koe epäonnistui *the test failed*

Kahden vuoden seuranta-aika *Two years' follow-up*

53. Elossa *living*
    1. Kyllä *yes*
    2. Ei, kuolinsyy? *no, cause of death?*

54. Asuu edelleen paikkakunnalla *still living in the area*
    1. Kyllä *yes*
    2. Ei *no*

55. Seuranta-aikana uusi rasituskoe *new exercise test during follow-up*
    1. Ei *no*
    2. Kyllä *yes*

56. Koronaariangiografia *coronary angiography*
    1. Ei *no*
    2. Kyllä *yes*

57. Ohitusleikkaus *by-pass operation*
    1. Ei *no*
    2. Kyllä *yes*

58. Sepelvaltimotautidiagnoosi seuranta-ajan jälkeen *diagnosis of CHD after the follow-up period*
    1. Ei *no*
    2. Kyllä *yes*

14.2 II HeSSup questionnaire (in Finnish)