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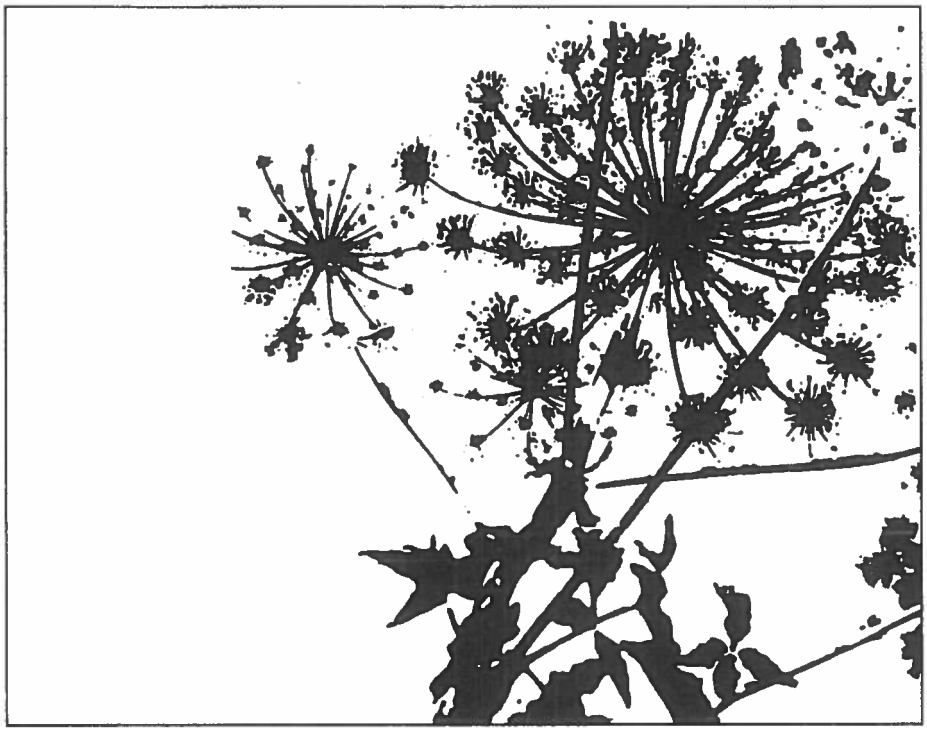

Haemoglobin, anaemia and haematological malignancies

The Tromsø Study 1974-1995

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Tromsø 2006

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Åssen gjør'n når'n teller da?" spurte purka.

"Jeg gjør bare sånn," sa geitekillingen. "*En* for meg og *to* for kalven og *tre* for kua og *fire* for oksen og *fem* for hesten og *seks* for purka. 1 – 2 – 3 – 4 – 5 – 6."

"Å! Nå telte han deg også," rautet kalven.

Fra *Geitekillingen som kunne telle til ti* av Alf Prøysen.

CONTENTS

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Tromsø, September 2005

Tove Skjelbakken

LIST OF PAPERS

The thesis is based on the following papers, referred to in the text by their Roman numerals:

I. Skjelbakken T, Langbakk B, Dahl IMS, Løchen M-L: Haemoglobin and anaemia in a gender perspective: The Tromsø Study. Eur J Haematol. 2005: 74: 381-388.

II. Skjelbakken T, Dahl IMS, Wilsgaard T, Langbakk B, Løchen M-L: Changes in lifestyle influence change in haemoglobin levels in men in a general population. The Tromsø Study 1974-1995. Submitted.

III. Skjelbakken T, Wilsgaard T, Førde OH, Arnesen E, Løchen M-L: Haemoglobin predicts mortality in a general young and middle-aged male population. The Tromsø Study. Submitted.

IV. Skjelbakken T, Løchen M-L, Dahl IMS: Haematological malignancies in a general population, based on information collected from a population study, hospital records, and the Cancer Registry of Norway. The Tromsø Study. Eur J Haematol 2002: 69: 67-75.

1. INTRODUCTION

Haemoglobin measurement is one of the most frequently performed laboratory tests. The haemoglobin level has well known variability according to age and gender [1-3]. However, the reference values are often from elderly cross sectional studies of younger subjects, and may not reflect the populations' actual distribution today.

Several lifestyle factors, including body mass index (BMI) and smoking habits, are associated with haemoglobin [4-7]. The last decade's changes in nutritional status and lifestyle may influence on the distribution of haemoglobin.

Although the interpretation of the significance of high or low levels of haemoglobin is central in clinical settings, possible population based changes in haemoglobin distribution have not been subject to much study. Because haemoglobin levels predict mortality and morbidity [8-12], a population-based change in haemoglobin level could have significant implications for health.

Little is known about the distribution of haematological malignancies within a general population. Since haematological malignancies comprise a heterogeneous group of conditions [13], with various grades of aggressiveness, several sources of information are needed to address the prevalence and incidence of the diseases. Automated blood cell count including haemoglobin measurement within a setting of a population study, could be one of these sources.

2. AIMS OF THE THESIS

The present thesis is from a population-based study of 20-49 year old men in 1974, and from a study of men and women more than 24 years in 1994-95. The aims of the thesis were:

1. To examine the gender specific distribution of haemoglobin and the applicability of the World Health Organization (WHO) criteria for anaemia compared to the 2.5 percentile for haemoglobin.

2. To investigate how changes in lifestyle factors with time influence the longitudinal changes on haemoglobin in men.

3. To assess whether haemoglobin predicts total mortality in a 20-year follow-up study of men.

4. To investigate the prevalence and incidence of haematological malignancies in a general population of men and women.

3. SUBJECTS AND METHODS

3.1. Data sources

Table 1 lists the different data sources used in the subprojects. The surveys in 1979-80 and 1986-87 are presented in parenthesis due to the minor contributions from these surveys.

Table 1. Data sources.

	Paper I	Paper II	Paper III	Paper IV
Tromsø I (1974)		X	X	
Tromsø II (1979-80)		(X[a])		
Tromsø III (1986-87)		(X[b])		
Tromsø IV (1994-95)	X	X		X
Statistics Norway			X	
The Hospital records				X
The Cancer Registry				X

[a)] Changes in alcohol habits and coffee consumption were calculated as the difference between the levels in 1994-95 and 1979-80.

[b)] Changes in physical activity were calculated as the difference between 1994-95 and 1986-87.

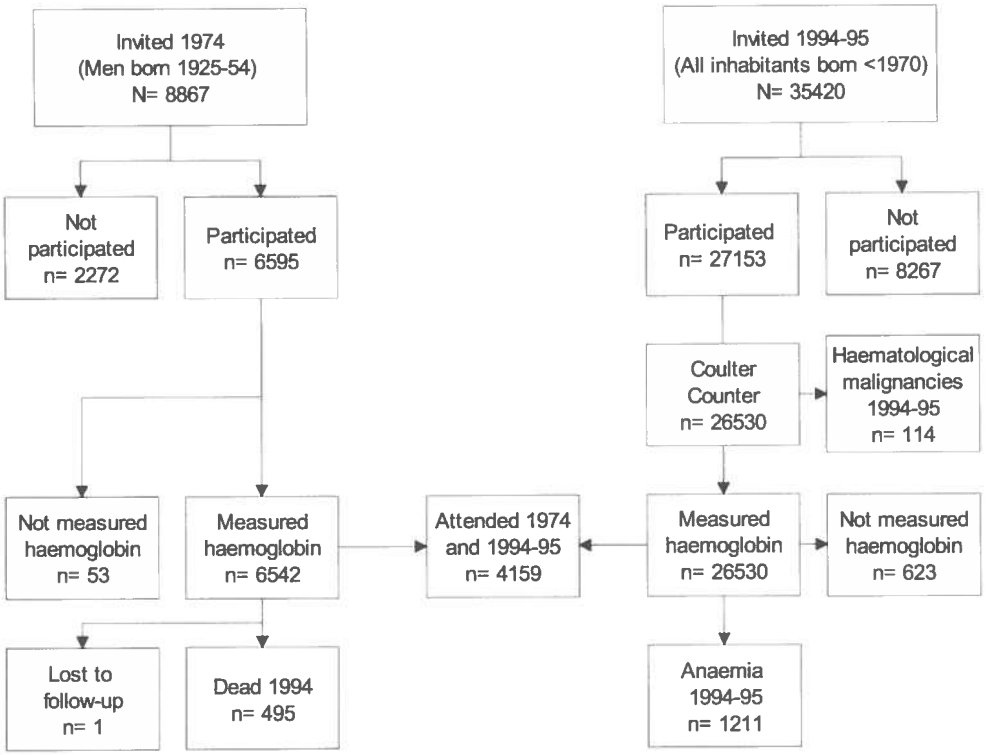
3.1.1. The Tromsø Study

The municipality of Tromsø is situated at sea level in the northern part of Norway. The population is predominately middle-class of Norwegian origin, but also Finnish and Sami origins are relatively prevalent. From 1974, repeated health surveys (The Tromsø Study) have been carried out in the municipality.

In 1974 (Tromsø I), all men born between 1925 and 1954 were invited (aged 20-49). In all 8867 men were invited, but 935 men lived outside the municipality. In total, 6595 (83.1% of the eligible population) attended the examination [14], and 6542 had their haemoglobin analyzed (paper III). The second survey (Tromsø II) was conducted in 1979-1980. All men born between 1925 and 1959 (aged 20-54) and all women born between 1930 and 1959 (aged 20-49) were invited. A total of 16621 (78%) attended [15]. In 1986-87, the third survey (Tromsø III) was conducted. All men born between 1925 and 1966 and all women born between 1930 and 1966 were invited, 20602 (75%) of the invited population attended [16]. In 1994-95, all inhabitants born before 1970 (aged 25+) were invited (Tromsø IV). In total, 27153 (77%) of the invited population participated. The population size is presented in paper IV (see errata).

Tromsø I was conducted by the University of Tromsø. Tromsø II and the following surveys were conducted in a co-operation between the Institute of Community Medicine, University of Tromsø and the National Health Screening Service. The study is a multipurpose, population-based, prospective study of total birth cohorts, and was initiated in order to investigate predictors and prevalence of coronary heart disease. Later on, the study has expanded; the aim of the study is now to identify potentially modifiable causes of chronic disease in order to develop preventive or therapeutic strategies.

Figure 1. Flow chart of the study population. The Tromsø Study 1974 - 1994-95.



At each survey, the persons invited received a mailed letter with an invitation along with a one- page questionnaire on the reverse side. The procedures and the questionnaires in each survey have been mainly the same [14, 17, 18]. The first questionnaire included the following main topics: current, previous and family history of cardiovascular disease; physical activity; smoking habits. The first questionnaires were returned and checked for inconsistency when participants met for the physical examination of blood pressure, non-fasting blood samples, weight and height conducted by specially trained personnel. From Tromsø II, the participants were also given a stamped and addressed envelope with the second

questionnaire. They were asked to answer the questionnaire at home and return it by mail. The following main topics were covered: dietary and alcohol habits; current, previous and family history of illnesses; social and psychological conditions (appendices 1-6, questionnaires relevant for this thesis).

Figure 1 shows a flow cart of the populations included in the subprojects of this thesis.

3.1.2. Statistics Norway

The study file from 1974 was matched with the Registry of Death at Statistics Norway of 1 September 1994, and 495 deaths were found (paper III).

3.1.3. Hospital records

In order to find subjects with haematological malignancies, a computer search through the patient administrative system for in- and outpatients from the University Hospital of North Norway was conducted (paper IV). All subjects invited to the survey in 1994-95 were searched for possible haematological diseases using the International Classification System, ninth revision (ICD-9) during the period from 1 January 1991 to 31 December 1996. In appendix 7, the main ICD-9 codes used for detecting cases from the hospital records are listed. The records from patients with possible haematological diseases were manually read through and validated. A total of 689 of the invited inhabitants were registered with one of these codes. The medical records were read and classified by T Skjelbakken (TS) consulting IMS Dahl (IMSD) when required. Haematological malignancies were verified in 83 of the subjects (36 non-participants and 47 participants). Forty-five records (6.5%) were obviously miscoded (e.g. 250.0 Diabetes mellitus was coded as 205.0 Acute myeloid leukaemia). Until 1998 a diagnostic code was not obligatory for registration in the hospital's patient administrative system. We found that 18%

of the outpatient consultations did not have a diagnostic code.

The Department of Information Technology at the University Hospital of North Norway conducted all the electronic searches.

3.1.4. Cancer registry

The author's affiliation to the Department of Haematology provided the opportunity to receive personal identifiable information from the Cancer Registry of Norway. In paper IV, all identified cases of haematological malignancies from the screening or hospital records were matched with cases in the Cancer Registry of Norway using the national 11-digit personal identification number for matching. Additionally, we received information about all cases from the municipality who were registered with haematological malignancies. The medical records were checked when discrepancies were found. The information from the Cancer Registry was based on ICD-7 or ICD-10 codes and converted into to ICD-9 codes for comparison.

3.2. Blood sampling and analysis

In 1974 (paper II, III), the haemoglobin analyses and standardizations were performed manually by the cyanomethemoglobin method [19]. The 1994-1995 haemoglobin samples (paper I, II, IV) were analyzed within 12 hours of sampling with an automated blood cell counter (Coulter Counter ®). Additionally, the automated blood cell counter conducted a whole blood examination with red cell indices, differential count of white blood cells and platelet counts and size. A specialist in clinical chemistry evaluated the blood results and one of three experienced haematologists determined further action according to predefined criteria (Paper IV). Two experienced physicians (TS and M-L Løchen) retrospectively classified the records of the 303 subjects. An experienced haematologist was consulted (IMSD) in call of questions.

Total cholesterol (paper III), was determined manually by the Liebermann-Burchard procedure [20].

All blood determinations were from venous blood samples. The Department of Clinical Chemistry, University Hospital of North Norway, conducted the analyses except for determination of total cholesterol in 1974 that was conducted by the Division of Clinical Chemistry, Institute of Medical Biology, University of Tromsø.

3.3. Classification criteria

3.3.1. Anaemia

Anaemia was defined according to the WHO criteria: Hemoglobin <130 g/L in men and <120 g/L in non-pregnant women [21]. In total, 351 (2.8%) men and 860 (6.3%) women were anaemic according to the WHO criteria (paper I).

In 1994-95, 30 subjects had haemoglobin below the predefined criteria for follow up; <100 g/L for men and <90 g/L for women (paper I). After a second blood sample, 14 subjects had haemoglobin consistently below the criteria and were classified as having severe anaemia. In 1974, haemoglobin <125 g/L was one of the recall criteria. After re-examination of 59 men, 10 (0.2%) men still had haemoglobin below the criteria [22].

3.3.2. Haematological malignancies

We used the diagnostic criteria and the categories of disease currently used by clinical haematologists [23]. According to the WHO's definition of haematological malignancies [13], lymphomas were included. A total of 170 samples fulfilled the predefined criteria for follow-up, based on haemoglobin, white blood cells or platelets counts. In all, 17 of these subjects suffered from a haematological malignancy. Nine were diagnosed due to the screening. Additionally 133 subjects were selected due to minor combined criteria and evaluated. Among these subjects; eight suffered from a haematological malignancy and four of them had not been diagnosed previously.

3.4. Statistics

Results were considered statistically significant with a p-value of 0.05 or less. EpiInfo (Version 6, Center for Disease Control, Atlanta, Georgia) or SAS software package (Version 6-9.1, SAS Institute Inc., Cary, NC) were used for all analyses.

3.5. Ethics

The Committee for Medical Research Ethics was not established during the first three Tromsø Studies, but has approved the Tromsø Study 1994-1995. In 1994-1995 the attendees gave signed informed consent.

4. MAIN RESULTS AND CONCLUSIONS

4.1. Haemoglobin and anaemia in a gender perspective

The gender specific distribution of haemoglobin was presented, and the WHO criteria for anaemia were compared with the 2.5 percentile for haemoglobin, using the 12542 men and 13689 non-pregnant women who attended the survey in 1994-95 (Tromsø IV). The 2.5-97.5 percentile for haemoglobin was 129-166 g/L for men and 114-152 g/L for women. In men, mean haemoglobin decreased by age, particularly between 55-64 years to 85+ years old, where haemoglobin decreased from 148 g/L to 137 g/L. In women, mean haemoglobin peaked after menopause; from 132 g/L at age 35-44 to 137 g/L at age 65-74 years, then decreased to 131 g/L among the 85+ years old. In total, 1211 subjects (4.5%) were anaemic according to the WHO criteria. In men, the difference between the WHO critera (<130 g/L) and the 2.5 percentile (<129 g/L) was small

and clinically unimportant. However, in women the WHO criteria (<120 g/L) gave a two to three times higher prevalence of anaemia than the 2.5 percentile (<114 g/L).

4.2. Changes in lifestyle influence change in haemoglobin levels in men

We wanted to examine how changes in lifestyle factors such as body mass index (BMI), and smoking habits influenced changes in haemoglobin levels. The cohort consisted of 4159 men who at age 20-49 attended the survey in 1974 and then again were re-examined in 1994-95. Mean haemoglobin (148 g/L) did not change between the two surveys despite the ageing of the cohort. During the same period, mean BMI increased by 2.1 kg/m^2, more so among the youngest. The prevalence of daily smokers decreased for all age groups, more so among the oldest (-24.6 percentage points). In a multiple regression model, BMI change was positively associated with haemoglobin change, whereas smoking cessation was negatively associated with haemoglobin change compared to those who never smoked. We found that the effect of smoking cessation was weakened if BMI increased. Those who stopped smoking and whose BMI increased >2.5 kg/m^2 had an increase in haemoglobin of 0.8 g/L compared to a decrease of 6.7 g/L in those who lost weight. Although smoking cessation was related to lower haemoglobin levels, this probably healthy effect was partly counteracted by the increased prevalence of obesity.

4.3. Heamoglobin predicts mortality in a male population

To assess whether the haemoglobin levels could predict total mortality, we followed the 6542 men from the first survey in 1974 until 1 September 1994. During follow-up (127120 person-years), 495 deaths were identified. Total crude and age adjusted mortality rates were 3.89 and 3.69 per 1000 person-years, respectively. Compared to quintile 3 of haemoglobin, the multiple adjusted hazard ratios (95% confidence

interval) among 35-49 years old were 1.83 (1.31-2.57) and 1.72 (1.23-2.41), in quintile 1 and quintile 5, respectively. We found that a U-shaped relationship between quintiles of haemoglobin and total mortality was present in smokers as well as in non-smokers. However, the relationship was most pronounced in smokers in a dose response manner. Adjustments for other risk factors like body mass index, total cholesterol and systolic blood pressure did not change the estimates. Haemoglobin was a possible independent predictor of total mortality. Smokers in quintile 1 and quintile 5 of haemoglobin were at increased risk of dying.

4.4. Haematological malignancies in a general population

Different data sources were used in order to investigate the prevalence and incidence of haematological malignancies. The three sources were automated blood cell count from 27145 subjects attending the Tromsø study in 1994-1995, medical records from the only hospital serving the area and the Cancer Registry of Norway. We also compared the rates found in the screening and hospital data with those reported from the Cancer Registry. During 1991-1996 there were 114 (4‰) period prevalent cases. We found the point prevalence of leukaemia, lymphoma and myleoma to be 2.2‰, of which 86% of the cases were reported to the Cancer Registry. The age adjusted incidence between 1 January 1994 to 31 December 1996 was 1.6‰ in our study, approximately the same as reported from the Cancer Registry of Norway. None of the three sources were complete and it was therefore recommended to use several sources of information to find the prevalence and incidence of haematological malignancies.

5. GENERAL DISCUSSION

5.1. Methodological considerations

5.1.1. Bias

Bias is defined as any systematic error in an epidemiological study that distorts the results of the research [24]. The results are potentially biased if the selection of participants is different between groups, or if the collection, interpretation or reporting of information is different between groups.

Selection bias

If the individuals included in the study are not representative for the total source population, selection bias may be present (lack of internal validity) [24]. In prospective cohort studies such as the Tromsø study, potential selection bias is most likely due to non-participation. Non-participants may differ from participants with respect to lifestyle, morbidity and mortality [25-32]. The participation rates in The Tromsø Study have been generally high, but the rates have been lower in some age cohorts. Table 2 presents the population size and participation rates of the 1974 survey and of the follow up in 1994-95. Of those who participated in 1974, 60-70% participated in the re-examination 20 years later (1994-95) (data not shown).

Table 3 presents data on differences between those who participated both in 1974 and 1994-95, and those who did not participate in the follow-up in 1994-95 (dropouts). Even though the dropout group was younger and smoked more, there was no reason to suspect any influence on how lifestyle changes predicted haemoglobin changes.

Table 2. Population size according to age and participation. The Tromsø Study 1974 - 1994-95.

	Invited 1974	Participated in 1974		Participated in 1974 and 1994-95	
Age 1974	N	n	% of invited 1974	n	% of invited 1974
20-24	1662	1008	60.6	606	36.5
25-29	1995	1363	68.3	827	41.5
30-34	1741	1312	75.4	832	47.8
35-39	1250	1016	81.3	693	55.4
40-44	1095	917	83.7	638	58.3
45-49	1124	926	82.4	563	50.1
Total	8867	6542	73.8	4159	46.9

The participation rates from the 1994-95 survey are presented in paper IV. In contrast to the youngest non-participants, the low representation among the very oldest may be due to health related issues and could probably alter the age related haemoglobin distribution (paper I). In paper IV, no differences in occurrence of haematological malignancies were found between participants and non-participants, but the complete number of cases was probably not found.

Table 3. Descriptive characteristics of men who attended both the baseline examination in 1974 and the follow-up examination in 1994-95, compared to those who did not attend the follow-up. Values are mean (SD) or percentages. The Tromsø Study 1974-1995.

Characteristics in 1974	Attended follow-up	Did not attend follow up
	N= 4159	N= 2383
Haemoglobin (g/L)	148.2 (9.3)	148.7 (9.7)
Age (years)	34.0 (8.2)	33.3 (8.5)
Body mass index (kg/m^2)	24.0 (2.7)	23.9 (2.9)
Diastolic blood pressure (mm/Hg)	78 (12)	78 (12)
Systolic blood pressure (mm/Hg)	126 (15)	127 (16)
Total cholesterol mmol/L	6.61 (1.45)	6.59 (1.49)
Daily smoking (%)	58.9	63.9
Number of cigarettes among smokers	14.7 (7.3)	15.7 (7.7)
Leisure regular or hard physical activity (%)	24.8	23.0
Reporting chronic diseases (%)[a]	3.3	4.5

[a)] Reporting to have or had suffered from heart attack, angina pectoris, cerebral stroke, diabetes or duodenal ulcers (yes/no).

Information bias

Information bias is the misclassification due to measurement errors, or misclassification of disease or a risk factor [33]. Systematic, differential or non-random classifications are potentially serious since they can cause invalid conclusions. Non-differential errors produce findings that are too high or too low at random, and true associations are underestimated.

By using the same well-established, validated laboratory within a short distance from the place of the examination, the quality of the laboratory data became very high and the chance of informational bias became less. The personnel at the survey were trained to conduct the procedures, but some degree of error is always possible. Different medical doctors diagnosed the haematological malignancies. This author later validated all diagnoses.

Self-administered questionnaires can cause bias due to imperfect memory of the individuals. Recall bias refers to the phenomenon that occurs when subjects who have experienced an adverse event or disease are more likely to recall previous risk factors than subjects that do not have this experience. In our population study, the subjects were not aware of haematological disorders as possible end-points. The recall bias would therefore tend to be random and the associations would then be weakened.

5.1.2. Interaction and confounding

Interaction is present if the relationship of interest varies at different levels of the predictor [34]. Multivariate techniques make it possible to determine whether interaction is present. The proper way to deal with interaction is stratification with different levels of the explanatory variable.

In Paper I all predictors were presented as dummy variables. Interaction between smoking status and BMI was present. Figure 2 demonstrates how the association between haemoglobin and BMI is somewhat stronger among smokers, especially in men.

Interaction was also present between age group and different levels of BMI. Figure 3 demonstrates that the association between haemoglobin and BMI tended to be strongest among those above 64 years.

Figure 2. Haemoglobin by categories of BMI, smoking status and sex, adjusted for age and self-rated health by using proc GLM (SAS).

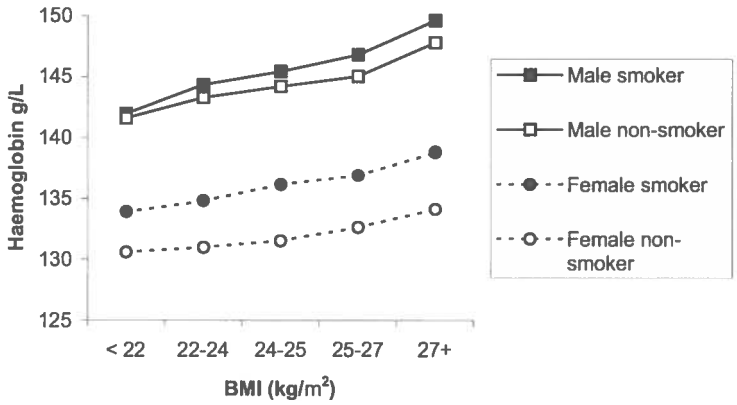
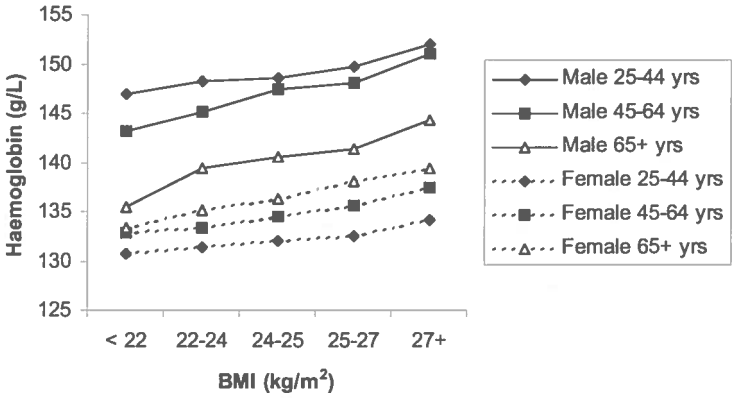


Figure 3. Haemoglobin by categories of BMI, age groups and sex, adjusted for smoking status and self-rated health by using proc GLM (SAS).



In Paper II and III, different two-way interactions were modelled but no interactions were present. In paper IV, two-way interactions were modelled as the products of participation and sex- or age-group. The association between malignant haematological disease and age was stronger for participants than non-participants.

Confounding is present if the effect of the exposure variable is confused or mixed together with the effect of another variable [33]. Part or all of the expressed effect of one variable is then actually due to the other [35]. The confounder must be associated with both the predictor and the response and may even change the direction of an association. There are several methods to control confounding: 1) In 1974, no women were invited to the survey. The survey was restricted to men only, consequently; confounding by gender was avoided. 2) In the data analysis, we used multivariate statistical modelling (paper I, II and III), and thus included the possible confounders as covariates. 3) The final method was stratification; by age (paper I, III, IV); by sex (paper I, IV); by BMI (paper I, II, III), by total cholesterol and systolic blood pressure (paper III) and; by smoking habits (paper II, III).

In paper III, both low and high levels of haemoglobin predicted mortality, and the association was most pronounced in smokers. Since smoking was associated both to the response (mortality) and the predictor (haemoglobin), smoking could be a possible confounder. However, adjusting for smoking did not change the relationship between quintiles of haemoglobin and mortality.

5.1.3. Generalizability

In epidemiological studies there is a question as to whether the results from the source population are applicable to other populations, i.e. generalizability or external validity. Generalization regarding women cannot be made from the first study in 1974 (paper II and III). With respect to age

distribution, the Tromsø population is representative at large for the Norwegian population [36]. However, the population in Tromsø, as in other parts of Northern Norway, consists mainly of a mixture of people of Norwegian, Samii and Finnish origin. Apart from this, few ethnic differences are present. About 30% of the population report education from college or university, compared to 23.5% in Norway [37]. The location at 69 degrees north results in extreme seasonal variations in hours of daylight. However, there is no reason to expect the distribution of haemoglobin, or the prevalence of anaemia or haematological malignancies in Tromsø to differ from the population of Norway.

5.2. Risk factors

In epidemiology, a risk factor may be defined as a characteristic that increases the probability of a disease in subjects who have the characteristic compared with subjects who do not [35]. Statistical associations are often called risk factors or predictors. The risk factor is however, not a necessary or a causal factor of the disease, even if a statistical significant association is observed. Sir Bradford Hill published nine features to answer the question: "...what ought we specifically to consider in drawing conclusions about the nature of the relationship - *causation* or merely *association*?" [38]. These features, later known as "The Hill criteria", were never intended to be a checklist determining whether an observed relation is causal. However, many have applied them as such, and this has been criticised [33, 39].

Changes in haemoglobin levels influence blood viscosity, flow and oxygen carrying capacity [40]. Many studies on haemoglobin as a predictor for mortality and morbidity have used haemoglobin as a continuous or dichotomous variable, and by this failed to recognise the associations [9-12, 41, 42]. In paper III, we evaluated how different levels of haemoglobin predicted total mortality. We found a

significantly increased risk for mortality in the lowest and highest quintile of haemoglobin compared to the mid quintiles. Adjustment for the other risk factors did not change the U-shaped relationship between haemoglobin level and mortality, suggesting that haemoglobin is an independent risk factor of total mortality.

WHO has recommended other criteria for anaemia in smokers [43, 44]. Within quintile 1 of haemoglobin, some of the heavy smokers could in fact have been anaemic even if haemoglobin was within normal reference values. A haemoglobin level in the lowest and highest quintile among smokers should be accompanied by clinical evaluation and smoking cessation should be recommended. The prevalence of male smokers is decreasing in industrial countries [45]. At the same time, the prevalence of obesity increases and by this the risk of mortality also increases [46]. There is a possibility that this obesity epidemic could counteract some of the gains on mortality from smoking cessation.

5.3. Screening for anaemia and haematological malignancies

To be suitable for screening programmes several requirements regarding the disease, the tests and the feasibility of the screening programme should be fulfilled [24]. The disease should be serious, treatment given before symptoms compared to after debut of symptoms should reduce morbidity and mortality, and the prevalence of disease should be high. The screening test used should be inexpensive, easy to administer, give minimal discomfort for the subject, and the result should be valid and reproducible. Evaluation of potential screening programmes should evaluate the feasibility and the efficacy of the programme.

Anaemia could be serious, however, mild iron deficiency is most common and early treatment hardly improves the prognosis. The prevalence of anaemia is

highest among fertile women and the elderly. The haemoglobin blood test fulfils all the above-mentioned criteria for screening tests. However, a widespread screening programme towards anaemia is probably not feasible or effective in industrial countries. Today's policy with screening during pregnancy and with low threshold for haemoglobin test among subgroups as young women and the elderly is probably adequate.

Haematological malignancies are heterogeneous with regard to seriousness and the benefit of early detection. The prevalence of the diseases is low. No single test could detect all the different entities, but an automated blood count could detect most entities affecting the bone marrow. This test fulfils all the above-mentioned criteria for screening tests. In all, a screening programme for haematological malignancies would not be feasible or effective and is not recommended.

5.4. Haemoglobin

The methods of haemoglobin measurement in The Tromsø Study changed between 1974 and 1994-95. Both haemoglobin measurement methods were based on the cyanomethhaemoglobin method. The manual method was the gold standard and analytically very stable, but the automated blood cell count is even more precise with low analytic variance. Others have reported haemoglobin values measured by the automated method to be lower than the manual method [47, 48]. We were not able to directly compare the two methods used for haemoglobin measurements. However, most of the haemoglobin values were within the normal range, and the methods used were the same for all subjects. We therefore assume that the change in method would effect all measurements similarly. The effect of lifestyle factors changes on haemoglobin change was probably not affected by methodological differences (paper II).

In the cross sectional study (paper I), BMI and increasing number of cigarettes smoked were positively associated to haemoglobin. The associations between these lifestyle factors and haemoglobin were confirmed in the longitudinal study (paper II). However, influence of age on the haemoglobin level differed between the cross sectional (paper I) and the longitudinal (paper II) analyses. While haemoglobin in men tended to decrease with advancing age in the cross sectional perspective, the repeated measurement of haemoglobin from the same cohort demonstrated a stable haemoglobin level with ageing. We explained this phenolmenon by changes in lifestyle. In the cross sectional study (paper I), other lifestyle factors such as alcohol and coffee consumption, and leisure time physical activity were associated with haemoglobin. Table 4 demonstrates the dose response relationship between haemoglobin and these lifestyle factors. We were not able to confirm these associations in the longitudinal study on men (paper II).

5.5. Anaemia

WHO's definition of anaemia was modified in 1968. The modification was based on a limited set of reports where young, non-pregnant women and the elderly were not represented [21]. Due to the limited reports on the distribution of haemoglobin in women, the arbitrarily set WHO criteria for anaemia may not be suitable for women in our population and medicalization of healthy subjects may occur. In men, a study of 15-21 year old Norwegian male industrial workers contributed to the WHO modification [49]. The overall 2.5 percentile for haemoglobin in Tromsø IV men corresponded well with the WHO criteria (paper I). The Tromsø IV cohort is on average older compared to the cohorts that the WHO based their criteria on [49, 50]. BMI was probably considerably higher in the Tromsø IV

Table 4. Age adjusted haemoglobin and p for trend in stratified groups of alcohol and coffee consumption, and physical activity. The Tromsø Study 1974 - 1994-95.

	Men			Women		
	n	Mean	p for trend*	n	Mean	p for trend*
Alcohol per fortnight (Glasses)						
0	1 968	145		3 556	132	
1-4	3 467	145		4 642	133	
5-14	4 348	145		2 462	133	
15+	1 181	146	0.01	235	134	<0.0001
Coffee per day (Cups)						
0	1 029	146		1 472	133	
1-5	5 227	145		6 925	133	
6-9	3 082	144		3 154	134	
10+	2 314	144	<0.0001	1 223	135	<0.0001
Hard physical activity						
None	5 125	146		7 723	134	
< 1 hour per week	2 717	146		2 588	133	
1+ hours per week	4 632	144	<0.0001	3 257	133	0.00031

*p for trend with independent variables as 1,2,3 and if necessary 4.

cohorts, and this may explain why the WHO criteria is still suitable for men in our population. How an increasing epidemic of obesity would affect the prevalence of anaemia is not clear. Since BMI and haemoglobin are positively

associated to each other one could expect a decrease in the prevalence of anaemia. However, in children and adolescents there are some reports on an increasing prevalence of iron deficiency with increasing BMI, probably due to limited intake of iron-rich food [51, 52]. It is not known if this is representative for adults, but increasing iron deficiency could lead to an increased prevalence of anaemia.

Anaemia is a widespread global health problem. WHO estimates anaemia to affect 4-23% of the population in industrial countries and 30-50% of the population in non-industrial countries [44]. Children and childbearing women are especially at risk mainly due to nutritional iron-deficiency, but in non-industrial countries the problems are exaggerated by infections such as malaria, hockworms, schistosomiasis and HIV/AIDS, and a high prevalence of haemoglobinopathies or other nutritional deficiencies. Severe anaemia during pregnancy increases maternal mortality [44, 53]. The anaemic women in our study (paper I) were mainly mildly affected, and causal evidence is lacking or contradictory for mother and child consequences of mild anaemia [53]. However, the Norwegian screening programme during pregnancy takes iron-deficiency into consideration. Even if anaemia is prevalent in subgroups of populations from industrial countries, the risk and problems are minor compared to the challenges of non-industrial countries.

5.6. Prevalence and incidence of haematological malignancies

Prevalence is defined as the number of subjects in a given population who have a specified disease. By prevalence we usually mean point prevalence, which is the prevalence at a point in time [35]. Period prevalence is the number of persons who have the disease during a specified period in time, including both cases present at the start of the period but also new cases that develop during the period.

Haematological malignancies are heterogeneous entities. Some of them have a long preclinical phase. After treatment some malignancies have a long stable plateau phase without signs of disease but without being defined as cured. To be able to include the non-participants in the estimates, we chose to use period prevalence with a long pre-survey phase and a drawn out phase after the survey. The period was assumed to be long enough to find treated subjects without signs of disease, and to expect some of the non-participants to potentially have become symptomatic and being diagnosed anyway.

Incidence is the number of new cases of a disease, with the total population at risk as the denominator (incidence proportion), or the total person-time under observation as the denominator (incidence rate) [33]. The long observational time was the reason why the 13 newly diagnosed cases after the screening were not excluded from the analysis. The observational period was probably so long, that one could expect some of these to have been diagnosed anyway. Screening for diseases may increase incidences, especially if the preclinical phase is long. The number of cases with haematological malignancies among the participants became artificially high due to the effect of screening (paper IV).

The Norwegian age-adjusted incidence rates for cancers in lymphatic and haematopoietic tissues were 27.1 per 100 000 males and 18.1 per 100 000 females in 1996 [54]. Most registries report sex and entity specific rates and directly comparable rates are not readily available. However, the incidence of leukaemia, multiple myeloma and lymphoma has shown little geographical variation within countries in northern Europe [55, 56]. The rates in Norway are about 20% lower than the rates for northern America but about 70% higher than for Japan [57].

Three compulsory sources of information provide the Cancer Registry of Norway with data on new cancer cases:

death certificates from Statistics Norway; a clinical form from the physician; and reports from the pathology laboratories [54]. The Cancer Registry of Norway is known for its completeness [54, 58-60]. However, an underreporting of haematological malignancies has been reported [54, 60]. The haematological malignancies are often diagnosed without assistance from the pathology laboratory, and many patients with these malignancies survive for years. A systematic reporting from the haematological laboratories is not established. The compulsory clinical form from the physician who diagnosed the patient was therefore often the only source of information to the Cancer Registry. In most clinical practices, there has been no automatic reminder or systematic electronic reporting of these forms. We found an underreporting of 14% of the haematological malignancies to the Cancer Registry of Norway. However, from 1998 the Cancer Registry has received information from the patient administrative systems on all patients treated for malignant disorders [54]. As a result, the completeness has improved also for the years before 1998. The development within information technology allows for new and better reporting routines, independent of the physicians' memory, and this provides as complete statistics as possible.

5.7. Gender differences in risk factors and disease

Women are more susceptible than males to the detrimental effect of smoking with regards to risk for myocardial infarction, lung cancer and chronic obstructive pulmonary disease [61-63]. The detectable difference of higher mean haemoglobin in smokers compared to non-smokers was strongest in women (paper I). The effect of smoking on haemoglobin was present even in low dose female smokers (1-10 cigarettes per day). This finding is in contrast to male smokers, where the dose related increase in haemoglobin was most

pronounced in more excessive smokers. The increase in haemoglobin by smoking may have implications for the detection of anaemia [7, 43]. However, the possible dose response gender difference is not reflected in WHO's adjusted cut off values for anaemia in smokers [44].

The incidence rates for cancers in lymphatic and haematopoietic tissues are generally higher for men than women [55, 64]. We found the prevalence of haematological malignancies to be higher in men than women (paper IV). The increase in prevalence with age was present somewhat 10 years earlier in men compared to women. The same time lag in women is found in the prevalence of anaemia in the elderly (paper I), and in coronary mortality [65]. Perhaps the biological ageing of men is faster than in women?

6. IMPLICATIONS FOR CLINICAL PRACTICE AND FURTHER RESEARCH

Findings of anaemia in men are likely to represent disease and further evaluation is needed. Haemoglobin is a predictor of morbidity [11, 12]. Future changes in lifestyle may contribute to a change in the distribution of haemoglobin, and lack of awareness of these changes may increase the risk of missing early signs of disease. Haemoglobin within normal reference values have prognostic value among smokers in particular. Haemoglobin values within quintile 1 among some smokers could be regarded as anaemia and should be followed by clinical evaluation. Haemoglobin values within quintile 5 among smokers are even more predicative for mortality and smoking cessation should be encouraged.

Despite the frequency of haemoglobin measurements, the epidemiological interest in this field is scarce. The Tromsø Study has given us the opportunity to future

research. In 2001 the fifth survey was conducted and we were then able to measure not only haemoglobin, but also white blood cells and platelets counts. The study reinvestigated 6961 subjects who attended a more extended examination of the 1994-95 survey (89% of those invited: all men born 1925-39, all women born 1925-44 and a 5-10% random selection of the other age groups). In addition, all inhabitants born 1971, -61, -56 and -41 were invited in 2001. The data are now ready for analysis.

We will now be able to evaluate how changes in lifestyle factors predict changes in other haematological variables as well as haemoglobin. How white blood cells and platelets can predict mortality and morbidity in general populations is still unclear. The haematological variables' significance as predictors of chronic diseases should be evaluated. Since these cohorts are older than the 1974 cohorts, the death rates are probably higher, allowing for evaluation of haematological variables as predictors of different causes of death in addition to total mortality.

The 1974 study was restricted to men only and the gender perspective was therefore absent in two of the subprojects of this thesis. Since women differ from men in a number of aspects, including the distribution of haemoglobin, the gender perspective should be central in future projects.

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ERRATA

Paper I

Page 387, column 1, section 2, line 3-4: *..,8130 subject (78 % of the invited) were reinvestigated.* In total, 8130 subjects (78 % of total invited) were investigated, 6961 subjects were from the cohort of Tromsø IV (89%).

Paper IV

Last number in the conclusion of the abstract; 2.2% should be 2.2‰.

Table 5 presents incidence proportions not incidence rates.

In general

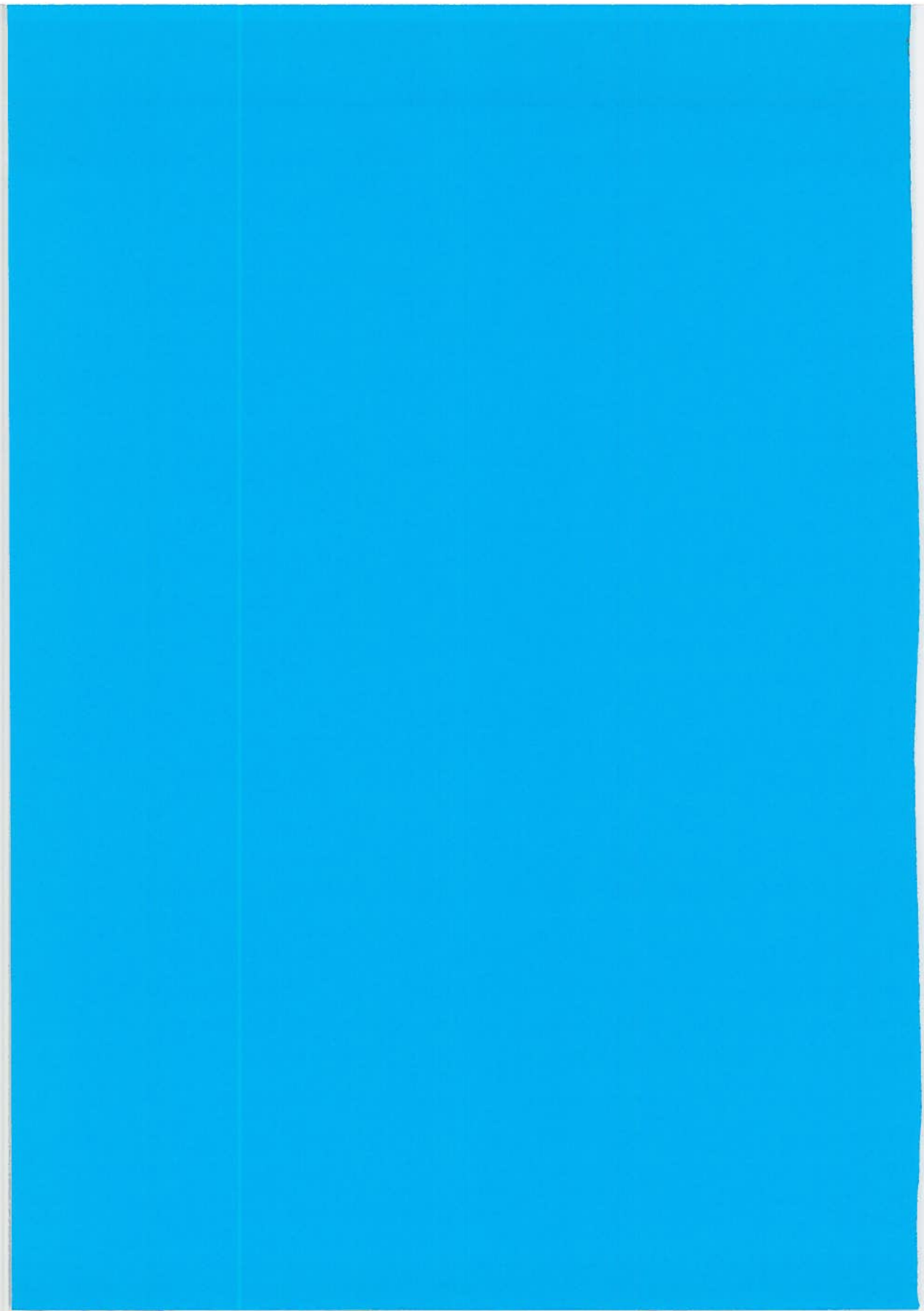
Participation to the survey implicates that the individual was registered at the screening, but in a few cases, this is about all that is registered about the subject. In different publications from the Tromsø study the number of participants have varied slightly. In paper I of this thesis the participated population was reported to be 27 153, and in paper IV; 27 145.

The eligible population of the Tromsø Study 1994-95 has recently been revised to be 35 420.

Appendix 1

Questionnaire I Tromsø Study 1974

Original Norwegian version and English translation



MELDING OM SKJERMBILDEFOTOGRAFERING OG HJERTE-KARUNDERSØKELSE

(Gjelder bare den person brevet er adressert til)

Skjermbildefotograferingen kommer nå til Deres distrikt.

Tid og sted for Deres framrnete vil De finne nedenfor.

Denne gangen vil en del av befolkningen også få tilbud om hjerte-karundersekelse. De tilhører denne gruppe. En orientering om undersekelsen er gitt i vedlagte brosjyre.

Vennligst fyll ut sperreskjemaet på baksiden og ta det med til undersøkelsen. Ta også med tuberkulinkort eller frelsebok; om De har.

Fravær bes eventuelt meldt på vedlagte seddel.

Undersekelsen koster 1,– krone.

Med hilsen

HELSERÅDET FYLKESLEGEN
STATENS SKJERMBILDEFOTOGRAFERING

Født dato	Personnr	Kommune		Kretsnr
Møtested		Kjenn	Første bokstav etternavn Dag og dato	Klokkeslett

A

Har De, eller har De hatt:

		JA	NEI
Hjerteinfarkt?	33		
Angina pectoris (hjertekrampe)?	34		
Annen hjertesykdom?	35		
Åreforkalkning i bena?	36		
Hjerneslag?	37		
Sukkersyke?	38		
Er De under behandling for:			
Høyt blodtrykk?	39		
Bruker De:			
Nitroglycerin?	40		

B

Får De smerter eller ubehag i brystet når De:

		JA	NEI
Går i bakker, trapper eller fort på flat mark?	41		
Går i vanlig takt på flat mark?	42		
Hvis De får smerter eller ubehag i brystet ved gange, pleier De da å:			
1 Stanse?	43		
2 Saktne farten?			
3 Fortsette i samme takt?			
Hvis De stanser eller saktner farten, forsvinner smertene da:			
1 Etter mindre enn 10 minutter?	44		
2 Etter mer enn 10 minutter?			
Får De smerter i tykkleggen når De:			
Går?	45		
Er i ro?	46		
Hvis De får leggsmerter, besvar da:			
Forverres smertene ved raskere tempo eller i bakker?	47		
Gir smertene seg når De stopper?	48		
Har De vanligvis:			
Hoste om morgenen?	49		
Oppspytt fra brystet om morgenen?	50		

C

Bevegelse og kroppslig anstrengelse i Deres **fritid**.
Hvis aktiviteten varierer meget f.eks. mellom sommer og vinter så ta et gjennomsnitt.

Spørsmålet gjelder bare det siste året.

Sett kryss i den ruten hvor „JA" passer best.

		JA
1 Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse?	51	
2 Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uken? (Heri medregnes også gang eller sykling til arbeidsstedet, søndagsturer m.m.)		
3 Driver mosjonsidrett, tyngre hagearbeid e.l.? (Merk at yirksomheten skal være minst 4 timer i uken.		
4 Trener hardt eller driver konkurranseidrett, regelmessig og flere ganger i uken?		

D

		JA	NEI
Røyker De daglig for tiden?	52		
Hvis svaret var „JA" på forrige spørsmål, besvar da:			
Røyker De sigaretter daglig? (håndrullede eller fabrikkframstilte)	53		
Hvis De ikke røyker sigaretter nå, besvar da:			
Har De røykt sigaretter daglig tidligere?	54		
Hvis De svarte „JA", hvor lenge er det siden De sluttet?			
1 Mindre enn 3 månader?	55		
2 3 måneder - 1 år?			
3 1 - 5 år?			
4 Mer enn 5 år?			
Besvares av dem som røyker nå eller har røykt tidligere:			
Hvor mange år tilsammen har De røykt daglig?	56-57	Antall år:	
Hvor mange sigaretter røyker eller røykte De daglig? Oppgi antall pr. dag (håndrullede + fabrikkframstilte)	58-61	Ant. sigaretter:	
Røyker De noe annet enn sigaretter daglig?			
Sigarer eller sarutter/cigarillos?	62		
Pipe?	63		
Hvis De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipa pr. uke?		Ant. tobak:	
Oppgi gjennomsnittlig antall pakker pr. uke.	64-66		

E

		JA	NEI
Har De vanligvis skiftarbeid eller nattarbeid?	67		
Kan De vanligvis komme hjem fra arbeidet:			
Hver dag?	68		
Hver helg?	69		
Har De i perioder lengre arbeidsdager enn vanlig? (f.eks. under sesongfiske, onnearbeid)	70		
Har De i løpet av siste året hatt:			
Sett kryss i den ruten hvor „JA" passer best.			
1 Overveiende stillesittende arbeid? (f.eks. skrivebordsarb., urmakerarb., montering)	71		
2 Arbeid som krever at De går mye? (f.eks. ekspeditørarb., lett industriarb., undervisn.)			
3 Arbeid hvor De går og løfter mye? (f.eks. postbud, tyngre industriarb., bygningsarb.)			
4 Tungt kroppsarbeid? (f.eks. skogsarbeid, tungt jordbruksarb., tungt bygningsarb.)			
Har De i løpet av de siste 12 mnd måttet flytte fra hjemstedet på grunn av forandring i arbeidssituasjonen?	72		
Er husmorarbeid Deres hovedyrke?	73		
Har De i løpet av de siste 12 mnd fått arbeidsledighetstrygd?	74		
Er De for tiden sykmeldt, eller får De attføringspenger?	75		
Har De full eller delvis uførepensjon?	76		

F

		JA	NEI	Vet ikke
Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)?	77			
Er to eller flere av Deres besteforeldre av finsk ætt?	78			
Er to eller flere av Deres besteforeldre av samisk ætt?	79			

English translation of the questionnaire used in the cardiovascular disease study in Oslo* 1972-73, Norwegian counties 1974-78 (Finnmark, Oppland and Sogn og Fjordane) and Tromsø 1974.

English translation; Mr. Kevin McCafferty

Tick "yes/no" or "yes", as appropriate.

Part A

Have you, or have you had:
- a heart attack?
- angina pectoris (heart cramp)?
- any other heart disease?
- hardened arteries in the legs?
- a cerebral stroke?
- diabetes?

Are you being treated for:
- high blood pressure?

Do you use:
- nitroglycerine?

Part B

Do you have pain or discomfort in the chest when:
- walking up hills or stairs, or walking fast on level ground?
- walking at normal pace on level ground?

If you get pain or discomfort in the chest when walking, do you usually:
- (1) stop?
- (2) slow down?
- (3) carry on at the same pace?

If you stop or slow down, does the pain disappear:
- (1) within 10 minutes?
- (2) after more than 10 minutes?

Do you have pain in the calf while:
- walking?
- resting?

If you get pain in the calf, then:
- does the pain increase when you walk faster or uphill?
- does the pain disappear if you stop?

Do you usually have:
- cough in the morning?
- phlegm chest in the morning?

Part C

Exercise and physical exertion in *leisure time.* If your activity varies much, for example between summer and winter, then give an average. The questions refer only to the last twelve months.

Tick "YES" beside the description that fits best:
- (1) Reading, watching TV, or other sedentary activity?
- (2) Walking, cycling, or other forms of exercise at least 4 hours a week? (including walking or cycling to place of work, Sunday-walking, etc.)
- (3) Participation in recreational sports, heavy gardening, etc.? (note: duration of activity at least 4 hours a week).
- (4) Participation in hard training or sports competitions, regularly several times a week?

Part D*

Do you smoke daily at present?
If "Yes":
- Do you smoke cigarettes daily? (handrolled or factory made)

If you do not smoke cigarettes at present:
- Have you previously smoked cigarettes daily?

If "Yes", how long is it since you stopped?
- (1) Less than 3 months?
- (2) 3 months to 1 year?
- (3) 1 to 5 years?
- (4) More than 5 years?

For those who smoke or have smoked previously:

How many years altogether have you smoked daily? Number of years .....

How many cigarettes do you, or did you, smoke daily? Give number of cigarettes per day (handrolled + factory made)

Number of cigarettes .....

Do you smoke tobacco products other than cigarettes daily?

- cigars or cigarillos?
- a pipe?

If you smoke a pipe, how many packs of tobacco (50 grams) do you smoke per week?

Give average number of packs per week.

Number of tobacco packs .....

Part E

Do you usually work shifts or at night?

Can you usually come home from work:

- every day?
- every weekend?

Are there periods during which your working days are longer than usual? (e.g.: fishing season, harvest)

During the last year, have you had: (Tick "YES" beside description that fits best):

(1) mostly sedentary work? (e.g., office work, watchmaker, light manual work)

(2) work that requires a lot of walking? (e.g., shop assistant, light industrial work, teaching)

(3) work that requires at lot of walking and lifting? (e.g., postman, heavy industrial work, construction)

(4) heavy manual labour? (e.g., forestry, heavy farmwork, heavy construction)

During the last 12 months, have you had to move house for work reasons?

Is housekeeping your main occupation?

Have you within the last 12 months received unemployment benefit?

Are you at present on sick leave, or receiving rehabilitation allowance?

Do you receive a complete or partial disability pension?

Part F (alternatives: yes, no, don't know)

Have one or more of your parents or sisters or brothers had a heart attack (heart wound) or angina pectoris (heart cramp)?

In Finnmark and Tromsø only:

Are two or more of your grandparents of Finnish origin?

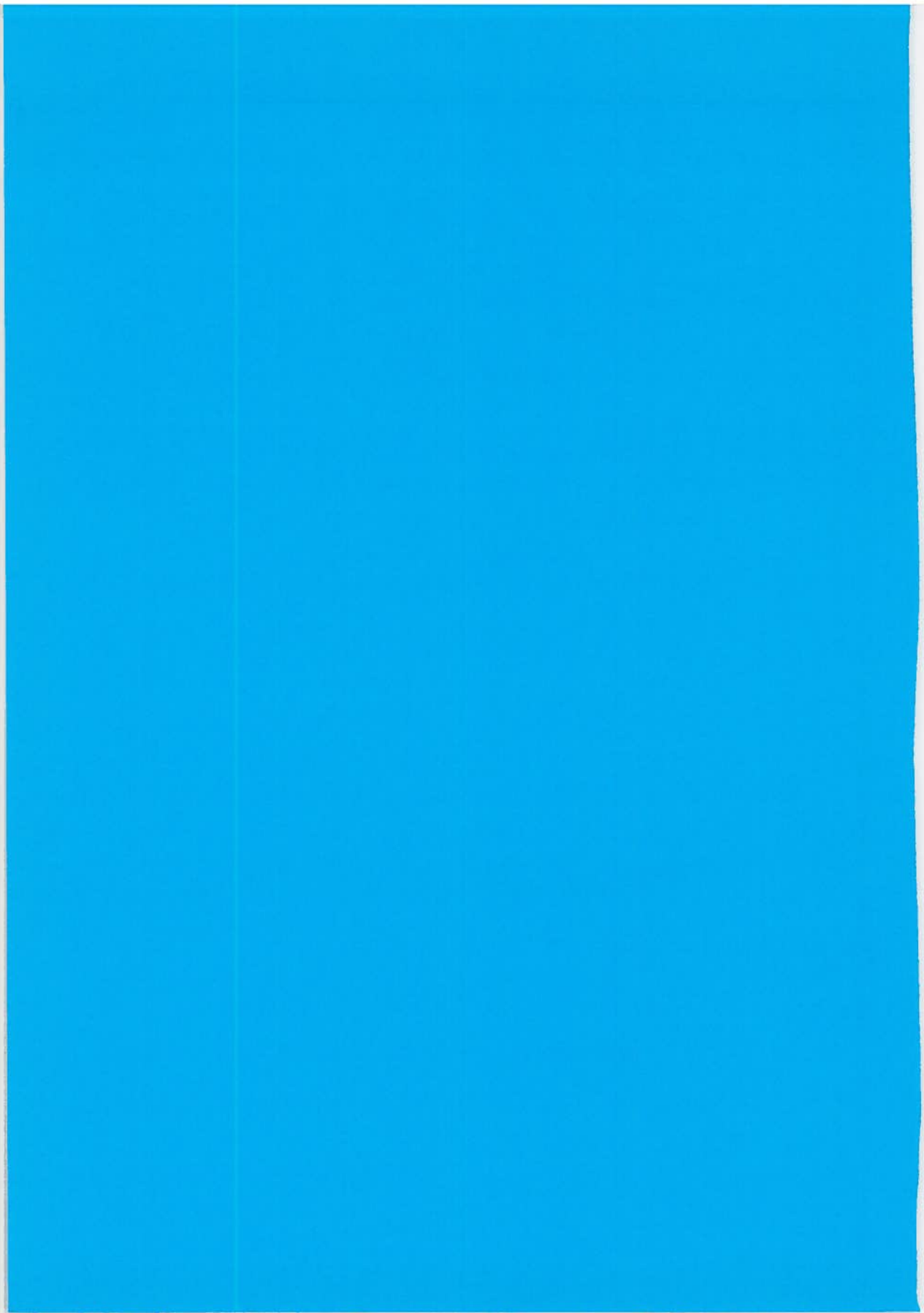
Are two or more of your grandparents of Lapp origin?

*In Oslo preset groups of cigarettes smoked per day and packs of pipe tobacco smoked per day (see original questionnaire)

Appendix 2

Questionnaire II Tromsø Study 1979-1980

Original Norwegian version and English translation



ETIKETT

TR - II

TILLEGGS-SPØRSMÅL FOR DEM SOM HAR VÆRT TIL SKJERMBILDEUNDERSØKELSE I TROMSØ

Sammen med innkallingen fikk De et spørreskjema fra Statens Skjermbilde-fotografering. Dette leverte De ved undersøkelsen.

Hjertekarsykdommene er imidlertid en mangeartet sykdomsgruppe med tildels dårlig kjente årsaksforhold. I Tromsø vil vi derfor forsøke å få en mer fullstendig kartlegging av forhold som kan være av betydning for sykdommens forløp, f.eks. kosthold, psykisk press ("stress"), sosiale forhold og sykdomsforekomst blant slektninger. Vi håper De vil være brydd med å fylle ut også dette skjema, og sende det tilbake til Tromsø Helseråd i den utleverte konvolutt.

Alle opplysninger i forbindelse med skjermbildeundersøkelsen vil bli behandlet strengt konfidensielt.

I EGET KOSTHOLD

1. Hva slags brød spiser De oftest?
   Sett kryss i den ruten der „JA" passer best.

	JA
Loff	1
Fint (lyst) brød, alminnelig brød	2
Grovt (mørkt) brød, kneipp o.l.	3
Hjemmebakt (grovt) brød	4

2. Hva slags smør eller margarin bruker De oftest?
   Sett kryss i den ruten der „JA" passer best.

	JA
Meieri eller fjellsmør	1
Vanlig margarin	2
Plantemargarin	3
Myk (soft) margarin	4

3. Hvor mange brødskiver spiser De vanligvis daglig?
   Sett kryss i den ruten der „JA" passer best.

	JA
Mindre enn 2 skiver	1
2-6 skiver	2
7-12 skiver	3
13 skiver eller flere	4

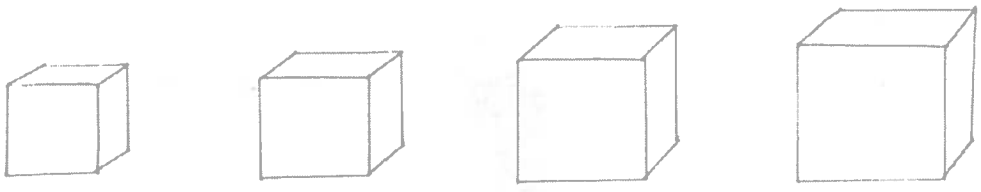
4. Hva slags melk drikker De vanligvis?
   Sett kryss i den ruten der „JA" passer best.

	JA
Drikker ikke melk	1
Melk (helmelk), søt, sur	2
Skummet melk, søt, sur	3
Blanding av skummet og helmelk	4

5. Tegningen nedenfor forestiller terninger av smør eller margarin i naturlig størrelse.
   Kryss av for den terning som likner mest på den mengde De bruker til 1 skive brød.
   Er De i tvil, forsøk å prøvesmøre en skive.

Bruker ikke smør eller margarin ☐

1. ☐ 2. ☐ 3. ☐ 4. ☐



6. Hvor mange glass / kopper melk drikker De vanligvis daglig?

Sett kryss i den ruten der „JA" passer best.

JA

Drikker ikke, eller mindre enn et glass / en kopp 1
1-2 glass / kopper 2
3-4 glass / kopper 3
5 eller flere glass / kopper 4

7. Hvor mange kopper kaffe drikker De vanligvis daglig?

Sett kryss i den ruten der „JA" passer best.

JA

Drikker ikke, eller mindre enn en kopp 1
1-4 kopper 2
5-8 kopper 3
9 eller flere kopper 4

8. Er De totalavholdsmann / kvinne? .....

JA NEI

Hvis nei,

— Hvor ofte pleier De å drikke øl?

Sett kryss i den ruten der „JA" passer best.

Aldri, eller noen få ganger i året 1
1-2 ganger i måneden 2
Omtrent 1 gang i uken 3
2-3 ganger i uken 4
Omtrent hver dag 5

— Hvor ofte pleier De å drikke vin?

Sett kryss i den ruten der „JA" passer best.

Aldri, eller noen få ganger i året 1
1-2 ganger i måneden 2
Omtrent 1 gang i uken 3
2-3 ganger i uken 4
Omtrent hver dag 5

— Hvor ofte pleier De å drikke brennevin?

Sett kryss i den ruten der „JA" passer best.

Aldri, eller noen få ganger i året 1
1-2 ganger i måneden 2
Omtrent 1 gang i uken 3
2-3 ganger i uken 4
Omtrent hver dag 5

9. Omtrent hvor ofte har De i løpet av de siste 12 måneder drukket så mye øl, vin eller brennevin at De har vært beruset?

Sett kryss i den ruten der „JA" passer best.

JA

Har aldri vært beruset eller ikke vært beruset i løpet av siste år 1
Noen få ganger i året 2
1-2 ganger i måneden 3
1-2 ganger i uken 4
3 eller flere ganger i uken 5

10. Hvor ofte består middagsmåltidet av fisk eller retter med fisk?

Sett kryss i den ruten der „JA" passer best.

JA

Sjeldnere enn 1 gang i uken 1
1-2 ganger i uken 2
3-4 ganger i uken 3
5-6 ganger i uken 4
7 ganger i uken 5

11. Hvor ofte bruker De frukt eller grønnsaker?

Sett kryss i den ruten der „JA" passer best.

JA

Bruker aldri frukt eller grønnsaker 1
Noen få ganger i året 2
1-2 ganger i måneden 3
Omtrent 1 gang i uken 4
2-3 ganger i uken 5
Omtrent hver dag 6

12. Hvor mange ganger i måneden spiser De kokte eller stekte pølser, kjøttkaker eller annen opplaget kjøttmat?

Sett kryss i den ruten der „JA" passer best.

JA

Aldri eller sjeldnere enn 1 gang i måneden 1
1-2 ganger i måneden 2
3-4 ganger i måneden (inntil 1 gang i uken) 3
5-8 ganger i måneden (inntil 2 ganger i uken) 4
Mer enn 8 ganger i måneden, (mer enn 2 ganger i uken.) 5

13. Har De i løpet av de siste 5 årene forandret Deres kosthold når det gjelder disse varene?
Sett ett kryss for hver enkelt vare.

	Som før	Mer nå	Mindre nå
Vanlig margarin eller smør			
Skummet melk			
Magert kjøtt			
Helmelk			
Soya (soft) margarin			
Kjøtt med mye fett			

II Tidligere/nåværende egne sykdommer

	JA	NEI
14. Har De noen gang hatt?		
Plutselig lammelse eller nummenhet i en side av kropp eller ansikt, i en hånd eller fot		
Plutselig tap av taleevnen		
Plutselig tap av synet helt eller delvis, eller plutselig dobbeltsyn		
15. Har De hatt magesår?		
Har De ofte sugende smerter øverst i magen?		
Har De mye plager med sure oppstøt eller halsbrann?		
Er De mye plaget av oppblåsthet og rumling i magen?		
Har De ofte knipsmerter i magen?		
Har De noen gang tatt røntgenbilde av tykktarmen?		
Har De hatt gallestein?		
16. Har De hatt nyresteinsanfall (nyregrus) eller stein i urinveier?		
Hvis ja, hvor mange ganger?	ANTALL GANGER:	
og når hadde De siste anfall?	ÅRSTALL:	
17. Har De noen gang hatt kreftsykdom?		
Hvis ja, hvilket år ble sykdommen oppdaget?	ÅRSTALL:	

	JA	NEI
18. Har De, eller har De hatt hudsykdommen psoriasis?		
19. Har De i løpet av de siste 12 måneder hatt allergisk eksem på hendene?		
20. Har De i løpet av de siste 3 år vært sykemeldt eller arbeidsufør pg.a. allergisk eksem på hendene?		
21. Har De, eller har De hatt leddgikt? (Kronisk reumatisk artritt)		
22. Har De i løpet av de siste 12 måneder vært plaget av smerter i ryggen som har vart lenger enn 4 uker?		
Hvis ja, bedrer ryggsmertene seg dersom De beveger Dem?		
23. Har De vært plaget av stivhet i ryggen om morgenen som varte lenger enn 30 minutter?		
24. Har De i løpet av de siste 3 år vært plaget av smerter i noen av de følgende ledd i mer enn 3 måneder?		
Kneleddene		
Albueleddene		
De innerste fingerleddene		
Andre ledd		
Hvis ja, merket De stivhet i leddene om morgenen av mer enn 30 minutters varighet?		
25. Har De hatt noen infeksjonssykdom de siste 14 dagene? (Influensa, forkjølelse, "ræksjuka", el.)		
26. Har De brukt jerntabletter de siste 14 dagene?		

27. Hvor ofte bruker De smertestillende midler som Globoid, Novid, Dispril, Alboyl el.l.?
Sett kryss i den ruten der „JA" passer best.

	JA	NEI
1-3 ganger i uken 1		
1-3 ganger i måneden 2		
Sjelden eller aldri 3		
Har De brukt slike smertestillende midler de siste 14 dagene?		

28. Har De endret mengden av fysisk aktivitet i fritiden de siste 5 årene?
Sett kryss i den ruten der „JA" passer best.

	JA
Som før 1	
Mer enn før 2	
Mindre enn før 3	

III. Sykdommer hos foreldre og søsken

29. Har noen av disse slektninger hatt:

	Mor	Far	Søstre	Brødre
Hjerneslag eller hjerneblødning				
Sukkersyke				
Leddgikt (kronisk reumatisk artritt)				
Kreft				
Nyrestein eller stein i urinveier				
Psoriasis				
Magesår				
Ingen av nevnte sykdommer				

IV. Sosiale forhold og psykisk press ("stress")

30. Hvor mange års skolegang har De?
(Medregnet folkeskole og ungdomsskole.) ..... Antall år:

31. Hvordan var de økonomiske forhold i familien under Deres oppvekst?
Sett kryss i den ruten der „JA" passer best.

	JA
Meget gode 1	
Gode 2	
Vanskelige 3	
Meget vanskelige 4	

32. Hender det at De er plaget av søvnløshet?
Hvis ja, når på året pleier De å være plaget?
Sett kryss i den ruten der „JA" passer best.

	JA	NEI
Ingen spesiell tid 1		
Særlig i mørketiden 2		
Særlig i midnattsoltiden 3		
Særlig høst og vår 4		
Hvordan arter søvnløsheten seg?		
Vanskelig å sovne om kvelden 1		
Våkner ofte opptil av natten 2		
Sover tidlig om morgenen 3		

33. Har De i de siste par ukene hatt vansker med å sove?
Sett kryss i den ruten der „JA" passer best.

	JA
Ikke i det hele tatt 1	
Ikke mer enn vanlig 2	
Heller mer enn vanlig 3	
Mye mer enn vanlig 4	

34. Har De i de siste par ukene følt Dem ulykkelig og nedtrykt (deprimert)?
Sett kryss i den ruten der „JA" passer best.

	JA
Ikke i det hele tatt 1	
Ikke mer enn vanlig 2	
Heller mer enn vanlig 3	
Mye mer enn vanlig 4	

35. Har De i de siste par ukene følt Dem ute av stand til å mestre Deres vanskeligheter?
Sett kryss i den ruten der „JA" passer best.

	JA
Ikke i det hele tatt 1	
Ikke mer enn vanlig 2	
Heller mer enn vanlig 3	
Mye mer enn vanlig 4	

ADDITIONAL QUESTIONS FOR PERSONS ATTENDING THE MASS X-RAY EXAMINATION IN TROMSØ.

English translation; Mrs. Anne Clancy and Mr. Kevin McCafferty

Together with the invitation to attend you received a questionnaire from the National Mass Radiography Service. You delivered this questionnaire at the examination.

Cardiovascular diseases are, however, a complex group of diseases. The causes are still partly unknown. In Tromsø we are therefore trying to obtain a more complete description of factors which may be of importance for the course of these diseases, such as diet, psychological pressure ("stress"), social conditions, and occurrence of disease in relatives. We hope you will take the trouble to complete this questionnaire as well, and return it to the Tromsø Board of Health in the enclosed envelope.

All information in connection with the mass x-ray examination will be treated as strictly confidential.

I YOUR OWN DIET

1. What type of bread do you usually eat?

Tick the most appropriate box;	*Yes*
White bread (e.g. French bread)	❸
Ordinary bread (light texture)	❸
Whole meal (brown) bread	❸
Home-made (brown) bread	❸

2. What type of butter or margarine do you usually eat?

Tick the most appropriate box;	*Yes*
Butter	❸
Ordinary margarine	❸
Plant margarine	❸
Soft margarine spread	❸

3. How many slices of bread do you usually eat daily ?

Tick the most appropriate box;	*Yes*
Less than two slices	❸
2-6 slices	❸
7-12 slices	❸
13 or more slices	❸

4. What type of milk do you usually drink?

Tick the most appropriate box;	*Yes*
Do not drink milk	❸
Full cream milk: ordinary type or curdled	❸
Skimmed milk: ordinary type or curdled	❸
Mixture of full cream and skimmed milk	❸

5. The drawings below show cubes of butter or margarine(actual size).
Tick the box above the cube which best resembles the amount you spread on a slice of bread.
If in doubt, try buttering a slice.

Do not use butter or margarine ❸

1. ❸ 2. ❸ 3. ❸ 4. ❸

6. How many glasses/cups of milk do you usually drink daily?

Tick the most appropriate box	*Yes*
Do not drink milk, or drink less than 1 glass /cup	❸
1-2 glasses	❸
3-4 glasses/cups	❸
5 or more glasses/cups	❸

7. How many cups of coffee do you usually drink daily?

Tick the most appropriate box	*Yes*
Do not drink coffee or drink less than 1 cup	❸
1 - 4 cups	❸
5 - 8 cups	❸
9 or more cups	❸

8 . Are you a teetotaller? *Yes* ❸ *No* ❸

If *"No"* :

How often do you usually drink beer?

Tick the most appropriate box	*Yes*
Never or just a few times a year	❸
Once or twice a month	❸
About once a week	❸
2-3 times a week	❸
More or less daily	❸

How often do you usually drink wine?

Tick the most appropriate box	*Yes*
Never or just a few times a year	❸
Once or twice a month	❸
About once a week	❸
2-3 times a week	❸
More or less daily	❸

How often do you usually drink spirits?

Tick the most appropriate box	*Yes*
Never or a just few times a year	❸
Once or twice a month	❸
About once a week	❸
2-3 times a week	❸
More or less daily	❸

9. Approximately how often during the past 12 months have you drunk so much wine, beer or spirits that you got drunk?

Tick the most appropriate box	*Yes*
Have never been drunk, or have not been drunk during the past year	❸
A few times during the last year	❸
Once or twice a month	❸
Once or twice a week	❸
3 or more times a week	❸

10. How often does your main meal consist of fish or fish dishes?

Tick the most appropriate box	*Yes*
Less than once a week	❸
Once or twice a week	❸
3 - 4 times a week	❸
5 - 6 times a week	❸
7 days a week	❸

11. How often do you eat fruit or vegetables?

Tick the most appropriate box	*Yes*
Never eat fruit or vegetables	❸
A few times a year	❸
Once or twice a month	❸
About once a week	❸
2 to 3 times a week	❸
More or less daily	❸

12. How many times a month do you eat boiled sausages or fried meat balls, processed meat, etc.?

Tick the most appropriate box	*Yes*
Never or less than once a month	❸
Once or twice a month	❸
3 - 4 times a month (up to once a week)	❸
5 - 8 times a month (up to twice a week)	❸
More than 8 times a month, (more than twice a week)	❸

13. Have you made any changes in your diet during the last 5 years as regards the following food items?

Tick each item in the appropriate box

	As before	More now	Less now
Ordinary margarine or butter:	❸	❸	❸
Skimmed milk :	❸	❸	❸
Lean meat:	❸	❸	❸
Full cream milk:	❸	❸	❸
Soya margarine (soft):	❸	❸	❸
Fatty meat:	❸	❸	❸

II. OWN ILLNESSES PAST OR PRESENT

Tick the appropriate box "Yes" or "No"

14. Have you ever had ? *Yes No*
- Sudden paralysis or numbness on one side of your face or body, in your hand or foot ❸ ❸
-Sudden loss of ability to speak ❸ ❸
-Sudden loss of eyesight, complete or partial, or sudden onset of double vision ❸ ❸

15. Have you had a peptic ulcer? *Yes No* ❸ ❸

Do you often have a gnawing pain in the upper part of your stomach? ❸ ❸
Do you suffer much from heartburn or regurgitation of gastric juices? ❸ ❸
Do you suffer much from wind and rumbling in your stomach? ❸ ❸
Do you often get cramps in your stomach ? ❸ ❸
Have you ever had your large intestine x-rayed? ❸ ❸
Have you ever had gall stones? ❸ ❸

16. Have you had kidney stones or stones in the urinary tract? *Yes No* ❸ ❸

If yes, how many times ? .....
and
When did you have your last attack? *Year*:.....

17. Have you ever had cancer? *Yes No* ❸ ❸
If "yes", in what year was the disease discovered? *Year:* .....

18. Do you have, or have had you the skin disease psoriasis? *Yes No* ❸ ❸

19. Have you had allergy-induced eczema on your hands during the last 12 months? *Yes No* ❸ ❸

20. Have you been on sick leave, or been unable to work due to allergic eczema on your hands at any time during the past 3 years? *Yes No* ❸ ❸

21. Have you ever had arthritis? (chronic rheumatoid arthritis) *Yes No* ❸ ❸

22. Have you suffered from back pain during the past 12 months lasting for more than 4 weeks? *Yes No* ❸ ❸

If *"Yes"* did the back pain improve if you exercised? *Yes No* ❸ ❸

23. Have you suffered from morning stiffness in your back lasting more than 30 minutes? *Yes No* ❸ ❸

24. Have you suffered from pains lasting more than 3 months, in the joints listed below during the last 3 years? *Yes No*
Knees: ❸ ❸
Elbows: ❸ ❸
Innermost finger joints: ❸ ❸
Other joints: ❸ ❸

If *"Yes"*, did you suffer from stiff joints in the mornings lasting more than 30 minutes? *Yes No* ❸ ❸

25. Have you had any infectious disease during the past 14 days? (influenza , common cold , vomiting, diarrhoea, etc.) *Yes No* ❸ ❸

26. Have you taken iron tablets during the past 14 days? *Yes No* ❸ ❸

27. How often do you take painkillers such as Globoid, Novid, Dispril, Albyl, etc.?

Tick the appropriate box *Yes*
1 - 3 times a week ❸
1 - 3 times a month ❸
Seldom or never ❸

Have you used such painkillers during the past 14 days? *Yes No* ❸ ❸

28. Have you changed the amount of physical exercise you take in leisure during time the last five years?

Tick the most appropriate box. *Yes*
As before ❸
More than before ❸
Less than before ❸

III ILLNESS IN PARENTS AND SIBLINGS

29. Have any of these relatives had:	mother	father	sister	brother
Cerebral stroke or brain haemorrhage	❸	❸	❸	❸
Diabetes	❸	❸	❸	❸
Arthritis (chronic rheumatoid arthritis)	❸	❸	❸	❸
Cancer	❸	❸	❸	❸
Kidney stones or stone in urinary tract	❸	❸	❸	❸
Psoriasis	❸	❸	❸	❸
Peptic ulcer	❸	❸	❸	❸
None of the above-mentioned illnesses	❸	❸	❸	❸

IV SOCIAL CONDITIONS AND PSYCHOLOGICAL PRESSURE ("STRESS")

30. How many years schooling have you had? (including secondary and folk high schools) number of years .....

31. What was your family's financial situation when you were growing up?

Tick the appropriate box	*Yes*
Very good	❸
Good	❸
Poor	❸
Very poor	❸

32 .Do you suffer from sleeplessness?	*Yes*	*No*
	❸	❸

If *"yes"*, at what time of the year do you suffer from sleeplessness?

Tick the appropriate box	Yes
No particular time	❸
Especially during the 'dark time'	❸
Especially during the arctic summer (midnight sun)	❸
Especially in spring and autumn	❸

What form your sleeplessness take?

Tick the most appropriate box	*Yes*
Difficult to fall asleep at night?	❸
Wake up a lot during the night ?	❸
Wake up very early in the morning?	❸

33. Have you had difficulty sleeping in the past couple of weeks?

Tick the most appropriate box	*Yes*
Not at all	❸
No more than usual	❸
Rather more than usual	❸
Much more than usual	❸

34. Have you felt unhappy and depressed during the past couple of weeks?

Tick the appropriate box	*Yes*
Not at all	❸
No more than usual	❸
Rather more than usual	❸
Much more than usual	❸

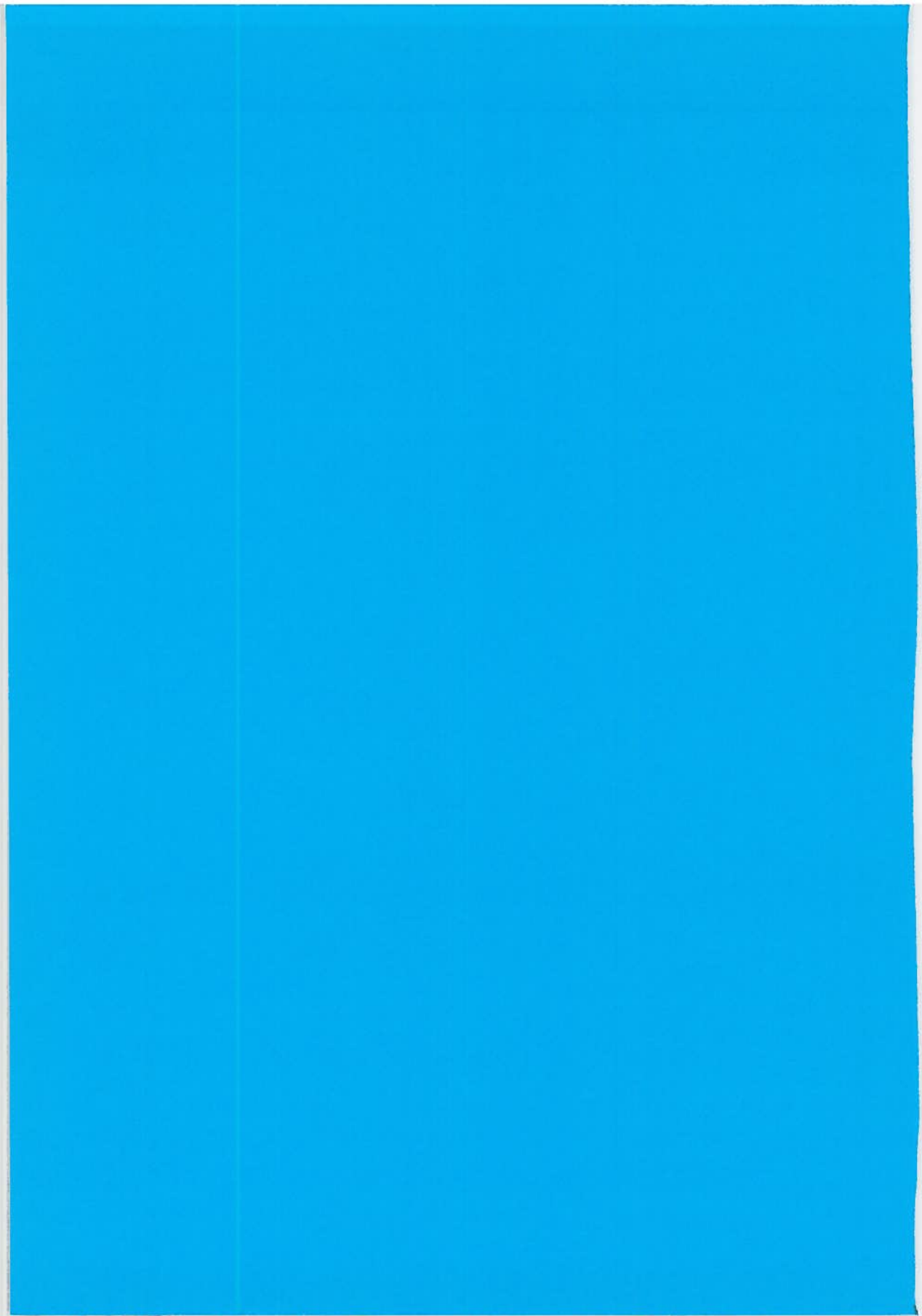
35. Have you felt unable to cope with your difficulties during the past couple of weeks?

Tick the appropriate box	*Yes*
Not at all	❸
No more than usual	❸
Rather more than usual	❸
Much more than usual	❸

Appendix 3

Questionnaire I Tromsø Study 1986-1987

Original Norwegian version and English translation



TROMSØ III

HELSEUNDERSØKELSEN I TROMSØ

(Gjelder bare den person som brevet er adressert til.)

Helseundersøkelsen kommer nå til Deres distrikt

Tid og sted for frammøte vil De finne nedenfor.

De finner en orientering om undersøkelsen i den vedlagte brosjyren.

Vi ber Dem vennligst fylle ut spørreskjemaet på baksiden og ta med dette til undersøkelsen.

Vi ber Dem eventuelt melde fra om fravær på den vedlagte fraværsmeldingen.

Med hilsen

KOMMUNEHELSETJENESTEN I TROMSØ
FYLKESLEGEN I TROMS UNIVERSITETET I TROMSØ
STATENS HELSEUNDERSØKELSER

Født dato Personnr. Kommune Krets nr.

Møtested Kjønn Første bokstav i etternavn Dag og dato Klokkeslett

HØYDE VEKT ANM 70	M P Ø KODE 75 KODE 76	AVVIK ARM MAN APP NR TSM 82
MÅLING 1	**MÅLING 2**	**MÅLING 3**
MAR S 85 86	MAR S 91 94	MAR S 97 100
HR D 103 106	HR D 109 112	HR D 115 119

A FAMILIE

JA | NEI | VET IKKE

Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? 12

B EGEN SYKDOM

JA | NEI

Har De, eller har De hatt:

Hjerteinfarkt? 13
Angina pectoris (hjertekrampe)? 14
Hjerneslag? 15
Sukkersyke? 16

Er De under behandling for:

Høyt blodtrykk? 17

Bruker De:

Nitroglycerin? 18

C SYMPTOMER

JA | NEI

Får De smerter eller ubehag i brystet når De:

Går i bakker, trapper eller fort på flat mark? 19
Går i vanlig takt på flat mark? 20

Dersom De får smerter eller vondt i brystet ved gange, pleier De da:

Stoppe? 21
Saktne farten? 1
Fortsette i samme takt? 2
3

Dersom De stopper eller saktner farten, går da smertene bort:

Etter mindre enn 10 minutter? 22
Etter mer enn 10 minutter? 1
2

Har De vanligvis:

JA | NEI

Hoste om morgenen? 23
Oppspytt fra brystet om morgenen? 24

D MOSJON

Bevegelse og kroppslig aktivitet i Deres fritid. Dersom aktiviteten varierer mye, f.eks. mellom sommer og vinter, så ta ett gjennomsnitt. Spørsmålet gjelder bare det siste året.

Sett kryss i den ruten som passer best.

Løser, ser på fjernsyn eller annen stillesittende beskjeftigelse? ..... 25 — 1

Spaserer, sykler eller beveger Dem på annen måte minst 4 timer i uken? ..... (Her skal De også regne med gang eller sykling til arbeidsstedet, søndagsturer m.m.) — 2

Driver mosjonsidrett, tyngre hagearbeid e.l.? .. (Merk at aktiviteten skal være i minst 4 timer i uken.) — 3

Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uken? ..... — 4

E SALT/FETT

Hvor ofte bruker De salt kjøtt eller salt fisk til middag?

Sett kryss i den ruten som passer best.

Aldri eller sjeldnere enn en gang i måneden ..... 26 — 1
Inntil en gang i uken 2
Inntil to ganger i uken 3
Mer enn to ganger i uken 4

Hvor ofte pleier De å strø ekstra salt på middagsmaten?

Sett kryss i den ruten som passer best.

Sjelden eller aldri ..... 27 — 1
Av og til eller ofte 2
Alltid eller nesten alltid 3

Hva slags margarin eller smør bruker De vanligvis på brødet?

Sett kryss i den ruten som passer best.

Bruker ikke smør eller margarin på brød ..... 28 — 1
Smør 2
Hard margarin 3
Myk (Soft) margarin 4
Smør/margarin blanding 5

Hva slags fett blir vanligvis brukt til matlaging i husholdningen Deres?

Sett kryss i den ruten som passer best.

Smør eller hard margarin ..... 29 — 1
Myk (Soft) margarin eller olje 2
Smør/margarin blanding 3

F RØYKING

JA | NEI

Røyker De daglig for tida? 30

Dersom svaret er «JA», svar da på dette:

Røyker De sigaretter daglig? 31
(håndrullede eller fabrikkfremstilte)

Dersom De ikke røyker sigaretter nå, svar da på dette:

Har De røykt sigaretter daglig tidligere? 32

Dersom De svarte «JA», hvor lenge er det da siden De sluttet?

Mindre enn 3 måneder? ..... 33 — 1
3 måneder – 1 år? 2
1–5 år? 3
Mer enn 5 år? 4

Skal besvares av de som røyker nå eller som har røykt tidligere:

Hvor mange år til sammen har De røykt daglig? ..... 34 — År

Hvor mange sigaretter røyker eller røykte De daglig?
Gi opp antallet sigaretter daglig ..... 36 — Sigaretter
(håndrullede + fabrikkframstilte)

Røyker De noe annet enn sigaretter daglig?

Sigarer eller serutter/sigarillos? 40
Pipe? 41

Dersom De røyker pipe, hvor mange pakker tobakk (50 gram) bruker De i pipen på en uke?

Gi opp gjennomsnittlig tall på pakker i uken ..... 42 — Tobakkspk.

G KAFFE

Hvor mange kopper kaffe drikker De vanligvis hver dag?

Sett kryss i den ruten som passer best.

Drikker ikke kaffe, eller mindre enn en kopp ..... 45 — 1
1 – 4 kopper 2
5 – 8 kopper 3
9 eller flere kopper 4

Hva slags kaffe drikker De vanligvis hver dag?

Kokekaffe 46
Filterkaffe 47
Pulverkaffe 48
Koffeinfri kaffe 49
Drikker ikke kaffe 50

H ARBEID

JA | NEI

Har De i de siste 12 månedene fått arbeidsledighetstrygd? 51

Er De for tiden sykemeldt, eller får De attføringspenger? 52

Har De full eller delvis uførepensjon? 53

Har De vanligvis skiftarbeid eller nattarbeid 54

Har De i det siste året hatt:

Sett kryss i den ruten som passer best.

For det meste stillesittende arbeid? ..... 55 — 1
(f.eks. skrivebordsarb., urmakerarb., montering)
Arbeide som krever at De går mye? 2
(f.eks. ekspeditørarb., lett industriarb., undervisn.)
Arbeide der De går og løfter mye? 3
(f.eks. postbud, tyngre industriarb., bygningsarb.)
Tungt kroppsarbeid? 4
(f.eks. skogsarb., tungt jordbruksarb., tungt bygningsarb.)

JA | NEI

Er husmorarbeid hovedyrket Deres? 56

I ETTERUNDERSØKELSE

Har noen i husstanden Deres (utenom Dem selv) vært innkalt til nærmere undersøkelse hos lege etter den siste hjerteundersøkelsen? 57

Dersom denne helseundersøkelsen viser at De bør undersøkes nærmere: Hvilken almenpraktiserende lege ønsker De da å bli henvist til?

Skriv navnet på legen her →

..... 58

Ingen spesiell lege .....

61

Ikke skriv her

QUESTIONNAIRE I, TROMSØ SURVEY 1986-87

English translation; Mrs. Anne Clancy and Mr. Kevin McCafferty

A FAMILY

Have one or both of your parents, or any of your siblings (brothers and sisters) had a heart attack or angina pectoris (heart cramp)?

Yes	*No*	*Don't know*
❸	❸	❸

B OWN ILLNESSES

Have you, or have you had:	*Yes*	*No*
A heart attack?	❸	❸
Angina pectoris (heart cramp) ?	❸	❸
A cerebral stroke?	❸	❸
Diabetes?	❸	❸

Are you receiving treatment for:	*Yes*	*No*
High blood pressure?	❸	❸
Do you use nitroglycerine?	❸	❸

C SYMPTOMS

Do you get pain or discomfort in the chest, when:	*Yes*	*No*
Walking up hills, stairs or walking fast on level ground?	❸	❸
Walking at ordinary pace on level ground?	❸	❸

If you get pain or discomfort in your chest when walking, do you usually :

	Yes
Stop	❸
Slow down	❸
Carry on at the same pace	❸

If you stop or slow down, does the pain disappear:

	Yes
After less than 10 minutes?	☐
After more than 10 minutes?	☐

D EXERCISE

Exercise and physical exertion in leisure time. If your activity varies much, for example between summer and winter, then give an average. The questions refer only to the last twelve months.

Tick "yes" in the most appropriate box:

	Yes
- Reading , watching TV or other sedentary activity?	❸
- Walking, cycling or other forms of exercise at least 4 hours a week? (including walking or cycling to place of work, Sunday walking ,etc.)	❸
- Participation in recreational sports, heavy gardening, etc.? (Note: duration of activity at least 4 hours a week)	❸
- Participation in hard training or sports competitions regularly several times a week?	❸

E SALT/ FAT

How often do you use salted meat or salted fish for dinner?

Tick the appropriate box	*Yes*
Never or less than once a month	❸
Once a week or less	❸
Twice a week or less	❸
More than twice a week	❸

How often do you add extra salt to your dinner ?

Tick the appropriate box	*Yes*
Rarely or never	❸
Sometimes or often	❸
Always or nearly always	❸

What type of margarine or butter do you usually use on your bread?

Tick the most appropriate box	*Yes*
Do not use margarine or butter on bread	❸
Butter	❸
Margarine	❸
Soft (soya) margarine spread	❸
Butter/ margarine mixtures	❸

What type of cooking fat do you normally use in your household ?

Tick the appropriate box.	*Yes*
Butter or hard margarine	❸
Soft (soya) margarine or oil	❸
Butter/ margarine mixtures	❸

F SMOKING

Do you smoke daily at present?	*Yes*	*No*
If "*Yes* ":	❸	❸
Do you smoke cigarettes daily? (hand-rolled or factory made)	❸	❸

If you do not smoke cigarettes at present:

Have you previously smoked cigarettes on a daily basis?	*Yes*	*No*
	❸	❸

If "*Yes*", how long is it since you gave up smoking ?

	Yes
More than 3 months?	❸
3 months to 1 year?	❸
1 - 5 years?	❸
More than 5 years?	❸

The following questions are to be answered by those who smoke at present or who have smoked previously.

How many years altogether have you smoked on a daily basis: .....

How many cigarettes do you smoke or did you smoke daily: .....
(hand-rolled + factory made)

Do you smoke anything else other than cigarettes daily?

	Yes
Cigars, cigarillos, cheroots ?	❸
Pipe?	❸

If you smoke a pipe, how many packets of tobacco (50 gr.) do you smoke in a week? Give the average number of packets a week: .....

G COFFEE

How many cups of coffee do you usually drink daily?

Tick the most appropriate box	*Yes*
Do not drink coffee, or less than one cup	❸
1 - 4 cups	❸
5 - 8 cups	❸
9 or more cups	❸

What type of coffee do you usually drink daily?

Coarse ground coffee for brewing (boiled)	❸
Finely ground filter coffee	❸
Instant coffee	❸
Caffeine free coffee	❸
Do not drink coffee	❸

H EMPLOYMENT

Have you received unemployment benefit within the past 12 months?	*Yes*	*No*
	❸	❸
Are you at present on sick leave, or receiving rehabilitation allowance?	❸	❸
Are you on a full time or partial disability pension?	❸	❸
Do you usually work shifts or do night work?	❸	❸

During the past year have you had :

Tick the most appropriate box.	*Yes*
- Mostly sedentary work? (office work, watchmaker, light manual work)	❸
- Work requiring a lot of walking? (shop assistant, light industrial work, teaching)	❸
- Work requiring a lot of walking and lifting? (postman, heavy industrial work, construction)	❸
- Heavy manual labour? (forestry, heavy farmwork, heavy construction)	❸

Is house-keeping your main occupation?	*Yes*	*No*
	❸	❸

I FOLLOW - UP EXAMINATION

Has any one in your household (other than yourself) been called in to a doctor for further medical examination after the previous cardiovascular disease survey?	*Yes*	*No*
	❸	❸

If as a result of this survey you need further medical examination, which general practitioner do you wish to be referred to ? Write the doctor's name here:

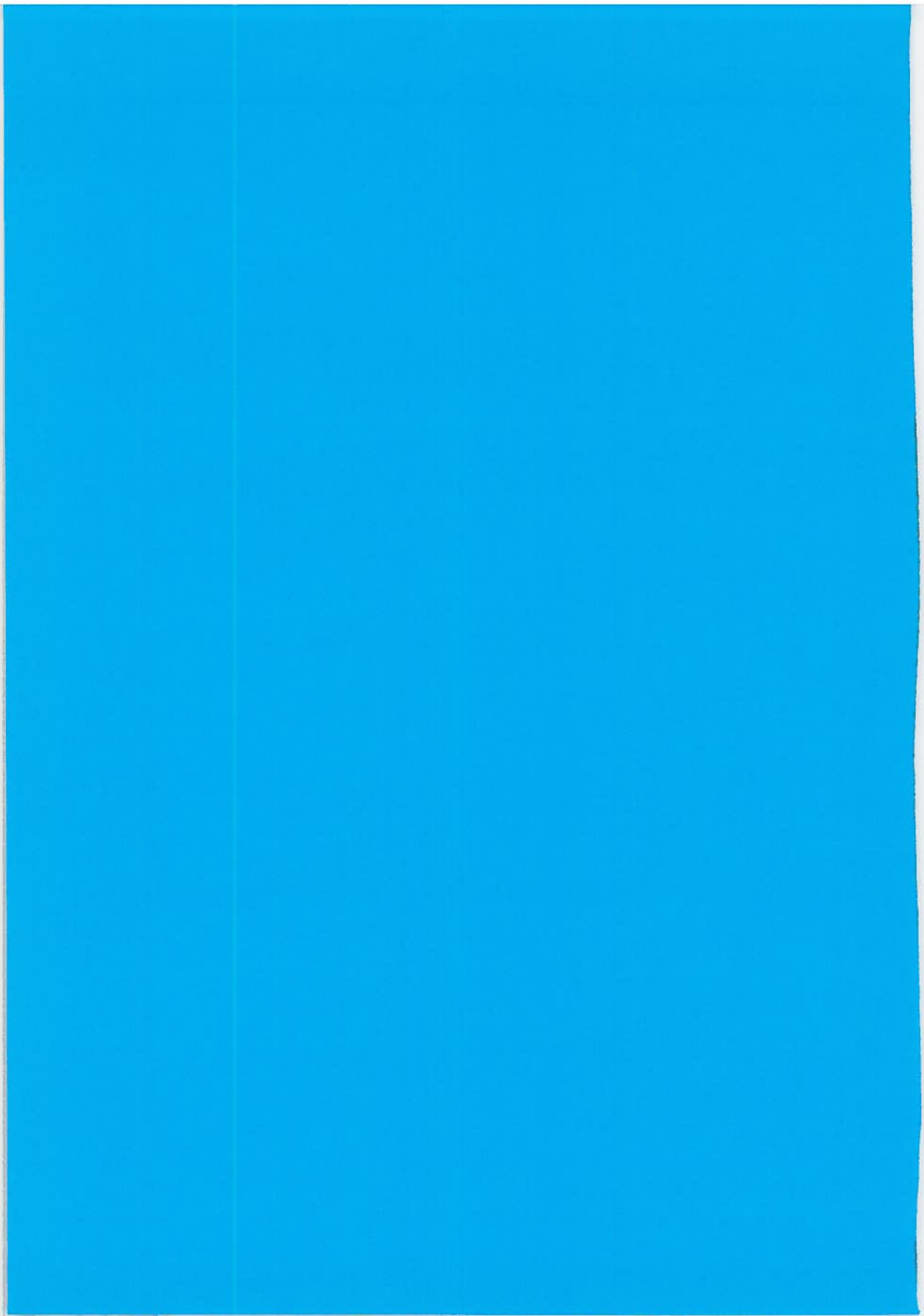
.....

No particular doctor .....

Appendix 4

Questionnaire I Tromsø Study 1994-1995

Original Norwegian version and English translation



Innbydelse til

HELSEUNDERSØKELSEN

Fødselsdato Personnr. Kommune Kretsnr.

Velkommen til helseundersøkelsen i Tromsø!

Helseundersøkelsen kommer nå til Tromsø. Tid og sted for frammøte finner du nedenfor. Du finner også en orientering om undersøkelsen i den vedlagte brosjyren.

Vi ber deg fylle ut spørreskjemaet på baksiden og ta det med til undersøkelsen.

Undersøkelsen blir mest verdifull om frammøtet blir så fullstendig som mulig. Vi håper derfor at du har mulighet til å komme. Møt selv om du kjenner deg frisk, om du er under legebehandling, eller om du har fått målt kolesterol og blodtrykk i den senere tid.

Vennlig hilsen

Kommunehelsetjenesten
Fagområdet medisin, Universitetet i Tromsø
Statens helseundersøkelser

HELSE

Hvordan er helsen din nå? *Sett bare ett kryss.*

Dårlig	12	1
Ikke helt god		2
God		3
Svært god		4

Har du, eller har du hatt:

	JA	NEI	Alder første gang
Hjerteinfarkt 13			år
Angina pectoris (hjertekrampe) 16			år
Hjerneslag/hjerneblødning 19			år
Astma 22			år
Diabetes (sukkersyke) 25			år

Bruker du medisin mot høyt blodtrykk?

Nå	28	1
Før, men ikke nå		2
Aldri brukt		3

Har du i løpet av det siste året vært plaget med smerter og/eller stivhet i muskler og ledd som har vært i minst 3 måneder sammenhengende? 29 JA NEI

Har du de siste to ukene følt deg:

	Nei	Litt	En god del	Svært mye
Nervøs og urolig? 30				
Plaget av angst? 31				
Trygg og rolig? 32				
Irritabel? 33				
Glad og optimistisk? 34				
Nedfor/deprimert? 35				
Ensom? 36				
	1	2	3	4

MOSJON

Hvordan har din fysiske aktivitet i fritiden vært det siste året? *Tenk deg et ukentlig gjennomsnitt for året. Arbeidsvei regnes som fritid.*

	Timer pr. uke: Ingen	Under 1	1-2	3 og mer
Lett aktivitet *(ikke svett/andpusten)* 56				
Hard fysisk aktivitet *(svett/andpusten)* 57				
	1	2	3	4

KAFFE

Hvor mange kopper kaffe drikker du daglig?

Sett 0 hvis du ikke drikker kaffe daglig.

		Antall kopper
Kokekaffe	58	
Annen kaffe	60	Antall kopper

ALKOHOL

Er du total avholdsmann/-kvinne? 62 JA NEI

Hvor mange ganger i måneden drikker du vanligvis alkohol? *Regn ikke med lettøl. Sett 0 hvis mindre enn 1 gang i mnd.* 63 — Antall ganger

Hvor mange glass øl, vin eller brennevin drikker du vanligvis i løpet av to uker? 65 *Regn ikke med lettøl. Sett 0 hvis du ikke drikker alkohol.*

Øl	Vin	Brennevin
glass	glass	glass

FETT

Hva slags margarin eller smør bruker du vanligvis på brødet? *Sett ett kryss.*

Bruker ikke smør/margarin	71	1
Meierismør		2
Hard margarin		3
Blot (soft) margarin		4
Smør/margarin blanding		5
Lettmargarin		6

RØYKE

Røykte noen av de voksne hjemme da du vokste opp? 37 JA NEI

Bor du, eller har du bodd, sammen med noen dagligrøykere etter at du fylte 20 år? 38 JA NEI

Hvis "JA", hvor mange år tilsammen? 39 — Antall år

Hvor lenge er du vanligvis daglig tilstede i røykfylt rom? 41 — Antall timer

Sett 0 hvis du ikke oppholder deg i røykfylt rom.

Røyker du selv:

	JA	NEI
Sigaretter daglig? 43		
Sigarer/sigarillos daglig? 44		
Pipe daglig? 45		

Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet? 46 — Antall år

Hvis du røyker daglig nå eller har røykt tidligere:

Hvor mange sigaretter røyker eller røykte du vanligvis daglig? 48	Antall sigaretter
Hvor gammel var du da du begynte å røyke daglig? 52	Alder — år
Hvor mange år tilsammen har du røykt daglig? 54	Antall år

UTDANNING/ARBEID

Hvilken utdanning er den høyeste du har fullført?

Grunnskole, 7-10 år, framhaldsskole, folkehøgskole	72	1
Realskole, middelskole, yrkesskole, 1-2-årig videregående skole		2
Artium, ok.gymnas, allmennfaglig retning i videregående skole		3
Høgskole/universitet, mindre enn 4 år		4
Høgskole/universitet, 4 år eller mer		5

Hva slags arbeidssituasjon har du nå?

Lønnet arbeid	73	
Heltids husarbeid	74	
Utdanning, militærtjeneste	75	
Arbeidsledig, permittert	76	

Hvor mange timer lønnet arbeid har du i uka? 77 — Antall timer

Mottar du nå noen av følgende ytelser?

Syketrygd (sykmeldt)	79	
Attføring	80	
Uførepensjon	81	
Alderspensjon	82	
Sosialstøtte	83	
Arbeidsløshetstrygd	84	

SYKDOM I FAMILIEN

Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)? 85

JA	NEI	VET IKKE

English translation of invitation with the first questionnaire used in the health survey in Tromsø 1994/95

Translation based on translations by Kevin McCafferty and Anne Clancy

HEALTH SURVEY
INVITATION

"This is your chance"

Date of birth Social security No.

Municipality Electoral ward No.

Welcome to the Tromsø Health Survey!

The Health Survey is coming to Tromsø. This leaflet will tell you when and where. You will also find information about the survey in the enclosed brochure.

We would like you to fill in the form overleaf and take it with you to the examination.

The more people take part in the survey, the more valuable its results will be. We hope, therefore, that you will be able to come. Come along even if you feel healthy, if you are currently receiving medical treatment, or if you have had your cholesterol and blood pressure levels taken recently.

Yours sincerely,
Municipal Health Authorities
Faculty of Medicine - University of Tromsø
National Health Screening Service

"This is a real opportunity — Take it!"

Your own health

What is your current state of health?
Tick one box only.

Poor	☐
Not so good	☐
Good	☐
Very good	☐

Do you have, or have you ever had:

	YES	NO	Age first time
Myocardial infarction	☐	☐	_____ years
Angina pectoris	☐	☐	_____ years
Stroke/ brain haemorrhage	☐	☐	_____ years
Asthma	☐	☐	_____ years
Diabetes	☐	☐	_____ years

Do you take medicine for high blood pressure?

At the moment	☐
Used to, but not any longer	☐
Never have	☐

Have you during the last year suffered from pains and/or stiffness in muscles and joints that have lasted continuously for at least 3 months?

YES ☐ NO ☐

Have you in the last two weeks felt:

	No	A little	A lot	Very much
Nervous or worried?	☐	☐	☐	☐
Anxious?	☐	☐	☐	☐
Secure and calm?	☐	☐	☐	☐
Irritable?	☐	☐	☐	☐
Happy and optimistic?	☐	☐	☐	☐
Down/depressed?	☐	☐	☐	☐
Lonely?	☐	☐	☐	☐

Smoking

Did any of the adults at home smoke while you were growing up? YES ☐ NO ☐

Do you now, or have you previously, lived with daily smokers after your 20th birthday?

YES ☐ NO ☐

If "YES", for how many years in all? ____Years

How many hours a day do you normally spend in smoke-filled rooms? _____Hours
Put 0 if you do not spend time in smoke-filled rooms.

Do you yourself smoke:	YES	NO
Cigarettes daily?	☐	☐
Cigars/cigarillos daily?	☐	☐
Pipe daily ?	☐	☐

If you previously smoked daily, how long is it since you stopped? _____ Years

If you smoke daily at the moment, or have smoked before:

How many cigarettes do you smoke/did you smoke per day? _____ Cigarettes

How old were you when you began smoking daily? Age _____ Years

How many years in all have you smoked daily? _____ Years

Exercise

How has your physical activity in leisure time been during this last year? *Think of your weekly average for the year. Time spent going to work counts as leisure time.*

	Hours pr. week None	Less than 1	1-2	3 or more
Light activity (*not sweating or out of breath*)	☐	☐	☐	☐
Hard activity (*sweating/ out of breath*)	☐	☐	☐	☐

Coffee

How many cups of coffee do you drink daily? *Put 0 if you do not drink coffee daily.* Cups

Boiled coffee ☐☐☐
(i.e., grind boiled and allowed to draw)
Other coffee ☐☐☐

Alcohol

Are you a teetotaler? YES ☐ NO ☐

How many times a month do you normally drink alcohol? *Do not count low-alcohol beer. Put 0 if less than once a month.* ____ Times

How many glasses of beer, wine or spirits do you normally drink in a fortnight? *Do not count low-alcohol beer. Put 0 if less than once a month.*

Beer Glasses	Wine Glasses	Spirits Glasses
☐☐	☐☐	☐☐

Fat

What kind of margarine or butter do you normally use on bread? *Tick one box only.*

- Don't use butter/margarine ☐
- Creamery butter ☐
- Hard margarine ☐
- Soft margarine ☐
- Butter/margarine blend ☐
- Light margarine ☐

Education/work

What is the highest level of education you have completed?

- 7-10 years primary/secondary school, modern secondary school, folk high school ☐
- Technical school, middle school, vocational.. school, 1-2 years' senior high school ☐
- A-levels/High school diploma, (3-4 years)☐
- College/university, less than 4 years ☐
- College/university, 4 or more years ☐

What is your current work situation?

- Paid work ☐
- Full-time housework ☐
- Education, military service ☐
- Unemployed, redundant ☐

How many hours of paid work do you have pr. week? ____ Hours

Do you receive any of the following benefits?

- Sickness benefit (sick leave) ☐
- Rehabilitation benefit ☐
- Disability pension ☐
- Old-age pension ☐
- Social welfare benefits ☐
- Unemployment benefit ☐

Illness in the family

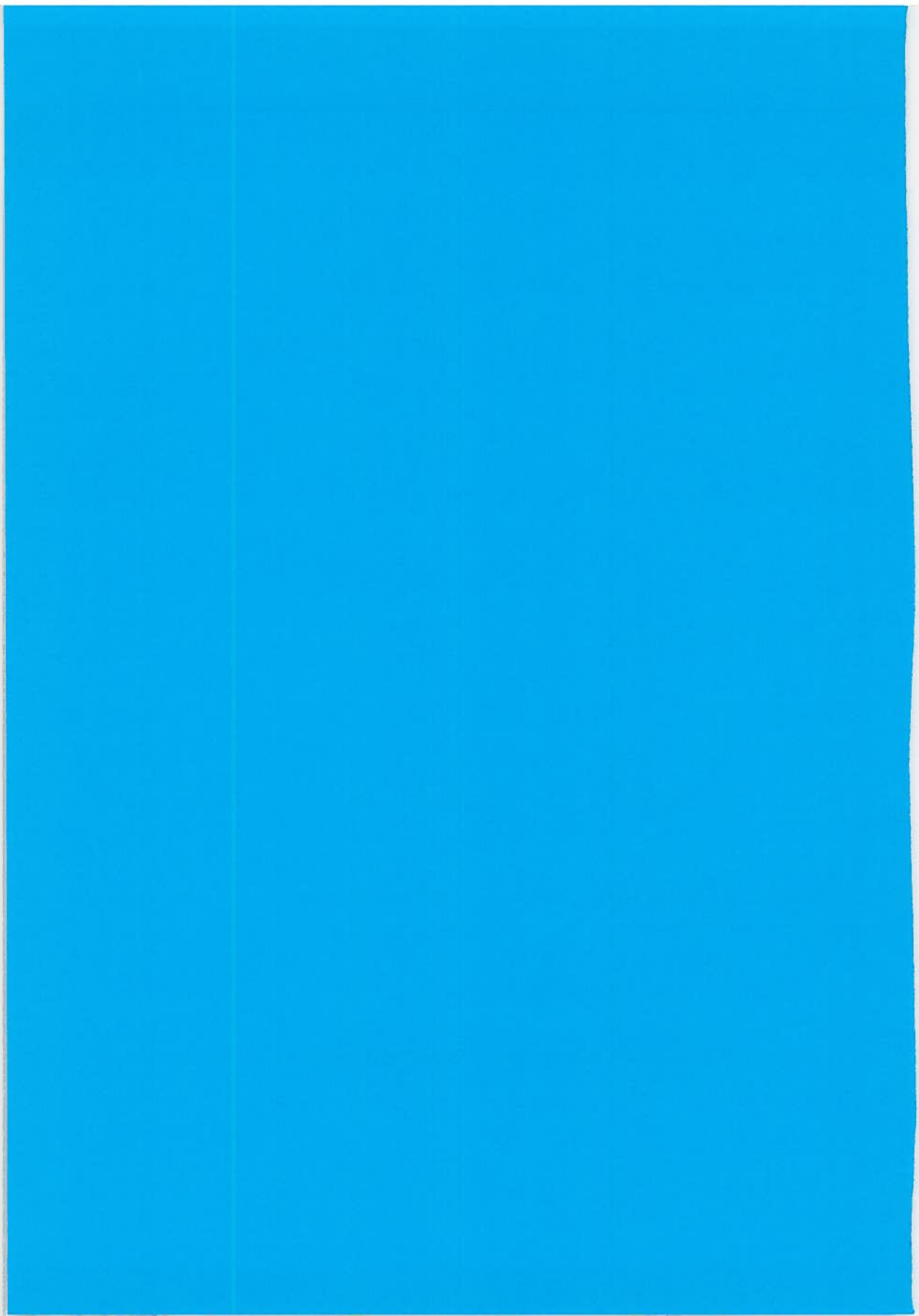
Have one or more of your parents or siblings had a heart attack or had angina (heart cramp)?

YES	NO	DON'T KNOW
☐	☐	☐

Appendix 5

Questionnaire II (subjects aged <70 years) Tromsø Study 1994-1995

Original Norwegian version and English translation



Helseundersøkelsen i Tromsø

Hovedformålet med Tromsøundersøkelsene er å skaffe ny kunnskap om hjerte-karsykdommer for å kunne forebygge dem. I tillegg skal undersøkelsen øke kunnskapen om kreftsykdommer og andre alminnelige plager som f.eks. allergier, smerter i muskulatur og nervøse lidelser. Vi ber deg derfor svare på noen spørsmål om forhold som kan ha betydning for risikoen for disse og andre sykdommer.

Skjemaet er en del av Helseundersøkelsen som er godkjent av Datatilsynet og av Regional komite for medisinsk forskningsetikk. Svarene brukes bare til forskning og behandles strengt fortrolig. Opplysningene kan senere bli sammenholdt med informasjon fra andre offentlige helseregistre etter de regler som Datatilsynet og Regional komite for medisinsk forskningsetikk gir.

Hvis du er i tvil om hva du skal svare, sett kryss i den ruten som du synes passer best.

Det utfylte skjema sendes i vedlagte svarkonvolutt. Portoen er betalt.

På forhånd takk for hjelpen!

Med vennlig hilsen

Fagområdet medisin
Universitetet i Tromsø **Statens helseundersøkelser**

Hvis du ikke ønsker å besvare spørreskjemaet, sett kryss i ruten under og returner skjemaet. Da slipper du purring.

Jeg ønsker ikke å besvare spørreskjemaet ..... 17 ☐

Dato for utfylling av skjema: ..... 18 Dag ...../ Mnd ...../ År .....

OPPVEKST

I hvilken kommune bodde du da du fylte 1 år?

..... 24-28

Hvis du ikke bodde i Norge, oppgi land i stedet for kommune.

Hvordan var de økonomiske forhold i familien under din oppvekst?

- Meget gode ..... 29 ☐ 1
- Gode ☐ 2
- Vanskelige ☐ 3
- Meget vanskelige ☐ 4

Hvor mange av de første 3 årene av ditt liv
- bodde du i by? ..... 30 _____ år
- hadde dere katt eller hund i hjemmet? ..... 31 _____ år

Hvor mange av de første 15 årene av ditt liv
- bodde du i by? ..... 32 _____ år
- hadde dere katt eller hund i hjemmet? ..... 34 _____ år

BOLIG

Hvem bor du sammen med?
Sett ett kryss for hvert spørsmål og angi antall

		Ja	Nei	Antall
Ektefelle/samboer	36	☐	☐	
Andre personer over 18 år	37	☐	☐	_____
Personer under 18 år	40	☐	☐	_____

Hvor mange av barna har plass i barnehage? ..... 43 _____

Hvilken type bolig bor du i?
- Enebolig/villa ..... 45 ☐ 1
- Gårdsbruk ☐ 2
- Blokk/terrasseleilighet ☐ 3
- Rekkehus/2-4 mannsbolig ☐ 4
- Annen bolig ☐ 5

Hvor stor er din boenhet? ..... 46 _____ m²

I omtrent hvilket år ble boligen bygget? ..... 49 _____

		Ja	Nei
Er boligen isolert etter 1970?	53	☐	☐
Bor du i underetasje/kjeller?	54	☐	☐
Hvis "Ja", er gulvbelegget lagt på betong?	55	☐	☐

Hvordan er boligen hovedsakelig oppvarmet?
- Elektrisk oppvarming ..... 56 ☐
- Vedfyring ☐
- Sentralvarmeanlegg oppvarmet med:
  - Parafin ☐
  - Elektrisitet ☐

		Ja	Nei
Er det heldekkende tepper i stua?	60	☐	☐
Er det katt i boligen?	61	☐	☐
Er det hund i boligen?	62	☐	☐

ARBEID

Hvis du er i lønnet eller ulønnet arbeid, hvordan vil du beskrive ditt arbeid?
- For det meste stillesittende arbeid? ..... 63 ☐ 1
  (f.eks. skrivebordsarbeid, montering)
- Arbeid som krever at du går mye? ☐ 2
  (f.eks. ekspeditorarb., lett industriarb., undervisning)
- Arbeid hvor du går og løfter mye? ☐ 3
  (f.eks. postbud, pleier, bygningsarbeid)
- Tungt kroppsarbeid? ☐ 4
  (f.eks. skogsarb., tungt jordbruksarb., tungt bygn.arb.)

Kan du selv bestemme hvordan arbeidet ditt skal legges opp?
- Nei, ikke i det hele tatt ..... 64 ☐ 1
- I liten grad ☐ 2
- Ja, i stor grad ☐ 3
- Ja, det bestemmer jeg selv ☐ 4

		Ja	Nei
Har du skiftarbeid, nattarbeid eller går vakter?	65	☐	☐

Har du noen av følgende yrker (heltid eller deltid)?
Sett ett kryss for hvert spørsmål

		Ja	Nei
Sjåfør	66	☐	☐
Bonde/gårdbruker		☐	☐
Fisker		☐	☐

EGNE SYKDOMMER

Har du noen gang hatt
Sett ett kryss for hvert spørsmål. Oppgi alderen ved hendelsen.
*Hvis det har skjedd flere ganger, hvor gammel var du **siste** gang?*

		Ja	Nei	Alder
Lårhalsbrudd	69	☐	☐	
Brudd ved håndledd/underarm	72	☐	☐	
Nakkesleng (whiplash)	75	☐	☐	
Skade som førte til sykehusinnleggelse	78	☐	☐	
Sår på magesekken	81	☐	☐	
Sår på tolvfingertarmen	84	☐	☐	
Magesår-operasjon	87	☐	☐	
Operasjon på halsen	90	☐	☐	

Har du eller har du hatt:
Sett ett kryss for hvert spørsmål.

		Ja	Nei
Kreftsykdom	93	☐	☐
Epilepsi (fallesyke)		☐	☐
Migrene		☐	☐
Kronisk bronkitt		☐	☐
Psoriasis		☐	☐
Benskjørhet (osteoporose)	98	☐	☐
Fibromyalgi/fibrositt/kronisk smertesyndrom		☐	☐
Psykiske plager som du har søkt hjelp for		☐	☐
Stoffskiftesykdom (skjoldbruskkjertel)		☐	☐
Sykdom i leveren		☐	☐
Nyrestein	103	☐	☐
Blindtarmsoperasjon		☐	☐
Allergi og overfølsomhet			
Alopisk eksem (f.eks. barneeksem)		☐	☐
Håndeksem		☐	☐
Høysnue		☐	☐
Matvareallergi	108	☐	☐
Annen overfølsomhet (ikke allergi)		☐	☐

Hvor mange ganger har du hatt forkjølelse, influensa, "ræksjuka" og lignende siste halvår? 110 _____ ganger

		Ja	Nei
Har du hatt dette siste 14 dager?	112	☐	☐

SYKDOM I FAMILIEN

Kryss av for de slektningene som har eller har hatt noen av sykdommene:
Kryss av for "Ingen" hvis ingen av slektningene har hatt sykdommen.

		Mor	Far	Bror	Søster	Barn	Ingen
Hjerneslag eller hjerneblødning	113	☐	☐	☐	☐	☐	☐
Hjerteinfarkt før 60 års alder	119	☐	☐	☐	☐	☐	☐
Kreftsykdom	125	☐	☐	☐	☐	☐	☐
Astma	131	☐	☐	☐	☐	☐	☐
Mage/tolvfingertarm-sår	137	☐	☐	☐	☐	☐	☐
Benskjørhet (osteoporose)	143	☐	☐	☐	☐	☐	☐
Psykiske plager	149	☐	☐	☐	☐	☐	☐
Allergi	155	☐	☐	☐	☐	☐	☐
Diabetes (sukkersyke)	161	☐	☐	☐	☐	☐	☐
– alder da de fikk diabetes	167	___	___	___	___	___	

SYMPTOMER

		Ja	Nei
Hoster du omtrent daglig i perioder av året?	177	☐	☐
Hvis "Ja":			
Er hosten vanligvis ledsaget av oppspytt?	176	☐	☐
Har du hatt slik hoste så lenge som i en 3 måneders periode i begge de to siste år?	179	☐	☐
Har du hatt episoder med piping i brystet?	180	☐	☐
Hvis "Ja", har dette oppstått:			
Sett ett kryss for hvert spørsmål.			
Om natten	181	☐	☐
Ved luftveisinfeksjoner		☐	☐
Ved fysiske anstrengelser		☐	☐
Ved sterk kulde		☐	☐
Har du merket anfall med plutselig endring i pulsen eller hjerterytmen siste år?	185	☐	☐

Hvor ofte er du plaget av søvnløshet?

Aldri, eller noen få ganger i året	186	☐ 1
1-2 ganger i måneden		☐ 2
Omtrent en gang i uken		☐ 3
Mer enn en gang i uken		☐ 4

Hvis du er plaget av søvnløshet i perioder, når på året er du mest plaget?

Ingen spesiell tid	187	☐ 1
Særlig i mørketiden		☐ 2
Særlig i midnattsoltiden		☐ 3
Særlig vår og høst		☐ 4

		Ja	Nei
Har du det siste året vært plaget av søvnløshet slik at det har gått ut over arbeidsevnen?	188	☐	☐

Hvor ofte er du plaget av hodepine?

Sjelden eller aldri	189	☐ 1
En eller flere ganger i måneden		☐ 2
En eller flere ganger i uken		☐ 3
Daglig		☐ 4

Hender det at tanken på å få alvorlig sykdom bekymrer deg?

Ikke i det hele tatt	190	☐ 1
Bare i liten grad		☐ 2
En del		☐ 3
Ganske mye		☐ 4

BRUK AV HELSEVESENET

Hvor mange ganger har du siste året, på grunn av egen helse eller sykdom, vært:
*Sett **0** hvis du **ikke** har hatt slik kontakt.*

		Antall ganger siste år
Hos vanlig lege/legevakt	191	
Hos psykolog eller psykiater		
Hos annen legespesialist utenfor sykehus		
På poliklinikk	197	
Innlagt i sykehus		
Hos bedriftslege		
Hos fysioterapeut	203	
Hos kiropraktor		
Hos akupunktor		
Hos tannlege	209	
Hos naturmedisiner (homøopat, soneterapeut o.l.)		
Hos håndspålegger, synsk eller "leser"		

LEGEMIDLER OG KOSTTILSKUDD

Har du det siste året periodevis brukt noen av de følgende midler daglig eller nesten daglig?
Angi hvor mange måneder du brukte dem.
*Sett 0 hvis du **ikke** har brukt midlene.*

Legemidler
- Smertestillende ..... 215 _____ mnd.
- Sovemedisin ..... _____ mnd.
- Beroligende midler ..... _____ mnd.
- Medisin mot depresjon ..... 231 _____ mnd.
- Allergimedisin ..... _____ mnd.
- Astmamedisin ..... _____ mnd.

Kosttilskudd
- Jerntabletter ..... 227 _____ mnd.
- Kalktabletter eller benmel ..... _____ mnd.
- Vitamin D-tilskudd ..... _____ mnd.
- Andre vitamintilskudd ..... 233 _____ mnd.
- Tran eller fiskeoljekapsler ..... _____ mnd.

Har du de siste 14 dager brukt følgende legemidler eller kosttilskudd?
*Sett **ett** kryss for **hvert** spørsmål.*

	Ja	Nei
Legemidler		
Smertestillende medisin 237	☐	☐
Febersenkende medisin	☐	☐
Migrenemedisin	☐	☐
Eksemsalve	☐	☐
Hjertemedisin (ikke blodtrykksmedisin)	☐	☐
Kolesterolsenkende medisin 242	☐	☐
Sovemedisin	☐	☐
Beroligende medisin	☐	☐
Medisin mot depresjon	☐	☐
Annen nervemedisin	☐	☐
Syrenøytraliserende midler 247	☐	☐
Magesårsmedisin	☐	☐
Insulin	☐	☐
Tabletter mot diabetes (sukkersyke)	☐	☐
Tabletter mot lavt stoffskifte (thyroxin)	☐	☐
Kortisontabletter 252	☐	☐
Annen medisin	☐	☐
Kosttilskudd		
Jerntabletter	☐	☐
Kalktabletter eller benmel	☐	☐
Vitamin D-tilskudd	☐	☐
Andre vitamintilskudd 257	☐	☐
Tran eller fiskeoljekapsler	☐	☐

VENNER

Hvor mange gode venner har du som du kan snakke fortrolig med og gi deg hjelp når du trenger det? ..... 259 ____ gode venner
Tell ikke med de du bor sammen med, men ta med andre slektninger!

Hvor mange av disse gode vennene har du kontakt med minst en gang i måneden? ..... 261 ____

	Ja	Nei
Føler du at du har nok gode venner? 263	☐	☐

Hvor ofte tar du vanligvis del i foreningsvirksomhet som f.eks. syklubb, idrettslag, politiske lag, religiøse eller andre foreninger?
- Aldri, eller noen få ganger i året ..... 264 ☐ 1
- 1-2 ganger i måneden ..... ☐ 2
- Omtrent en gang i uken ..... ☐ 3
- Mer enn en gang i uken ..... ☐ 4

KOSTVANER

Hvis du bruker smør eller margarin på brødet, hvor mange skiver rekker en liten porsjonspakning vanligvis til? Vi tenker på slik porsjonspakning som du får på fly, på kafé o.l. (10-12 gram).

Den rekker til omtrent ..... 265 _____ skiver

Hva slags fett blir vanligvis brukt til **matlaging** (ikke på brødet) i din husholdning?
- Meierismør ..... 268 ☐
- Hard margarin ..... ☐
- Bløt (Soft) margarin ..... ☐
- Smør/margarin blanding ..... ☐
- Oljer ..... 270 ☐

Hva slags type brød (kjøpt eller hjemmebakt) spiser du vanligvis?
Sett ett eller to kryss!

	Loff	Fint brød	Kneip-brød	Grov-brød	Knekke-brød
Brødtypen ligner mest på:	☐ 271	☐	☐	☐	☐ 275

Hvor mye (i **antall** glass, kopper, poteter eller brødskiver) spiser eller drikker du vanligvis **daglig** av følgende matvarer?
*Kryss av for **alle** matvarene.*

	0	Færre enn 1	1-2	3-4	5-6	Mer enn 6
Helmelk (søt eller sur) (glass) 276	☐	☐	☐	☐	☐	☐
Lettmelk (søt eller sur) (glass)	☐	☐	☐	☐	☐	☐
Skummet melk (søt eller sur) (glass)	☐	☐	☐	☐	☐	☐
Te (kopper)	☐	☐	☐	☐	☐	☐
Appelsinjuice (glass)	☐	☐	☐	☐	☐	☐
Poteter 281	☐	☐	☐	☐	☐	☐
Brødskiver totalt (inkl. knekkebrød)	☐	☐	☐	☐	☐	☐
Brødskiver med						
– fiskepålegg (f.eks. makrell i tomat)	☐	☐	☐	☐	☐	☐
– magert kjøttpålegg (f.eks. skinke)	☐	☐	☐	☐	☐	☐
– fetere kjøttpålegg (f.eks. salami)	☐	☐	☐	☐	☐	☐
– gulost 286	☐	☐	☐	☐	☐	☐
– brunost	☐	☐	☐	☐	☐	☐
– kaviar	☐	☐	☐	☐	☐	☐
– syltetøy og annet søtt pålegg	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

Hvor mange **ganger i uka** spiser du vanligvis følgende matvarer?
*Kryss av for **alle** matvarene.*

	Aldri	Færre enn 1	1	2-3	4-5	Omtrent daglig
Yoghurt 290	☐	☐	☐	☐	☐	☐
Kokt eller stekt egg	☐	☐	☐	☐	☐	☐
Frokostblanding/havregryn o.l.	☐	☐	☐	☐	☐	☐
Middag med						
– rent kjøtt	☐	☐	☐	☐	☐	☐
– pølser/kjøttpudding/-kaker	☐	☐	☐	☐	☐	☐
– feit fisk (f.eks. laks/uer) 295	☐	☐	☐	☐	☐	☐
– mager fisk (f.eks. torsk)	☐	☐	☐	☐	☐	☐
– fiskeboller/-pudding/-kaker	☐	☐	☐	☐	☐	☐
– grønnsaker	☐	☐	☐	☐	☐	☐
Majones, remulade o.l.	☐	☐	☐	☐	☐	☐
Gulrøtter 300	☐	☐	☐	☐	☐	☐
Blomkål/kål/brokkoli	☐	☐	☐	☐	☐	☐
Epler/pærer	☐	☐	☐	☐	☐	☐
Appelsiner, mandariner o.l.	☐	☐	☐	☐	☐	☐
Sukkerholdige leskedrikker	☐	☐	☐	☐	☐	☐
Sukkerfrie («Light») leskedrikker	☐	☐	☐	☐	☐	☐
Sjokolade	☐	☐	☐	☐	☐	☐
Vafler, kaker o.l. 307	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

ALKOHOL

Hvor ofte pleier du å drikke	øl?	vin?	brennevin?
Aldri, eller noen få ganger i året	☐ 1	☐ 1	☐ 1
1-2 ganger i måneden	☐ 2	☐ 2	☐ 2
Omtrent 1 gang i uken	☐ 3	☐ 3	☐ 3
2-3 ganger i uken	☐ 4	☐ 4	☐ 4
Omtrent hver dag	☐ 5	☐ 5	☐ 5
	308	309	310

Omtrent hvor ofte har du i løpet av siste år drukket alkohol tilsvarende minst 5 halvflasker øl, en helflaske vin eller 1/4 flaske brennevin?

- Ikke siste år ..... 311 ☐ 1
- Noen få ganger ☐ 2
- 1 - 2 ganger per måned ☐ 3
- 1 - 2 ganger i uken ☐ 4
- 3 eller flere ganger i uken ☐ 5

I omtrent hvor mange år har ditt alkoholforbruk vært slik du har svart i spørsmålene over? ..... 312 _____ år

SLANKING

Omtrent hvor mange ganger har du bevisst prøvd å slanke deg? Sett 0 hvis ingen forsøk.

- før 20 år ..... 314 _____ ganger
- senere ..... 316 _____ ganger

Hvis du har slanket deg, omtrent hvor mange kilo har du på det meste gått ned i vekt?

- før 20 år ..... 316 _____ kg
- senere ..... 320 _____ kg

Hvilken vekt ville du være tilfreds med (din "trivselsvekt")? ..... 22 _____ kg

UFRIVILLIG URINLEKKASJE

Hvor ofte har du ufrivillig urinlekkasje?

- Aldri ..... 325 ☐ 1
- Ikke mer enn en gang i måneden ☐ 2
- To eller flere ganger i måneden ☐ 3
- Ukentlig eller oftere ☐ 4

Dine kommentarer:

BESVARES BARE AV KVINNER

MENSTRUASJON

Hvor gammel var du da du fikk menstruasjon første gang? ..... 325 _____ år

Hvis du ikke lenger har menstruasjon, hvor gammel var du da den sluttet? ..... 328 _____ år

Når du ser bort fra svangerskap og barselsperiode, har du noen gang vært blødningsfri i minst 6 måneder? ..... 330 Ja ☐ Nei ☐

Hvis "Ja", hvor mange ganger? ..... 331 _____ ganger

Hvis du fremdeles har menstruasjon eller er gravid: dag/ mnd/ år

Hvilken dato startet din siste menstruasjon? ..... 333 ___/___/___

Bruker du vanligvis smertestillende legemidler for å dempe menstruasjonsplager? ..... 339 Ja ☐ Nei ☐

SVANGERSKAP

Hvor mange barn har du født? ..... 340 _____ barn

Er du gravid nå? ..... 342 Ja ☐ Nei ☐ Usikker ☐

Har du i forbindelse med svangerskap hatt for høyt blodtrykk og/eller eggehvite (protein) i urinen? ..... 343 Ja ☐ Nei ☐

Hvis "Ja", i hvilket svangerskap?

	Svangerskap: Første	Senere
For høyt blodtrykk 344	☐	☐
Eggehvite i urinen 345	☐	☐

Hvis du har født, fyll ut for hvert barn barnets fødselsår og omtrent antall måneder du ammet barnet.

Barn:		Fødselsår:	Antall måneder med amming:
1	348	_____	_____
2		_____	_____
3	356	_____	_____
4		_____	_____
5	364	_____	_____
6		_____	_____

PREVENSJON OG ØSTROGEN

Bruker du, eller har du brukt:	Nå	Før	Aldri
P-pille (også minipille) 372	☐	☐	☐
Hormonspiral	☐	☐	☐
Østrogen (tabletter eller plaster) 374	☐	☐	☐
Østrogen (krem eller stikkpiller)	☐ 1	☐ 2	☐ 3

Hvis du bruker p-pille, hormonspiral eller østrogen: hvilket merke bruker du nå?

376 .....

Hvis du bruker eller har brukt p-pille:

Alder da du begynte med P-piller? ..... 380 _____ år

Hvor mange år har du tilsammen brukt P-piller? ..... 382 _____ år

Dersom du har født, hvor mange år brukte du P-piller før første fødsel? ..... 384 _____ år

Hvis du har sluttet å bruke P-piller:

Alder da du sluttet? ..... 386 _____ år

Takk for hjelpen! Husk å postlegge skjemaet idag!

Helseundersøkelsen i Tromsø

English translation of the second questionnaire used in the health survey in Tromsø 1994/95 for subjects younger than 70 years.

Based on translations by K. McCafferty and A. Clancy

TROMSØ HEALTH SURVEY

The main aim of the Tromsø survey is to improve our knowledge of heart and circulatory conditions in order to aid prevention. The survey is also intended to improve our knowledge of cancer and other general conditions, such as allergies, muscle pains and nervous conditions. We would therefore like you to answer some questions about factors that may be relevant for your risk of getting these and other illnesses.

This form is part of the Health Survey, which has been approved by the Norwegian Data Inspectorate and the Regional Board of Research Ethics. The answers will only be used for research purposes and will be treated in strict confidence. The information you give us may later be stored along with information from other public health registers in accordance with the rules laid down by the Data Inspectorate and the Regional Board of Research Ethics.

If you are unsure about what to answer, tick the box that you feel fits best.

The completed form should be sent to us in the enclosed pre-paid envelope.

Thank you in advance for helping us.

Yours sincerely,

Faculty of Medicine
University of Tromsø

National Health
Screening Service

If you do not wish to answer the questionnaire, tick the box below and return the form. Then you will not receive reminders.

I do not wish to answer the questionnaire. ☐

Date for filling in this form: Day/Month/Year

CHILDHOOD/YOUTH

What Norwegian municipality did you live in at the age of 1 year? _____

If you did not live in Norway, give country of residence instead of municipality.

How was your family's economic situation while you were growing up?

- Very good ☐
- Good ☐
- Difficult ☐
- Very difficult ☐

For how much of the first three years of your life
- did you live in a town/city? ____ Years
- did your family have a cat or dog in the home? ____ Years

For how much of the first 15 years of your life
- did you live in a town/city? ____ Years
- did your family have a cat or dog in the home? ____ Years

HOME

Who do you live with?
Tick once for each item and give the number of persons.

	YES	NO	Number
Spouse/partner	☐	☐	_____
Other persons over 18 years	☐	☐	_____
Persons under 18 years	☐	☐	_____

How many of the children go to day care/kindergarten/ nursery school? ____

What type of home do you live in?

- Villa/ detached house ☐
- Farm ☐
- Flat / Apartment ☐
- Terraced /semi-detached house ☐
- Other ☐

How big is your home? _____ m2

Approximately what year was your home built? _____

	YES	NO
Has your home been insulated after 1970?	☐	☐
Do you live on the bottom floor/cellar level?	☐	☐
If "YES", is the floor laid on concrete?	☐	☐

What is the main source of heat in your home?

- Electric heating ☐
- Wood-burning stove ☐
- Central heating system using:
  - Paraffin ☐
  - Electricity ☐

	YES	NO
Do you have fitted carpets in the living-room?	☐	☐
Is there a cat in your home?	☐	☐
Is there a dog in your home?	☐	☐

WORK

If you are in paid or unpaid work, which statement describes your work best?

- I am mainly seated while working (*e.g., at a desk/assembly work*) ☐
- My work requires a lot of walking (*e.g., shop assistant, light industrial work, teaching*) ☐
- My work entails a lot of walking and lifting (*e.g., postman/woman, nurse, building work*) ☐
- I do heavy physical work (*e.g., forestry, heavy agricultural/construction work*) ☐

Do you have any influence on how your work is organised?

- No, not at all ☐
- To a small extent ☐
- Yes, to a large extent ☐
- Yes, I decide myself ☐

	YES	NO
Are you on call; do you work shifts or nights?	☐	☐

Do you do any of the following jobs (full- or part-time)?

Tick one box only for each item.	YES	NO
Driver	☐	☐
Farmer	☐	☐
Fisherman	☐	☐

YOUR OWN ILLNESSES

Have you ever had:

Tick one box only for each item. Give your age at the time. If you have had the condition several times, how old were you last time?

	YES	NO	AGE
Hip fracture	☐	☐	____
Wrist/forearm fracture	☐	☐	____
Whiplash	☐	☐	____
Injury requiring hospital admission	☐	☐	____
Stomach ulcer	☐	☐	____
Duodenal ulcer	☐	☐	____
An operation for stomach/ duodenal ulcer	☐	☐	____
Throat/ neck operation	☐	☐	____

Have you you ever had, or do you still have:

Tick one box only for each item.	YES	NO
Cancer	☐	☐
Epilepsy	☐	☐
Migraine	☐	☐
Chronic bronchitis	☐	☐
Psoriasis	☐	☐
Osteoporosis	☐	☐
Fibromyalgia/fibrositis/ chronic pain syndrome	☐	☐
Psychological problems for which you have sought help	☐	☐
Thyroid disease	☐	☐
Liver disease	☐	☐
Kidney stone	☐	☐
Appendectomy	☐	☐
Allergy and hypersensitivity:		
Atopic eczema (e.g., childhood eczema)	☐	☐
Hand eczema	☐	☐
Hay fever	☐	☐
Food allergy	☐	☐
Other hypersensitivity (not allergy)	☐	☐

How many times have you had a cold, influenza (flue), vomiting/diarrhoea, or similar in the last six months?

_____ times

Have you had any of these in the last two weeks?

YES	NO
☐	☐

ILLNESS IN THE FAMILY

Tick the appropriate box for relatives that have, or have ever had the following illnesses: *Tick "None" if none of your relatives have had the condition.*

	Mother	Father	Brother	Sister	Child	None
Stroke or brain haemorrhage	☐	☐	☐	☐	☐	☐
Myocardial infarction before age 60	☐	☐	☐	☐	☐	☐
Cancer	☐	☐	☐	☐	☐	☐
Asthma	☐	☐	☐	☐	☐	☐
Stomach/ duodenal ulcer	☐	☐	☐	☐	☐	☐
Osteoporosis	☐	☐	☐	☐	☐	☐
Psychological problems	☐	☐	☐	☐	☐	☐
Allergy	☐	☐	☐	☐	☐	☐
Diabetes	☐	☐	☐	☐	☐	☐
-age when they got diabetes	___	___	___	___	___	___

SYMPTOMS

	YES	NO
Do you cough approximately every day of the year?	☐	☐
If "Yes": Is your cough productive ?	☐	☐
Have you had this kind of cough for as long as 3 months in each of the last two years?	☐	☐
Have you had periods of wheezing in your chest?	☐	☐
If "Yes", has this occurred: *Tick one box only for each item.*		
At night	☐	☐
In connection with respiratory infections	☐	☐
In connection with physical exertion	☐	☐
In connection with very cold weather	☐	☐
Have you noticed sudden changes in your pulse or heart rhythm in the last year?	☐	☐

How often do you suffer from sleeplessness?

- Never, or just a few times a year ☐
- 1-2 times a month ☐
- Approximately once a week ☐
- More than once a week ☐

If you suffer from periods of sleeplessness, what times of the year does it affect you most?

- No particular time of year ☐
- Especially during the dark winter months ☐
- Especially during the midnight sun period ☐
- Especially in spring and autumn ☐

Have you in the last twelve months suffered from sleeplessness to the extent that it has affected your ability to work? YES ☐ NO ☐

How often do you suffer from headaches?

- Seldom/Never ☐
- Once a month or more ☐
- Once a week or more ☐
- Every day ☐

Does the thought of getting a serious illness ever worry you?

- Not at all ☐
- Only a little ☐
- Some ☐
- Very much ☐

USE OF HEALTH SERVICES

How many visits have you made during the past year due to your own health or illness? *Tick **0** if you have **not** had such contact*

	Number of times the past year
To a general practitioner (GP)/ Emergency GP	_____
Psychologist or psychiatrist	_____
Other medical specialist (not at a hospital)	_____
Hospital out-patient clinic	_____
Hospital admission	_____
Medical officer at work	_____
Physiotherapist	_____
Chiropractor	_____
Acupuncturist	_____
Dentist	_____
Alternative medical practitioner (homoeopath, foot zone therapist, etc.)	_____
Healer, Faith healer, clairvoyant	_____

MEDICATION AND DIETARY SUPPLEMENTS

Have you for any length of time in the past year used any of the following medicines every day or almost daily? Indicate how many months you used them for. *Write **0** for items you have **not** used.*

Medication:

- Painkillers _____ mths
- Sleeping pills _____ mths
- Tranquilizers _____ mths
- Antidepressants _____ mths
- Allergy drugs _____ mths
- Asthma drugs _____ mths

Dietary supplements

- Iron tablets _____ mths
- Calcium tablets or bonemeal _____ mths
- Vitamin D supplement _____ mths
- Other vitamin supplements _____ mths
- Cod liver oil or fish oil capsules _____ mths

Have you in the last 14 days used the following medicines or dietary supplements? *Tick **one** box only for **each** item.*

Medicines	YES	NO
Painkillers	☐	☐
Antipyretic drugs (to reduce fever)	☐	☐
Migraine drugs	☐	☐
Eczema cream/ointment	☐	☐
Heart medicine (not blood pressure)	☐	☐
Lipid lowering drugs	☐	☐
Sleeping pills	☐	☐
Tranquilizers	☐	☐
Antidepressants	☐	☐
Other drugs for nervous conditions	☐	☐
Antacids	☐	☐
Gastric ulcer drugs	☐	☐
Insulin	☐	☐
Diabetes tablets	☐	☐
Thyroxin tablets (for metabolic disorder)	☐	☐
Cortisone tablets	☐	☐
Other medicine(s)	☐	☐

Dietary supplements	YES	NO
Iron tablets	☐	☐
Calcium tablets or bonemeal	☐	☐
Vitamin D supplement	☐	☐
Other vitamin supplements	☐	☐
Cod liver oil or fish oil capsules	☐	☐

FRIENDS

How many good friends do you have whom you can talk confidentially with and who give you help when you need it? _____ good friends

Do not count people you live with, but do include other relatives!

How many of these good friends do you have contact with at least once a month? _____

Do you feel you have enough good friends? YES ☐ NO ☐

How often do you normally take part in organised gatherings, e.g., sewing circles, sports clubs, political meetings, religious or other associations?

- Never, or just a few times a year ☐
- 1-2 times a month ☐
- Approximately once a week ☐
- More than once a week ☐

DIET

If you use butter or margarine on your bread, how many slices does a small catering portion normally cover? By this, we mean the portion packs served on planes, in cafés, etc. (i.e., 10-12g)

A catering portion is enough for about ____ slices.

What kind of fat is normally used in **cooking** (not on the bread) in your home?

- Creamery butter ☐
- Hard margarine ☐
- Soft margarine ☐
- Butter/margarine blend ☐
- Oils ☐

What kind of bread (bought or home-made) do you usually eat? *Tick one or two boxes!*

The bread I eat is most similar to

- White bread ☐
- Light textured brown bread ☐
- Ordinary brown bread ☐
- Coarse brown bread ☐
- Crisp bread ☐

How much (in **number** of glasses, cups, potatoes or slices) do you usually eat or drink **daily** of the following foodstuffs? *Tick one box for **each** foodstuff.*

	0	Less than 1	1-2	3-4	5-6	More than 6
Full cream milk (fresh or soured) (glasses)	☐	☐	☐	☐	☐	☐
Semi-skimmed milk (low-fat) (fresh or soured) (glasses)	☐	☐	☐	☐	☐	☐
Skimmed milk (fresh or soured) (glasses)	☐	☐	☐	☐	☐	☐
Tea (cups)	☐	☐	☐	☐	☐	☐
Orange juice (glasses)	☐	☐	☐	☐	☐	☐
Potatoes	☐	☐	☐	☐	☐	☐
Slices of bread in total (incl. crispbread)	☐	☐	☐	☐	☐	☐
Slices of bread with fish (e.g., mackerel in tomato sauce	☐	☐	☐	☐	☐	☐
- lean meat (e.g., ham)	☐	☐	☐	☐	☐	☐
- fat meat (e.g., salami)	☐	☐	☐	☐	☐	☐
- cheese (e.g. Gouda/ Norvegia)	☐	☐	☐	☐	☐	☐
- brown cheese	☐	☐	☐	☐	☐	☐
- smoked cod caviar	☐	☐	☐	☐	☐	☐
- jam and other sweet spreads	☐	☐	☐	☐	☐	☐

How many **times per week** do you normally eat the following foodstuffs? *Tick a box for **all** foodstuffs listed.*

	Never	Less than 1	1	2-3	4-5	Roughly every day
Yoghurt	☐	☐	☐	☐	☐	☐
Boiled or fried egg	☐	☐	☐	☐	☐	☐
Breakfast cereal/ oat meal, etc.	☐	☐	☐	☐	☐	☐
For dinner						
- meat	☐	☐	☐	☐	☐	☐
- sausage/meatloaf/ meatballs	☐	☐	☐	☐	☐	☐
- fat fish (e.g., salmon/ redfish)	☐	☐	☐	☐	☐	☐
- lean fish (e.g., cod)						
- fishballs/fishpudding/ fishcakes	☐	☐	☐	☐	☐	☐
- vegetables	☐	☐	☐	☐	☐	☐
Mayonnaise, remoulade	☐	☐	☐	☐	☐	☐
Carrots	☐	☐	☐	☐	☐	☐
Cauliflower/cabbage/ broccoli	☐	☐	☐	☐	☐	☐
Apples/pears	☐	☐	☐	☐	☐	☐
Oranges, mandarines	☐	☐	☐	☐	☐	☐
Sweetened soft drinks	☐	☐	☐	☐	☐	☐
Sugarfree ("Light") soft drinks	☐	☐	☐	☐	☐	☐
Chocolate	☐	☐	☐	☐	☐	☐
Waffles, cakes, etc.	☐	☐	☐	☐	☐	☐

ALCOHOL

How often do you usually drink	beer?	wine?	spirits?
Never, or just a few times a year	☐	☐	☐
1-2 times a month	☐	☐	☐
Roughly once a week	☐	☐	☐
2-3 times a week	☐	☐	☐
Roughly every day	☐	☐	☐

Approximately how often in the last year have you drunk alcohol that equals at least 5 small bottles of beer, a bottle of wine, or 1/4 bottle of spirits?

- Not in the last year ☐
- Just a few times ☐
- 1-2 times a month ☐
- 1-2 times a week ☐
- 3 or more times a week ☐

For approximately how many years has your alcohol consumption been as you described above? _____ years

WEIGHT REDUCTION

About how many times have you deliberately tried to lose weight? *Write 0 if you never have.*

- before age 20 _____ times
- after age 20 _____ times

If you have lost weight, about how many kilos have you ever lost at the most?

- before age 20 _____ times _____ kg
- after age 20 _____ times _____ kg

What weight would you be satisfied with (your "ideal weight")? _____ kg

URINARY INCONTINENCE

How often do you suffer from urinary incontinence?

Never	☐
Not more than once a month	☐
Two or more times a month	☐
Once a week or more	☐

Your comments:

Thank you for helping us! Remember to post the form today!

Tromsø Health Survey

TO BE ANSWERED BY WOMEN ONLY

MENSTRUATION

How old were you when you had your first menstruation? _____ years

If you no longer menstruate, how old were you when you stopped having menstruation? _____ years

Apart from pregnancy and after giving birth, have you ever stopped having menstruation for 6 months or more?

YES ☐ NO ☐

If "Yes", how many times? _____ times

If you still menstruate or are pregnant:

What date did your last menstruation begin?

day/month/year ___ / ___ / ___

Do you normally use painkillers to relieve period pains?

YES ☐ NO ☐

PREGNANCY

How many children have you given birth to? _____ children

Are you pregnant at the moment? YES ☐ NO ☐ Don't know ☐

During pregnancy, have you had high blood pressure and/or proteinuria? YES ☐ NO ☐

If "Yes", during which pregnancy?

	Pregnancy: First	Later
High blood pressure	☐	☐
Proteinuria	☐	☐

If you have given birth, fill out for each child the year of birth and approximately how many months you breastfed the child.

Child:	Year of birth:	Number of months breastfed:
1	_____	_____ months
2	_____	_____ months
3	_____	_____ months
4	_____	_____ months
5	_____	_____ months
6	_____	_____ months

CONTRACEPTION AND OESTROGEN

Do you, or have you ever, used:	Now	Used to	Never:
Contraceptive pills (incl.minipill)	☐	☐	☐
A hormonal intrauterine device	☐	☐	☐
Oestrogen (tablets or patches)	☐	☐	☐
Oestrogen (cream or suppositories)	☐	☐	☐

If you use contraceptive pills, hormonal intrauterine device, or oestrogen, what brand do you currently use?

_____

If you use, or have ever used, contraceptive pills:

Age when you began taking the pill? _____years

How many years in total have you taken the pill? _____years

If you have given birth, how many years did you take the pill before your first child? _____years

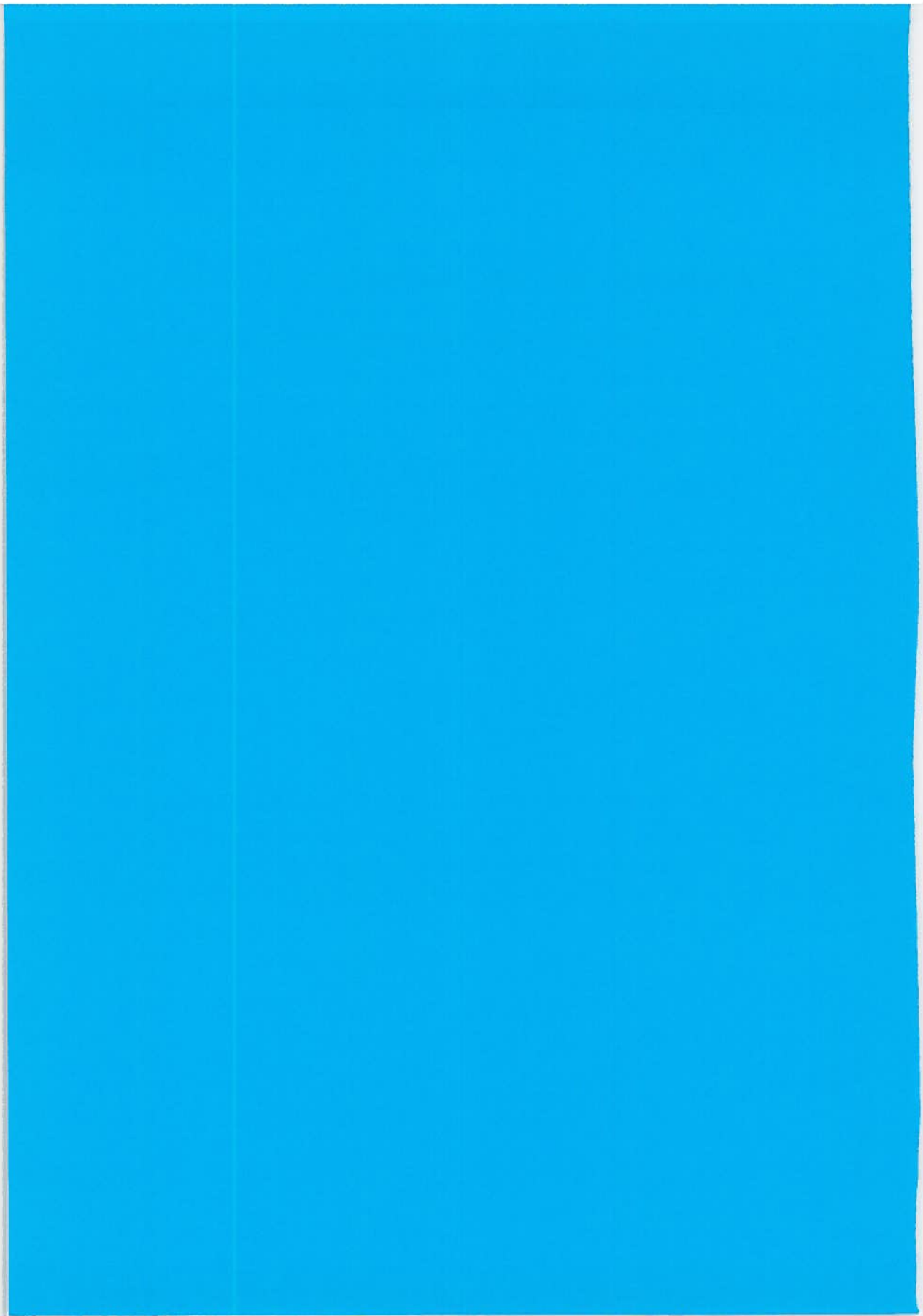
If you have stopped taking the pill:

Age when you stopped? _____years

Appendix 6

Questionnaire II (subjects aged ≥70 years) Tromsø Study 1994-1995

Original Norwegian version and English translation



Helseundersøkelsen i Tromsø

for dem som er 70 år og eldre.

Hovedformålet med Tromsøundersøkelsene er å skaffe ny kunnskap om hjerte-karsykdommer for å kunne forebygge dem. De skal også øke kunnskapen om kreftsykdommer og alminnelige plager som f.eks. allergier, smerter i muskulatur og nervøse lidelser. Endelig skal de gi kunnskap om hvorledes den eldste delen av befolkningen har det. Vi ber deg derfor svare på spørsmålene nedenfor.

Skjemaet er en del av Helseundersøkelsen som er godkjent av Datatilsynet og av Regional komite for medisinsk forskningsetikk. Svarene brukes bare til forskning og behandles strengt fortrolig. Opplysningene kan senere bli sammenholdt med informasjon fra andre offentlige helseregistre etter de regler som Datatilsynet og Regional komite for medisinsk forskningsetikk gir.

Hvis du er i tvil om hva du skal svare, sett kryss i den ruten som du synes passer best.

Det utfylte skjema sendes i vedlagte svarkonvolutt. Portoen er betalt.

På forhånd takk for hjelpen!

Med vennlig hilsen

Fagområdet medisin
Universitetet i Tromsø — Statens helseundersøkelser

Hvis du ikke ønsker å besvare spørreskjemaet, sett kryss i ruten under og returner skjemaet. Da slipper du purring.

Jeg ønsker ikke å besvare spørreskjemaet ..... 17 ☐

Dato for utfylling av skjema: ..... 18 Dag ...../ Mnd ...../ År .....

OPPVEKST

I hvilken kommune bodde du da du fylte 1 år?

..... 24-28

Hvis du ikke bodde i Norge, oppgi land i stedet for kommune.

Hvordan var de økonomiske forhold i familien under din oppvekst?

- Meget gode ..... 29 ☐ 1
- Gode ☐ 2
- Vanskelige ☐ 3
- Meget vanskelige ☐ 4

Hvor gamle ble dine foreldre?

- Mor ble ..... 30 _____ år
- Far ble ..... 32 _____ år

BOLIG

Hvem bor du sammen med?

Sett ett kryss for hvert spørsmål og angi antall.	Ja	Nei	Antall
Ektefelle/samboer 34	☐	☐	
Andre personer over 18 år 35	☐	☐	_____
Personer under 18 år 38	☐	☐	_____

Hvilken type bolig bor du i?

- Enebolig/villa ..... 41 ☐ 1
- Gårdsbruk ☐ 2
- Blokk/terrasseleilighet ☐ 3
- Rekkehus/2-4 mannsbolig ☐ 4
- Annen bolig ☐ 5

Hvor lenge har du bodd i boligen du bor i nå? ..... 42 _____ år

	Ja	Nei
Er boligen tilpasset til dine behov? 44	☐	☐
Hvis "Nei", er det problemer med:		
Plassen i boligen 45	☐	☐
Ujevn, for høy eller for lav temperatur 46	☐	☐
Trapper 47	☐	☐
Toalett 48	☐	☐
Bad/dusj 49	☐	☐
Vedlikehold 50	☐	☐
Annet (spesifiser) 51	☐	☐

Ønsker du å flytte til en eldrebolig? ..... 52 ☐ ☐

TIDLIGERE ARBEID OG ØKONOMI

Hvordan vil du beskrive det arbeidet du hadde de siste 5-10 årene før du ble pensjonist?

- For det meste stillesittende arbeid? ..... 53 ☐ 1
  (f.eks. skrivebordsarbeid, montering)
- Arbeid som krever at du går mye? ..... ☐ 2
  (f.eks. ekspeditørarbeid, husmor, undervisning)
- Arbeid hvor du går og løfter mye? ..... ☐ 3
  (f.eks. postbud, pleier, bygningsarbeid)
- Tungt kroppsarbeid? ..... ☐ 4
  (f.eks. skogsarb., tungt jordbruksarb., tungt bygn.arb.)

Har du hatt noen av følgende yrker (heltid eller deltid)?

Sett ett kryss for hvert spørsmål.	Ja	Nei
Sjåfør 54	☐	☐
Bonde/gårdbruker 55	☐	☐
Fisker 56	☐	☐

Hvor gammel var du da du ble pensjonert? ..... 57 _____ år

Hva slags pensjon har du?

- Minstepensjon ..... 59 ☐
- Tilleggspensjon ..... 60 ☐

Hvordan er din økonomi nå?

- Meget god ..... 61 ☐ 1
- God ☐ 2
- Vanskelig ☐ 3
- Meget vanskelig ☐ 4

HELSE OG SYKDOM

Er helsen din blitt forandret det siste året?
- Ja, dårligere 62 ☐ 1
- Nei, uforandret ☐ 2
- Ja, bedre ☐ 3

Hvordan synes du at helsen din er nå i forhold til andre på samme alder?
- Mye dårligere 63 ☐ 1
- Litt dårligere ☐ 2
- Omtrent lik ☐ 3
- Litt bedre ☐ 4
- Mye bedre ☐ 5

EGNE SYKDOMMER

Har du noen gang hatt:
Sett ett kryss for hvert spørsmål. Oppgi alderen ved hendelsen. Hvis det har skjedd flere ganger, hvor gammel var du siste gang?

	Ja	Nei	Alder
Lårhalsbrudd 64	☐	☐	_____
Brudd ved håndledd/underarm 67	☐	☐	_____
Nakkesleng (whiplash) 70	☐	☐	_____
Skade som førte til sykehusinnleggelse 73	☐	☐	_____
Sår på magesekken 76	☐	☐	_____
Sår på tolvfingertarmen 79	☐	☐	_____
Magesår-operasjon 82	☐	☐	_____
Operasjon på halsen 85	☐	☐	_____

Har du eller har du hatt:
Sett ett kryss for hvert spørsmål.

	Ja	Nei
Kreftsykdom 88	☐	☐
Epilepsi (fallesyke)	☐	☐
Migrene	☐	☐
Parkinsons sykdom	☐	☐
Kronisk bronkitt	☐	☐
Psoriasis 93	☐	☐
Benskjørhet (osteoporose)	☐	☐
Fibromyalgi/fibrositt/kronisk smertesyndrom	☐	☐
Psykiske plager som du har søkt hjelp for	☐	☐
Stoffskiftesykdom (skjoldbruskkjertel)	☐	☐
Sykdom i leveren 98	☐	☐
Gjentatt, ufrivillig urinlekkasje	☐	☐
Grønn stær	☐	☐
Grå stær	☐	☐
Siltasjegikt (artrose)	☐	☐
Leddgikt 103	☐	☐
Nyrestein	☐	☐
Blindtarmsoperasjon	☐	☐
Allergi og overfølsomhet		
Atopisk eksem (f.eks. barneeksem)	☐	☐
Håndeksem	☐	☐
Høysnue 108	☐	☐
Matvareallergi	☐	☐
Annen overfølsomhet (ikke allergi)	☐	☐

Hvor mange ganger har du hatt forkjølelse, influensa, "ræksjuka" og lignende siste halvår? 111 ____ ganger

	Ja	Nei
Har du hatt dette de siste 14 dager? 113	☐	☐

SYKDOM I FAMILIEN

Kryss av for de slektningene som har eller har hatt noen av sykdommene:
Kryss av for "Ingen" hvis ingen av slektningene har hatt sykdommen.

	Mor	Far	Bror	Søster	Barn	Ingen
Hjerneslag eller hjerneblødning 114	☐	☐	☐	☐	☐	☐
Hjerteinfarkt før 60 års alder 120	☐	☐	☐	☐	☐	☐
Kreftsykdom 126	☐	☐	☐	☐	☐	☐
Høyt blodtrykk 132	☐	☐	☐	☐	☐	☐
Astma 138	☐	☐	☐	☐	☐	☐
Benskjørhet (osteoporose) 144	☐	☐	☐	☐	☐	☐
Siltasjegikt (artrose) 150	☐	☐	☐	☐	☐	☐
Psykiske plager 156	☐	☐	☐	☐	☐	☐
Alderdomssløvhet 162	☐	☐	☐	☐	☐	☐
Diabetes (sukkersyke) 168	☐	☐	☐	☐	☐	☐
– alder da de fikk diabetes 174	__	__	__	__	__	

SYMPTOMER

	Ja	Nei
Hoster du omtrent daglig i perioder av året? 84	☐	☐
Hvis "Ja":		
Er hosten vanligvis ledsaget av oppspytt? 185	☐	☐
Har du hatt slik hoste så lenge som i en 3 måneders periode i begge de to siste år? 186	☐	☐
Har du hatt episoder med piping i brystet? 187	☐	☐
Hvis "Ja", har dette oppstått:		
Sett ett kryss for hvert spørsmål.		
Om natten 188	☐	☐
Ved luftvelsinfeksjoner	☐	☐
Ved fysiske anstrengelser	☐	☐
Ved sterk kulde 91	☐	☐
Har du merket anfall med plutselig endring i pulsen eller hjerterytmen siste år? 192	☐	☐
Har du gått ned i vekt siste året? 193	☐	☐
Hvis "Ja":		
Hvor mange kilo? 194	_____ kg	

Hvor ofte er du plaget av søvnløshet?
- Aldri, eller noen få ganger i året 196 ☐ 1
- 1-2 ganger i måneden ☐ 2
- Omtrent en gang i uken ☐ 3
- Mer enn en gang i uken ☐ 4

Hvis du er plaget av søvnløshet i perioder, når på året er du mest plaget?
- Ingen spesiell tid 197 ☐ 1
- Særlig i mørketiden ☐ 2
- Særlig i midnattsoltiden ☐ 3
- Særlig vår og høst ☐ 4

	Ja	Nei
Pleier du å ta en lur på dagen? 198	☐	☐
Føler du at du vanligvis får nok søvn?	☐	☐

Er du plaget av:	Nei	Litt	I stor grad
Svimmelhet 200	☐	☐	☐
Dårlig hukommelse	☐	☐	☐
Kraftløshet	☐	☐	☐
Forstoppelse 203	☐	☐	☐

Hender det at tanken på å få alvorlig sykdom bekymrer deg?

- Ikke i det hele tatt ..... 204 ☐
- Bare i liten grad ☐
- En del ☐
- Ganske mye ☐

LEGEMLIGE FUNKSJONER

Klarer du selv disse gjøremålene i det daglige uten hjelp fra andre?	Ja	Med noe hjelp	Nei
Gå innendørs i samme etasje 205	☐	☐	☐
Gå i trapper	☐	☐	☐
Gå utendørs	☐	☐	☐
Gå ca. 500 meter	☐	☐	☐
Gå på toalettet	☐	☐	☐
Vaske deg på kroppen 210	☐	☐	☐
Bade eller dusje	☐	☐	☐
Kle på og av deg	☐	☐	☐
Legge deg og stå opp	☐	☐	☐
Spise selv	☐	☐	☐
Lage varm mat 215	☐	☐	☐
Gjøre lett husarbeid (f.eks. oppvask)	☐	☐	☐
Gjøre tyngre husarbeid (f.eks. gulvvask)	☐	☐	☐
Gjøre innkjøp	☐	☐	☐
Ta bussen	☐	☐	☐

	Ja	Vanskelig	Nei
Kan du høre vanlig tale (evt. med høreapparat)? 220	☐	☐	☐
Kan du lese (evt. med briller)? 221	☐	☐	☐

Er du avhengig av noen av disse hjelpemidlene?

	Ja	Nei
Stokk 222	☐	☐
Krykke	☐	☐
Gåstol (rullator)	☐	☐
Rullestol	☐	☐
Høreapparat	☐	☐
Trygghetsalarm 227	☐	☐

BRUK AV HELSEVESENET

Hvor mange ganger har du siste året, på grunn av egen helse eller sykdom, vært: *Sett 0 hvis du ikke har hatt slik kontakt.*	Antall ganger siste år
Hos vanlig lege/legevakt 228	_____
Hos psykolog eller psykiater	_____
Hos annen legespesialist utenfor sykehus	_____
På poliklinikk 234	_____
Innlagt i sykehus	_____
Hos fysioterapeut	_____
Hos kiropraktor 240	_____
Hos akupunktør	_____
Hos tannlege	_____
Hos fotterapeut 246	_____
Hos naturmedisiner (homøopat, soneterapeut o.l.)	_____
Hos håndspålegger, synsk eller "leser"	_____

Har du hjemmehjelp?	Ja	Nei
Privat 252	☐	☐
Kommunal	☐	☐
Har du hjemmesykepleie?	☐	☐

Er du fornøyd med helse- og hjemmetjenesten i kommunen?	Ja	Nei	Vet ikke
Prinsippet med fast lege 255	☐	☐	☐
Hjemmesykepleien	☐	☐	☐
Hjemmehjelpen	☐	☐	☐

Er du trygg på at du kan få hjelp av helse- og hjemmetjenesten hvis du trenger det?

- Trygg ..... 258 ☐ 1
- Ikke trygg ☐ 2
- Svært utrygg ☐ 3
- Vet ikke ☐ 4

LEGEMIDLER OG KOSTTILSKUDD

Har du det siste året periodevis brukt noen av de følgende midler daglig eller nesten daglig? Angi hvor mange måneder du brukte dem.
Sett 0 hvis du ikke har brukt midlene.

Legemidler

Smertestillende 259	_____ mnd.
Sovemedisin	_____ mnd.
Beroligende midler	_____ mnd.
Medisin mot depresjon 265	_____ mnd.
Allergimedisin	_____ mnd.
Astmamedisin	_____ mnd.
Hjertemedisin (ikke blodtrykksmedisin) 271	_____ mnd.
Insulin	_____ mnd.
Tabletter mot diabetes (sukkersyke)	_____ mnd.
Tabletter mot lavt stoffskifte (thyroxin) 277	_____ mnd.
Kortisontabletter	_____ mnd.
Midler mot forstoppelse	_____ mnd.

Kosttilskudd

Jerntabletter 283	_____ mnd.
Vitamin C-tilskudd	_____ mnd.
Andre vitamintilskudd	_____ mnd.
Kalktabletter eller benmel 289	_____ mnd.
Tran eller fiskeoljekapsler	_____ mnd.

FAMILIE OG VENNER

Har du nær familie som kan gi deg hjelp og støtte når du trenger det? 293	Ja	Nei
	☐	☐

Hvis "Ja": Hvem kan gi deg hjelp?

- Ektefelle/samboer ..... 294 ☐
- Barn ☐
- Andre ☐

Hvor mange gode venner har du som du kan snakke fortrolig med og gi deg hjelp når du trenger det? ..... 297 _____ gode venner
Tell ikke med dem du bor sammen med, men ta med andre slektninger!

	Ja	Nei
Føler du at du har nok gode venner? 299	☐	☐

Føler du at du hører med i et fellesskap (gruppe av mennesker) som stoler på hverandre og føler forpliktelse overfor hverandre (f.eks. i politisk parti, religiøs gruppe, slekt, naboskap, arbeidsplass eller organisasjon)?

- Sterk tilhørighet ..... 300 ☐ 1
- Noe tilhørighet ☐ 2
- Usikkert ☐ 3
- Liten eller ingen tilhørighet ☐ 4

Hvor ofte tar du vanligvis del i foreningsvirksomhet som f.eks. syklubb, idrettslag, politiske lag, religiøse eller andre foreninger?

- Aldri, eller noen få ganger i året ..... 301 ☐ 1
- 1-2 ganger i måneden ..... ☐ 2
- Omtrent en gang i uken ..... ☐ 3
- Mer enn en gang i uken ..... ☐ 4

KOSTVANER

Antall

Hvor mange måltider spiser du vanligvis daglig (middag og brødmåltid)? ..... 302 _____

Hvor mange ganger i uken spiser du varm middag? ..... 304 _____

Hva slags type brød (kjøpt eller hjemmebakt) spiser du vanligvis?

Sett ett eller to kryss.

	Loff	Fint brød	Kneip-brød	Grov-brød	Knekke-brød
Brødtypen ligner mest på:	☐ 306	☐	☐	☐	☐ 310

Hva slags fett blir til vanligvis brukt til *matlaging* (ikke på brødet) i din husholdning?

- Meierismør ..... 311 ☐
- Hard margarin ..... ☐
- Bløt (Soft) margarin ..... ☐
- Smør/margarin blanding ..... ☐
- Oljer ..... 315 ☐

Hvor mye (i antall glass, poteter eller brødskiver) spiser/drikker du vanligvis daglig av følgende matvarer?

Kryss av for alle matvarene.

	Ingen	Mindre enn 1	1-2	3 og mer
Melk alle sorter (glass) 316	☐	☐	☐	☐
Appelsinjuice (glass)	☐	☐	☐	☐
Poteter	☐	☐	☐	☐
Brødskiver totalt (inkl. knekkebrød)	☐	☐	☐	☐
Brødskiver med				
– fiskepålegg (f.eks. makrell i tomat)	☐	☐	☐	☐
– gulost	☐	☐	☐	☐
– kaviar 322	☐ 1	☐ 2	☐ 3	☐ 4

Hvor mange ganger i uka spiser du vanligvis følgende matvarer?

Kryss av for alle matvarene.

	Aldri	Sjeldnere enn 1	1	2 og mer
Yoghurt 323	☐	☐	☐	☐
Kokt eller stekt egg	☐	☐	☐	☐
Frokostblanding/havregryn o.l.	☐	☐	☐	☐
Middag med				
– rent kjøtt	☐	☐	☐	☐
– feit fisk (f.eks. laks/uer)	☐	☐	☐	☐
– mager fisk (f.eks. torsk) 328	☐	☐	☐	☐
– grønnsaker (rå eller kokte)	☐	☐	☐	☐
Gulrøtter (rå eller kokte)	☐	☐	☐	☐
Blomkål/kål/brokkoli	☐	☐	☐	☐
Epler/pærer	☐	☐	☐	☐
Appelsiner, mandariner o.l. 333	☐ 1	☐ 2	☐ 3	☐ 4

TRIVSEL

Hvordan trives du med å bli gammel - alt i alt?

- Godt ..... 334 ☐ 1
- Ganske bra ..... ☐ 2
- Opp og ned ..... ☐ 3
- Dårlig ..... ☐ 4

Hvordan ser du på livet fremover?

- Lyst ..... 335 ☐ 1
- Ikke så verst ..... ☐ 2
- Nokså bekymret ..... ☐ 3
- Mørkt ..... ☐ 4

BESVARES BARE AV KVINNER

MENSTRUASJON

Hvor gammel var du da du fikk menstruasjon første gang? ..... 336 _____ år

Hvor gammel var du da menstruasjonen sluttet? ..... 338 _____ år

SVANGERSKAP

Hvor mange barn har du født? ..... 340 _____ barn

Hvis du har født, fyll ut for hvert barn barnets fødselsår og omtrent antall måneder du ammet barnet.
Hvis du har født mer enn 6 barn, noter fødselsår og antall måneder med amming for dem nederst på siden.

Barn:	Fødselsår:	Antall måneder med amming:
1	342 _____	_____
2	346 _____	_____
3	_____	_____
4	_____	_____
5	358 _____	_____
6	_____	_____

Har du i forbindelse med svangerskap hatt for høyt blodtrykk og/eller eggehvite (protein) i urinen? ..... 366 Ja ☐ Nei ☐

Hvis "Ja", i hvilket svangerskap?

	Svangerskap Første	Senere
For høyt blodtrykk 367	☐	☐
Eggehvite i urinen 369	☐	☐

ØSTROGEN-MEDISIN

Bruker du, eller har du brukt, østrogen-medisin?

	Nå	Før	Aldri
Tabletter eller plaster 371	☐	☐	☐
Krem eller stikkpiller 372	☐	☐	☐

Hvis du bruker østrogen, hvilket merke bruker du nå?

..... 373

Dine kommentarer:

Takk for hjelpen! Husk å postlegge skjemaet idag!
Helseundersøkelsen i Tromsø

English translation of the second questionnaire used in the health survey in Tromsø 1994/95 for subjects 70 years or older.

Based on translations by Kevin McCafferty and Anne Clancy.

TROMSØ HEALTH SURVEY
for the over 70s

The main aim of the Tromsø survey is to improve our knowledge of heart and circulatory conditions in order to aid prevention. The survey is also intended to improve our knowledge of cancer and other general conditions, such as allergies, muscle pains and nervous conditions. The ultimate aim is to gain an overview of the general health of the elderly population. We would therefore like you to answer the questions below.

This form is part of the Health Survey, which has been approved by the Norwegian Data Inspectorate and the Regional Board of Research Ethics. The answers will only be used for research purposes and will be treated in strict confidence. The information you give us may later be stored along with information from other public health registers in accordance with the rules laid down by the Data Inspectorate and the Regional Board of Research Ethics.

If you are unsure about what to answer, tick the box that you feel fits best.

The completed form should be sent to us in the enclosed pre-paid envelope.

Thank you in advance for helping us.

Yours sincerely,

Faculty of Medicine
University of Tromsø

National Health
Screening Service

If you do not wish to answer the questionnaire, tick the box below and return the form. Then you will not receive reminders.

I do not wish to answer the questionnaire. ☐

Date for filling in this form: Day/Month/Year

CHILDHOOD/YOUTH

What Norwegian municipality did you live in at the age of 1 year?

If you did not live in Norway, give country instead of municipality.

How was your family's financial situation while you were growing up?

- Very good ☐
- Good ☐
- Difficult ☐
- Very difficult ☐

How old were your parents when they died?

- Mother _____ years
- Father _____ years

HOME

Who do you live with?
Tick one box for each item and give the number of persons.

	YES	NO	Number
Spouse/partner	☐	☐	_____
Other persons over 18 years	☐	☐	_____
Persons under 18 years	☐	☐	_____

What type of home do you live in?

- Villa/detached house ☐
- Farm ☐
- Apartment/flat in block/terrace ☐
- Terraced/semi-detached house ☐
- Other ☐

How long have you lived in your present home? ____years

Is your home adapted to your needs? YES ☐ NO ☐
If "No", do you have problems with:

- Space ☐
- Variable temperature/too cold/too warm ☐
- Stairs ☐
- Toilet ☐
- Bath/shower ☐
- Maintenance ☐
- Other (please specify) ☐

Would you like to move into a retirement home?
YES ☐ NO ☐

PREVIOUS WORK AND FINANCIAL SITUATION

Which statement best describes the type of work you did for the last 5-10 years before you retired?

- I was mainly seated while working (*e.g., desk/assembly work*) ☐
- My work required a lot of walking (*e.g., shop assistant, housewife, teaching*) ☐
- My work required a lot of walking and lifting (*e.g., postman, nurse, construction work*) ☐
- I did heavy physical work (*e.g., forestry, heavy agricultural work, heavy construction work*) ☐

Did you do any of the following jobs (full- or part-time)?
Tick one box only for each item.

	YES	NO
Driver	☐	☐
Farmer	☐	☐
Fisherman	☐	☐

How old were you when you retired? _____ years

What kind of pension do you have?

- Basic state pension ☐
- Additional pension ☐

How is your current financial situation?

- Very good ☐
- Good ☐
- Difficult ☐
- Very difficult ☐

HEALTH AND ILLNESS

Has your state of health changed in the last year?

- Yes, it has got worse ☐
- No, unchanged ☐
- Yes, it has got better ☐

How do you feel your health is now compared to others of your age?

- Much worse ☐
- A little worse ☐
- About the same ☐
- A little better ☐
- Much better ☐

YOUR OWN ILLNESSES

Have you ever had:
Tick one box only for each item. Give your age at the time. If you have had the condition several times, how old were you last time?

	YES	NO	AGE
Hip fracture	☐	☐	____
Wrist /forearm fracture	☐	☐	____
Whiplash	☐	☐	____
Injury requiring hospital admission	☐	☐	____
Stomach ulcer	☐	☐	____
Duodenal ulcer	☐	☐	____
Stomach/duodenal ulcer operation	☐	☐	____
Throat/neck surgery	☐	☐	____

Have you ever had, or do you still have:
Tick one box only for each item.

	YES	NO
Cancer	☐	☐
Epilepsy	☐	☐
Migraine	☐	☐
Chronic bronchitis	☐	☐
Psoriasis	☐	☐
Osteoporosis	☐	☐
Fibromyalgia/fibrositis/ chronic pain syndrom	☐	☐
Psychological problems for which you have sought help	☐	☐
Thyroid disease	☐	☐
Liver disease	☐	☐
Thyroid disease	☐	☐
Liver disease	☐	☐
Recurrent urinary incontinence	☐	☐
Glaucoma	☐	☐
Cataract	☐	☐
Arthrosis (osteoarthritis)	☐	☐
Rheumatoid arthritis	☐	☐
Kidney stone	☐	☐
Appendectomy	☐	☐
Allergy and hypersensitivity		
Atopic eczema (e.g., childhood eczema)	☐	☐
Hand eczema	☐	☐
Hay fever	☐	☐
Food allergy	☐	☐
Other hypersensitivity (not allergy)	☐	☐

How many times have you had a cold, influenza (flue), diarrhea/vomiting, or similar in the last six months?
_____ times

Have you had any of these in the last two weeks?
YES ☐ NO ☐

ILLNESS IN THE FAMILY

Tick off relatives who have, or have ever had, any of the following conditions:
Tick "None" for conditions which none of your relatives have had.

	Mother	Father	Brother	Sister	Child	None
Stroke or brain haemorrhage	☐	☐	☐	☐	☐	☐
Myocardial infarction before age 60	☐	☐	☐	☐	☐	☐
Cancer	☐	☐	☐	☐	☐	☐
Hypertension	☐	☐	☐	☐	☐	☐
Asthma	☐	☐	☐	☐	☐	☐
Osteoporosis	☐	☐	☐	☐	☐	☐
Arthrosis (osteoarthritis)	☐	☐	☐	☐	☐	☐
Psychological problems	☐	☐	☐	☐	☐	☐
Dementia	☐	☐	☐	☐	☐	☐
Diabetes	☐	☐	☐	☐	☐	☐
-age when they got diabetes	___	___	___	___	___	___

SYMPTOMS

Do you cough daily for periods of the year? YES ☐ NO ☐

If "Yes":
Is your cough productive? ☐ ☐

Have you had this kind of cough for as long as 3 months in each of the last two years? ☐ ☐

Have you had periods of wheezing in your chest? ☐ ☐
If "Yes", has this occurred:
Tick one box only for each item.

At night	☐	☐
In connection with respiratory infections	☐	☐
In connection with physical exertion	☐	☐
In connection with very cold weather	☐	☐

Have you noticed sudden changes in your pulse or heart rhythm in the last year? ☐ ☐

Have you lost weight in the last year? ☐ ☐
If "Yes":
How many kilograms? _____ kg

How often do you suffer from sleeplessness?

- Never, or just a few times a year ☐
- 1-2 times a month ☐
- Approximately once a week ☐
- More than once a week ☐

If you suffer from periods of sleeplessness, what times of the year does it affect you most?

- No particular time of year ☐
- Especially during the 'dark winter months' ☐
- Especially during the midnight sun period ☐
- Especially in spring and autumn ☐

Do you usually take a nap during the day? YES ☐ NO ☐

Do you feel that you normally get enough sleep? YES ☐ NO ☐

	No	A little	A lot
Do you suffer from:	☐	☐	☐
Dizziness	☐	☐	☐
Poor memory	☐	☐	☐
Lack of energy	☐	☐	☐
Constipation	☐	☐	☐

Does the thought of getting a serious illness ever worry you?

- Not at all ☐
- Only a little ☐
- Some ☐
- Very much ☐

BODILY FUNCTIONS

Can you manage the following everyday activities on your own without help from others?

	Yes	With some help	No
Walking indoors on one level	☐	☐	☐
Walking up/down stairs	☐	☐	☐
Walking outdoors	☐	☐	☐
Walking approx. 500 metres	☐	☐	☐
Going to the toilet	☐	☐	☐
Washing yourself	☐	☐	☐
Taking a bath/shower	☐	☐	☐
Dressing and undressing	☐	☐	☐
Getting in and out of bed	☐	☐	☐
Eating meals	☐	☐	☐
Cooking ☐	☐	☐	
Doing light housework (e.g., washing up)	☐	☐	☐
Doing heavier housework (e.g., cleaning floors)	☐	☐	☐
Going shopping	☐	☐	☐
Taking the bus	☐	☐	☐

	Yes	With difficulty	No
Can you hear normal speech (if necessary with a hearing aid)?	☐	☐	☐
Can you read (if necessary with glasses)?	☐	☐	☐

Are you dependent on any of the following aids?

	Yes	No
Walking stick	☐	☐
Crutches	☐	☐
Walking frame/Zimmer frame	☐	☐
Wheelchair	☐	☐
Hearing aid	☐	☐
Safety alarm device	☐	☐

USE OF HEALTH SERVICES

How many visits have you made during the past year due to your own health or illness:

*Tick **0** if you have **not** had such contact*

	Number of times the past year
To a general practitioner (GP)/ emergency GP	____
Psychologist or psychiatrist	____
Other medical specialist (not at a hospital)	____
Hospital out-patient clinic	____
Hospital admission	____
Physiotherapist	____
Chiropractor	____
Acupuncturist	____
Dentist	____
Chiropodist	____
Alternative medical practitioner (homoeopath, foot zone therapist, etc.)	____
Healer, Faith healer, clairvoyant	____

	Yes	No
Do you have domestic help?		
Private	☐	☐
Municipal	☐	☐
Do you receive services from the district nurse?	☐	☐

Are you pleased with the health care and home assistance services your municipality supplies?

	Yes	No	Don't know
Assigned family GP	☐	☐	☐
District nurse	☐	☐	☐
Home assistance	☐	☐	☐

Do you feel confident that you can receive the health care and home assistance you require if you need it?

- Confident ☐
- Not confident ☐
- Very unsure ☐
- Don't know ☐

MEDICATION AND DIETARY SUPPLEMENTS

Have you for any length of time in the past year used any of the following medicines every day or almost daily? Indicate how many months you used them for.

*Write **0** for items you have **not** used.*

Medication:

Painkillers	_____ mths
Sleeping pills	_____ mths
Tranquillizers	_____ mths
Antidepressants	_____ mths
Allergy drugs	_____ mths
Asthma drugs	_____ mths
Heart medicine (not blood pressure)	_____ mths
Insulin	_____ mths
Diabetes tablets	_____ mths
Thyroxin tablets (for metabolic disorder)	_____ mths
Cortisone tablets	_____ mths
Remedies for constipation	_____ mths

Dietary supplements:

Iron tablets	_____ mths
Vitamin D supplement	_____ mths
Other vitamin supplements	_____ mths
Calcium tablets or bonemeal	_____ mths
Cod liver oil or fish oil capsules	_____ mths

FAMILY AND FRIENDS

Do you have close relatives who can give you help and support when you need it? Yes ☐ No ☐

If "Yes", who can give you help?

- Spouse/partner ☐
- Children ☐
- Others ☐

How many good friends do you have whom you can talk confidentially with and who give you help when you need it?

_____good friends

Do not count people you live with, but do include other relatives!

Do you feel you have enough good friends? Yes ☐ No ☐

Do you feel that you belong to a community or group of people who can depend on each other and who feel committed to each other (e.g., a political party, religious group, relatives, neighbours, work place, or organisation)?

- Strong sense of belonging ☐
- Some sense of belonging ☐
- Not sure ☐
- Little or no sense of belonging ☐

How often do you normally take part in organised gatherings, e.g., sewing circles, sports clubs, political meetings, religious or other associations?

- Never, or just a few times a year ☐
- 1-2 times a month ☐
- Approximately once a week ☐
- More than once a week ☐

DIET

How many meals a day do you normally eat (dinner and smaller meals)? _____ Number

How many times a week do you eat a hot dinner? _____ Number

What kind of bread (bought or home-made) do you usually eat? *Tick one or two boxes!*

The bread I eat is most similar to

- White bread ☐
- Light textured brown bread ☐
- Ordinary brown bread ☐
- Coarse brown bread ☐
- Crisp bread ☐

What kind of fat is normally used in **cooking** (not on the bread) in your home?

- Creamery butter ☐
- Hard margarine ☐
- Soft margarine ☐
- Butter/margarine blend ☐
- Oils ☐

How much (in **number** of glasses, cups, potatoes or slices) do you usually eat or drink **daily** of the following foodstuffs? *Tick one box for **each** foodstuff.*

	0	Less than 1	1-2	3-4	5-6	6-
Milk of all types (glasses)	☐	☐	☐	☐	☐	☐
Orange juice (glasses)	☐	☐	☐	☐	☐	☐
Potatoes	☐	☐	☐	☐	☐	☐
Slices of bread in total (incl. crispbread)	☐	☐	☐	☐	☐	☐
Slices of bread with fish (e.g., mackerel in tomato sauce)	☐	☐	☐	☐	☐	☐
- cheese (e.g., Norwegia)	☐	☐	☐	☐	☐	☐
- smoked cod caviar	☐	☐	☐	☐	☐	☐

How many **times per week** do you normally eat the following foodstuffs? *Tick a box for **all** foodstuffs listed.*

	Never	Less than 1	1	2-3	4-5	Roughly every day
Yoghurt	☐	☐	☐	☐	☐	☐
Boiled or fried egg	☐	☐	☐	☐	☐	☐
Breakfast cereal/ oat meal, etc.	☐	☐	☐	☐	☐	☐
For dinner - meat	☐	☐	☐	☐	☐	☐
- fat fish (e.g., salmon/ redfish)	☐	☐	☐	☐	☐	☐
- lean fish (e.g., cod) - vegetables (raw or cooked)	☐	☐	☐	☐	☐	☐
Carrots (raw or cooked)	☐	☐	☐	☐	☐	☐
Cauliflower/cabbage/broccoli	☐	☐	☐	☐	☐	☐
Apples/pears	☐	☐	☐	☐	☐	☐
Oranges, mandarines, etc.	☐	☐	☐	☐	☐	☐

WELL BEING

How content do you generally feel with growing old?

- Good ☐
- Quite good ☐
- Up and down ☐
- Bad ☐

What is your view of the future?

- Bright ☐
- Not too bad ☐
- Quite worried ☐
- Dark ☐

TO BE ANSWERED BY WOMEN ONLY

MENSTRUATION

How old were you when you had your first menstruation? _____ years

How old were you when you stopped having menstruations? _____ years

PREGNANCY

How many children have you given birth to? _____children

If you have given birth, fill out for each child the year of birth and approximately how many months you breastfed the child. If you have given birth to more than 6 children, note their birthyear and number of months you breastfed at the space provided below for comments.

Child:	Year of birth:	Number of months breastfed:
1	_____	_____ months
2	_____	_____ months
3	_____	_____ months
4	_____	_____ months
5	_____	_____ months
6	_____	_____ months

During pregnancy, have you had high blood pressure and/or proteinuria? Yes ☐ No ☐

If "Yes", during which pregnancy?

	Pregnancy First	Later
High blood pressure	☐	☐
Proteinuria	☐	☐

OESTROGEN

Do you, or have you ever used oestrogen:

	Now	Used to	Never
Tablets or patches	☐	☐	☐
Cream or suppositories	☐	☐	☐

If you use oestrogen, what brand do you currently use?

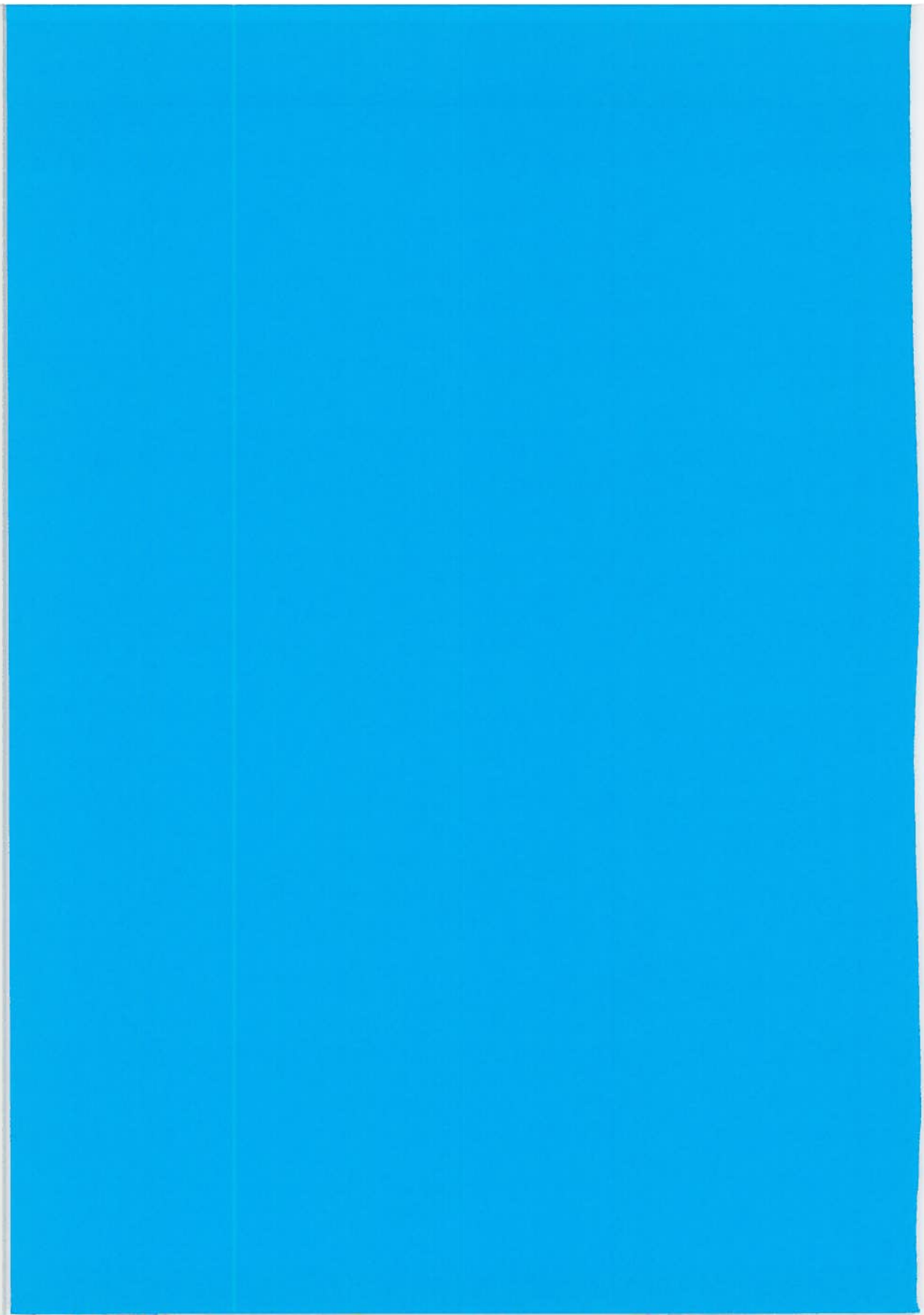
_____

Your comments:

Thank you for helping us! Remember to post the form today! **Tromsø Health Survey**

Appendix 7

International Classification of disease, ninth revision



Main ICD-9 codes

200 Non-Hodgkin lymphoma

201 Hodgkin's disease

202 Other malignant neoplasms of lymphoid and histiocytic tissue

203 Multiple myeloma and immunoproliferative neoplasms

204 Lymphoid leukaemia

205 Myeloid leukaemia

206 Monocytic leukaemia

207 Other specified leukaemia

208 Leukaemia of unspecified cell type

238 Tumor of uncertain behaviour of other and unspecified sites and tissues

273 Disorders of plasma protein metabolism

280 Iron deficiency anaemia

281 Other deficiency anaemias

282 Hereditary haemolytic anaemias

283 Acquired haemolytic anaemias

284 Aplastic anaemia

285 Other and unspecified anaemias

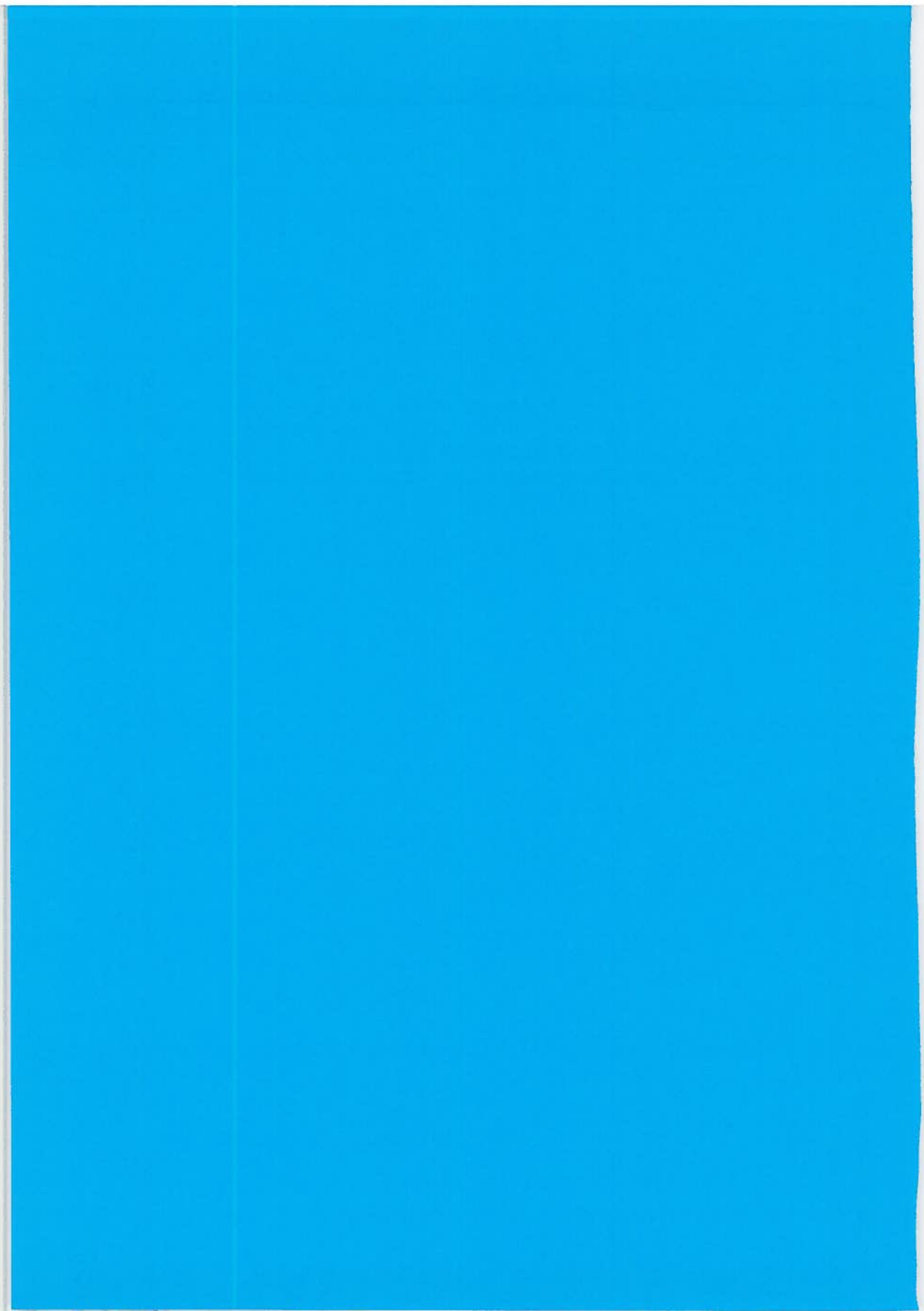
286 Coagulation defects

287 Purpura and other haemorrhagic conditions

288 Diseases of white blood cells

289 Other diseases of blood and blood-forming organs

Paper I



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Haemoglobin and anaemia in a gender perspective: The Tromsø Study*

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Abstract: *Objectives:* To examine the gender-specific distribution of haemoglobin (Hb) and the World Health Organization (WHO) criteria for anaemia compared with the 2.5 percentile for Hb. *Methods:* A population-based study from Tromsø, Northern Norway. All inhabitants above 24 yr were invited. In total, 26 530 (75%) had their Hb analysed. *Results:* The 2.5–97.5 percentile of Hb was 129–166 and 114–152 g/L for all men and women, respectively. In men, mean Hb decreased from 148 to 137 g/L between 55–64 and 85+ yr. In women, mean Hb increased from 132 to 137 g/L between 35–44 and 65–74 yr and then decreased to 131 g/L among the oldest.Using the WHO criteria for anaemia (Hb: < 130 and < 120 g/L, men and women respectively), the prevalence of anaemia in men increased with age from 0.6% aged 25–34 to 29.6% aged 85+. For women, the prevalence of anaemia varied from 9.1%, 2.2% and 16.5% in the age groups of 35–44, 55–64 and 85+ yr, respectively. The WHO criteria gave a two to three times higher prevalence of anaemia compared with the 2.5 percentile of Hb in women, but the difference was small in men. Poor self-rated health was not associated with low values of Hb in women. In men, there was an association in some age groups. *Conclusion:* The WHO criteria for anaemia and the 2.5 percentile for Hb corresponded well for men, but not for women. The WHO criteria of anaemia may result in medicalization of healthy women.

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Key words: haemoglobin, anaemia; prevalence; cross-sectional, lifestyle, self-rated health, men; women

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Measurement of haemoglobin (Hb) is one of the most frequently performed laboratory test in medical general practice as well as in hospitals. Mean Hb levels differ by age, gender and ethnicity (1–5), declines especially in elderly men and peaks after menopause for women (6, 7). Not all doctors are aware of how Hb is related to age. Reference values are often defined from healthy younger subjects. The use of young adults as basis for reference values of Hb may lead to a large percentage of elderly subjects being misdiagnosed with anaemia. Anaemia may be defined by the World Health Organization (WHO) criteria (8) or by the values below the 2.5 percentile of the population.

The Tromsø Study provided the opportunity to examine total birth cohorts of a free-living population of men and women in Northern Norway. We studied the distribution of Hb and compared the application of the WHO criteria for anaemia with the 2.5 percentile for Hb. We also investigated the association between different modifiable lifestyle variables and Hb. In order to study the clinical effects of anaemia, we further assessed whether lower Hb levels were related to a lower self-rated health.

*The Institute of Community Medicine, University of Tromsø conducted the survey in cooperation with the National Health Screening Service. Our salaries are from the University Hospital of North Norway and the University of Tromsø.

Materials and methods

Subjects

Tromsø is situated at sea level in Northern Norway. The population is predominately middle-class of Norwegian, Finnish and Sami origin. The Tromsø Study is a multipurpose, population-based, prospective study of total birth cohorts. Since 1974, the Institute of Community Medicine, University of Tromsø, has conducted the surveys, in cooperation with the National Health Screening Service.

In 1994–95, all inhabitants above 24 yr were invited, and 27 153 subjects (77%) participated. In total, 75% of the invited population had their Hb analysed (12 542 men, 13 689 non-pregnant and 299 pregnant women). A protocol similar to that used during the previous surveys was followed (9, 10). The Regional Board of Research Ethics approved the study. Each subject gave written informed consent.

Measurements

Two self-administrated questionnaires covered previous and present diseases and symptoms, self-rated health, use of drugs, tobacco and alcohol, food habits, physical activity and length of education.

A 5 mL non-fasting blood sample was drawn in a sitting position, from a cubital vein, into vacutainer tubes containing ethylenediaminetetraacetic acid (EDTA) as anticoagulant (K_3-EDTA 40 µL, 0.37 M per tube) and analysed within 12 h. Hb was analysed in an automated blood cell counter (Coulter Counter®; Coulter Electronics, Luton, UK) by the cyanmethhaemoglobin method. In case of pathological findings and for ethical reasons, the persons were offered further evaluation and follow up. Predefined criteria for evaluation was Hb <100 g/L or ≥ 180 g/L for men and <90 g/L or ≥ 170 g/L for women. One of three haematologists examined these subjects at the outpatients' clinic at the University Hospital of North Norway, Tromsø. Two doctors classified the medical records.

According to WHO, anaemia should be considered to exist if Hb <130 g/L for men and <120 g/L for non-pregnant women (8). In order to test these criteria's applicability to our population, we compared the WHO criteria with the 2.5 percentile for Hb.

Statistical analyses

Age-adjusted mean values were calculated with ANOVA. The Pearson chi-square test for cross-tables was used for analysing differences between Hb classes and self-rated health. Adjusting of crude prevalence rates for age was performed according to the direct method, using the European standard population (11). A linear regression model was used for evaluating the changes of Hb levels with age. The Hb interval between 2.5 and 97.5 percentile (central 95% interval) was estimated. Information on health problems that could influence on Hb were from the questionnaire: 'Have you or do you still have: cancer, chronic bronchitis, thyroid disease, liver disease, stomach/duodenal ulcers or ulcer operation, asthma, myocardial infarction, angina pectoris, stroke/brain haemorrhage, diabetes, suffered from pain/stiffness last year, iron medication last year'?

Haemoglobin was the dependent variable in a predefined multiple regression model, and analyses were performed separately for each gender. The independent variables were as follow: age [25–34 (reference group), 35–44, 45–54, 55–64, 65–74 and 75+ yr], body mass index (BMI, kg/m^2) [<22 (reference group), 22–24, 24–25, 25–27 and 27+ kg/m^2], daily smoking (yes = 1, no = 0). Self-rated health status was based on the question: 'How is your current state of health'? Four alternatives were given: poor, not so good, good or very good. Poor or not so good were added and used as reference group. In addition, the model was tested for: education [compulsory school (reference group), college or university, high-school], daily alcohol consumption (beer, wine or spirit per fortnight) [0 (reference group), 1–4, 5–14 and 15+ glasses], coffee consumption [0 (reference group), 1–5, 6–9 and 10+ cups], hard physical activity during leisure time in the past year (sweating/out of breath) [none (reference group), <1 h, 1–2 h, >2 h/wk]. For women, pregnancy and parity [0 (reference group), 1–2 and 3+ children] were included. Pregnant women were excluded from all analyses except from the multiple regression model where pregnancy was included as an independent variable.

All analyses were conducted with the SAS software package version 8.02.

Results

Characteristics of the population

Table I presents age-adjusted baseline characteristics of the population. Mean age was 47.3 yr for men (maximum 95 yr) and 48.2 yr for women (maximum 104 yr). Mean age-adjusted Hb [95% confidence interval (CI)] was 14.9 (14.7–15.2) g/L higher in men than women. For both genders, mean corpuscular volume (MCV) and mean corpuscular Hb (MCH) were 89 fL and 30 pg, respectively. The 2.5 percentile of MCV and MCH were, 82 fL and 28 pg, respectively in men, 79 fL and 26 pg, respectively in women (data not shown). About 37% of both genders were daily smokers. Mean BMI was between 25 and 26 for both genders.

Distribution of haemoglobin

The minimum and maximum level of Hb was 80–188 g/L and 60–184 g/L, in men and women, respectively (data not shown). Hb was almost normally distributed with a small tail to the left in both genders. The coefficients of kurtosis and

Table 1. Age-adjusted baseline characteristics of study population, values are mean ± SD or percentages (The Tromsø Study 1994–95)

Variable	Males	Females
Age (yr)	47.3 ± 14.5	48.2 ± 15.5
Haemoglobin (g/L)	147 ± 9	132 ± 10
Mean corpuscular volume (fL)	89 ± 4	89 ± 5
Mean corpuscular haemoglobin (pg)	30 ± 1	30 ± 2
Education, ≥4 yr college/university (%)	30.0	26.2
Body mass index (kg/m^2)	25.9 ± 3.3	25.1 ± 4.3
Daily smokers (%)	36.7	36.2
Number of cigarettes among smokers (per d)	12.4 ± 7.1	9.6 ± 5.4
Glasses of alcohol among non-teetotallers (per fortnight)	5.6 ± 7.6	2.2 ± 4.1
Cups of coffee among coffee drinkers (per d)	6.0 ± 3.9	4.8 ± 2.9
Hard physical activity ≥1 h/wk (%)	35.4	23.0
Poor or not so good self-rated health (%)	28.0	35.1
Number of childbirth		2.5 ± 1.5

skewness were 1.48 and −0.35 in men, and 2.32 and −0.46 in women.

Figure 1 presents the percentiles of Hb by age. The central 95% interval was 129–166 g/L for men and 114–152 g/L for women. For men, the range of variation increased by age because of more subjects with low Hb values. The variation for women was smallest around 60 yr, and largest during the years before menopause and in the oldest subjects. In men, Hb declined with age. The mean annual decline was most pronounced from 25–34, 65–74 (both 0.03 g/L) and 75–84 yr (0.05 g/L). In women, Hb declined by age among those below 35 yr (0.02 g/L/yr) and among women aged 75–84 (0.03 g/L/yr). In the age group 45–54 yr, there was an annual increase in mean Hb (0.03 g/L).

Categorization between subjects who reported previous or present diseases that could influence on Hb and those who did not report these diseases, gave mean Hb (95% CI) of 145.3 (144.8–145.8) g/L and 145.5 (145.0–146.0) g/L, respectively in men, 133.4 (133.0–133.9) g/L and 133.3 (132.8–133.8) g/L, respectively in women.

Prevalence of anaemia

Table 2 presents the prevalence of anaemia according to the WHO criteria, and according to the 2.5 percentile for all ages. According to the WHO criteria, the prevalence of anaemia for men (Hb < 130 g/L) increased with age from 0.6 to 29.6%, compared with an increase from 0.5 to 27.8% according to the overall 2.5 percentile for men (Hb < 129 g/L). For women, the highest prevalence was among the oldest where 16.5% were anaemic according to WHO (Hb < 120 g/L), in contrast to 8.7% anaemic according to the overall 2.5 percentile (Hb < 114 g/L). The lowest prevalence of anaemia was among those aged 55–64 yr, where the prevalence was 2.2 and 0.7%

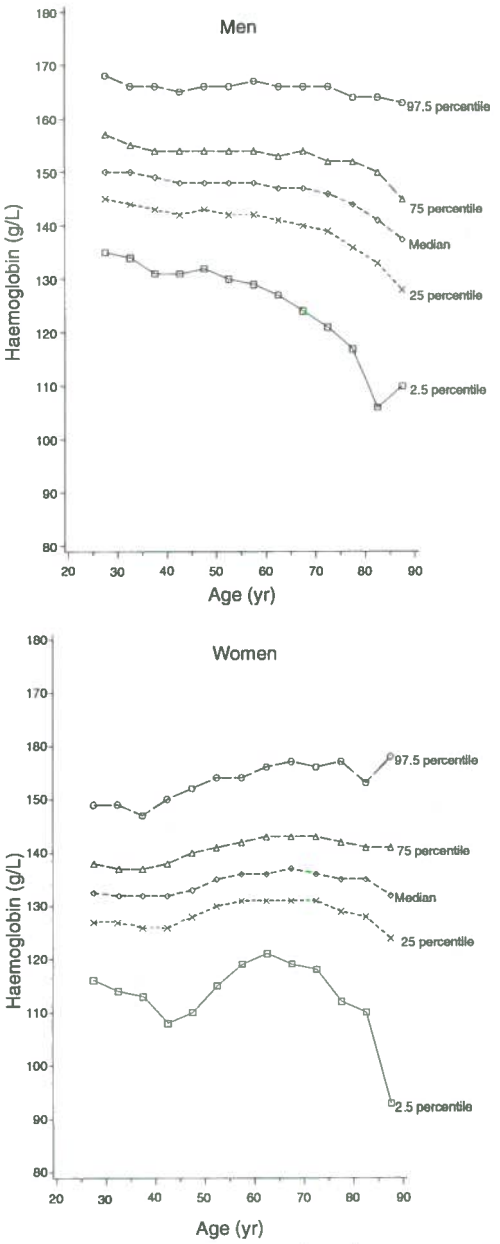

Fig. 1. Distribution of haemoglobin (g/L) in men and women according to age (The Tromsø Study 1994–95).

(WHO definition and the overall 2.5 percentile, respectively).

Table 3 presents mean Hb stratified by age and gender. For men, Hb declined from age group

Table 2. Prevalence (%) of low haemoglobin (Hb) values according to the WHO criteria (Hb < 130 g/L for men, <120 g/L for non-pregnant women), and as values below the overall 2.5 percentile values (Hb < 129 g/L for men and Hb < 114 g/L for women, The Tromsø Study 1994–95)

	Men					Women				
		WHO criteria (<130 g/L)		2.5 percentile (<129 g/L)			WHO criteria (<120 g/L)		2.5 percentile (<114 g/L)	
Age	*N*	*n*	%	*n*	%	*N*	*n*	%	*n*	%
25–34	2999	18	0.6	15	0.5	3265	206	6.3	66	2.0
35–44	3244	49	1.5	39	1.2	3421	310	9.1	119	3.5
45–54	2845	47	1.7	32	1.1	2880	185	6.4	81	2.8
55–64	1669	58	3.5	46	2.8	1680	37	2.2	11	0.7
65–74	1250	91	7.3	77	6.2	1521	46	3.0	15	1.0
75–84	481	72	15.0	66	13.7	807	57	7.1	29	3.6
85+	54	16	29.6	15	27.8	115	19	16.5	10	8.7
Crude	12 542	351	2.8	290	2.3	13 689	860	6.3	331	2.4
Age adjusted			3.5		2.9			6.1		2.4

55–64 yr, whereas mean Hb was lowest in both the youngest and the oldest women. The variation in Hb levels as measured by the SD increased with age among men, but was fairly constant up to 85 yr of age for women. The number of anaemic subjects who, due to our predefined criteria, needed further evaluation after the screening is shown. Six men and 24 women (1.1 ‰) had Hb below the predefined criteria. Two women did not attend the follow up. After a control blood sample, Hb of nine subjects was partially normalized. Another three had their Hb completely normalized, two of them because of iron supplement. Two men had chronic diseases. Among the two men and 12 women still severely anaemic (0.5 ‰), 11 subjects had chronic blood loss from menorrhagia or gastrointestinal tractus, and three subjects had insufficient food.

Elevated haemoglobin

Twelve subjects (0.5 ‰; seven men and five women) had a Hb value above the predefined criteria (Table 3). Two did not attend to follow up. After a control blood sample five had completely or partially normalized Hb. Five subjects (0.2 ‰) still had elevated Hb. One had previously diagnosed polycythemia vera, the other four subjects had chronic diseases or smoked excessively.

Lifestyle, self-rated health and haemoglobin

Table 4 presents the effect on Hb (g/L) of age, BMI, smoking, self-rated health and pregnancy from the multiple linear regression analysis. For men, age was negatively associated with Hb compared with the reference group 25–34 yr old, the estimated Hb decreased with age. For women, 35–44 yr old were negatively associated to Hb when compare with the 25–34 yr old, whereas the other age groups were positively associated to Hb. The effect was strongest among the 55–74 yr old. For both genders, BMI was positively associated to Hb when compare with the reference group (< 22 kg/m^2). The effect increased with increasing BMI. Smoking was positively associated with Hb, the effect was strongest in women. In either gender,

Table 3. Mean ± SD of haemoglobin (g/L) according to gender and age. Number of subjects fulfilling the criteria for further evaluation after the screening (The Tromsø Study 1994–95)

					Men				Women			
	Men		Women		Anaemia (<100 g/L)		Elevated haemoglobin (≥180 g/L)		Anaemia (<90 g/L)		Elevated haemoglobin (≥170 g/L)	
Age	*N*	Mean ± SD	*N*	Mean ± SD	*n*	%	*n*	%	*n*	%	*n*	%
25–34	2999	150 ± 8	3265	132 ± 9	1	0.03	0	0	2	0.06	0	0
35–44	3244	148 ± 9	3421	132 ± 10	0	0	1	0.03	8	0.23	0	0
45–54	2845	148 ± 9	2880	134 ± 10	0	0	4	0.14	10	0.35	1	0.03
55–64	1669	148 ± 10	1680	137 ± 9	1	0.06	2	0.12	0	0	2	0.12
65–74	1250	146 ± 11	1521	137 ± 10	1	0.08	0	0	1	0.07	1	0.07
75–84	481	142 ± 13	807	135 ± 11	3	0.62	0	0	1	0.12	1	0.12
85+	54	137 ± 13	115	131 ± 15	0	0	0	0	2	1.74	0	0
	12 542	148 ± 9	13 689	134 ± 10	6	0.05	7	0.06	24	0.18	5	0.04

Table 4. Effect on haemoglobin concentration (g/L) of lifestyle factors and self-rated health (multivariate analysis, The Tromsø Study 1994–95)

	Men (R^2 = 9.5%)		Women (R^2 = 12.2%)	
	Effect on haemoglobin concentration	95% CI	Effect on haemoglobin concentration	95% CI
Age groups				
25–34		Reference group		
35–44	−2.22	−2.67 to −1.77	−0.83	−1.28 to −0.39
45–54	−2.86	−3.33 to −2.39	0.97	0.49–1.45
55–64	−3.49	−4.05 to −2.93	3.40	2.83–3.98
65–74	−4.63	−5.25 to −4.01	3.90	3.29–4.50
75+	−8.72	−9.57 to −7.86	1.78	1.05–2.50
BMI (kg/m^2)				
<22		Reference group		
22–24	2.15	1.58–2.73	0.80	0.36–1.24
24–25	3.12	2.49–3.75	1.74	1.16–2.31
25–27	4.17	3.61–4.73	2.75	2.25–3.25
27+	6.92	6.37–7.47	4.43	3.98–4.88
Smoke (no = 0, yes = 1)	1.43	1.10–1.77	3.64	3.31–3.97
Self-rated health				
Poor or not so good		Reference group		
Good	0.25	−0.14 to 0.64	−0.34	−0.70 to 0.02
Very good	−0.24	−0.78 to 0.30	−0.43	−0.95 to 0.10
Pregnant (no = 0, yes = 1)			−10.49	−11.58 to −9.39

good or very good self-rated health was not associated to Hb when compare with poor or not so good health.

A second model was also assessed, adding other lifestyle factors as education, alcohol and coffee consumption, physical activity and parity (data not shown). Addition of these lifestyle factors did not change the associations presented in Table 4. The effect on Hb of these additional lifestyle factors was small. In women not men, education from high school, college or university was to some extend negatively associated to Hb (0.23 g/L and 0.39 g/L respectively) compared with compulsory school. Increasing amount of alcohol consumption showed a linear trend in both genders with the maximum effect on Hb when drinking 15+ glasses per fortnight compared with zero glasses (0.69 g/L and 0.98 g/L, men and women respectively). Coffee consumption and hard physical activity were to some extend negatively and linearly associated with Hb in men, but not in women. The strongest associations were at 10+ cups of coffee (−1.63 g/L) and with more than 2 h of hard physical activity per week (−1.22 g/L) compared with the reference groups. For women, three or more children were negatively associated with Hb (−1.02 g/L) compared with no children.

BMI had the largest impact on explained variance of Hb, contributing 5.6% and 2.7% for men and women, respectively. Age and smoking contributed 3.8% and 0.5% in men, and 2.3% and 2.9% in women. The effect of smoking was dose-dependent in both genders (data not shown). Cigarette smoking of 0, 1–10, 11–20 and 21+ cigarettes/d was associated with a Hb of 144 g/L, 144 g/L, 146 g/L and 148 g/L in men, respectively, and 132 g/L, 135 g/L, 137 g/L and 141 g/L in women respectively.

Self-rated poor or not so good health increased with age in both genders, but the trend levelled off among the oldest men (data not shown). The prevalence increased from about 14% among young subjects, to 57% and 79% in the oldest men and women. Figure 2 presents the crude- and age-adjusted association between poor or not so good self-rated health and quintiles of Hb. For men, the association between Hb and poor or not so good health was U-shaped with the lowest rates in the second and third quintile. For women, the association between Hb and poor or not so good health was J-shaped with the lowest rate in the second quintile. The difference of poor or not so good health between the first and second quintile of Hb was significant in men but not women. However, when stratified by age, there was no significant difference in self-rated poor or not so good health between the first and second quintile in either gender among those aged 25–44 yr. In contrast, there was a significant difference between the first and second quintile among men aged 65–74 yr and women above 74 yr.

Discussion

Haemoglobin

This is the first Norwegian study on distribution of Hb in total birth cohorts of a free-living population. The participation rates in this study increased from 55% among the youngest, to a maximum of

91% in women aged 55–64 yr. The high participation rates reinforce our results.

As in other studies (2, 6), mean Hb decreased with age for men. In women, Hb was highest after menopause and then declined among the oldest subjects. It has been discussed whether the mild anaemia in the elderly is likely to reflect physiological or pathological processes (2, 12–15). Nilsson-Ehle *et al.* have previously demonstrated an age-related decline in Hb also among healthy elderly subgroups of the population (16). This decline was most pronounced in men and might be explained by a reduced erythroid bone marrow capacity (13, 17).

Subjects who reported previous or present diseases that could influence on Hb did not differ in mean Hb compared with those who did not report these diseases. The overall mean ± SD of Hb in our study was 148 ± 9 g/L for men and 134 ± 10 g/L for women. In contrast, a previous Norwegian study reported mean Hb values of 156 ± 10 g/L for men, and 142 ± 10 g/L for women (18). The participants were highly selected employees from an electro-technical company, and smoking was probably more prevalent. Several Norwegian subgroups were investigated from 1952 to 1966 (6, 18–22). The cohorts consisted of industrial workers and old people from residential homes, and were not representative for the Norwegian population. As in our study, the method of cyanmethhaemoglobin was used in the analysis of Hb. Specially trained medical staff performed finger pricks from capillary blood (6, 19–22) or venopuncture from a cubital vein (18). Capillary blood specimens have slightly lower values than venous blood specimens. Different laboratories conducted their analyses. We used venous blood only, and a more precise, standardized automated blood cell counter from one laboratory with an analytic variance of < 1%. The distribution of Hb is probably more representative in our general population.

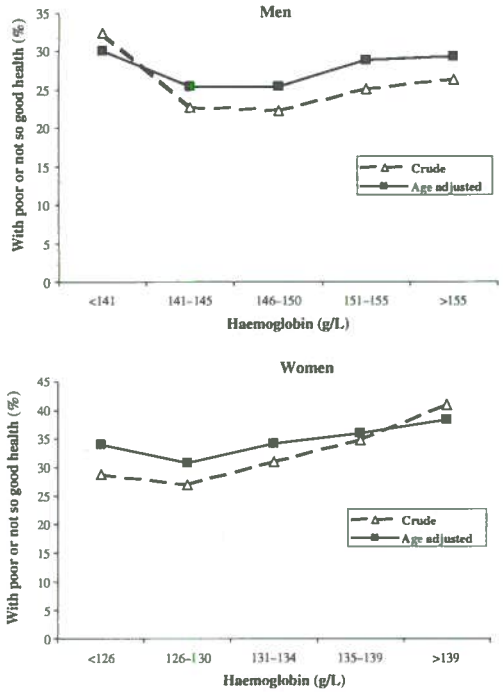

Fig. 2. Crude and age-adjusted association between poor self-rated health and quintiles of haemoglobin among men and women (The Tromsø Study 1994–95).

Several cross-sectional studies report a positive association between BMI and Hb (3, 23, 24). Why obese people have higher Hb than lean people is not clear. Our finding of higher mean Hb among smokers compared with non-smokers confirms earlier studies (3, 14, 25). For women, the detectable difference was strongest between non-smokers and smokers, whereas among men, higher Hb levels were most pronounced among excessive smokers. This is in accordance with data presented by others (4, 5, 14). The habit of coffee consumption to meals is prevalent in our population. To some extend, the negative association between Hb and coffee in men, may be explained by inhibited iron absorption (5, 26, 27). The negative association between Hb and education in women might be elucidated by smoking habits. Likewise, fewer smokers in the high activity cohort could explain the negative association between Hb and hard physical activity in men. The amount of exercise was probably too low to be explained by haemolyses or iron loss (28). The positive association between Hb and alcohol have been reported by Milman *et al.* (3). The association may be explained by the close relationship between alcohol and smoking, but Milman *et al.* have also found a positive association between alcohol and ferritin (26) that may be due to increased iron absorption or liver cell damage.

The total explained variance was 9.5% and 12.2%, men and women respectively, indicating that the observed variation in Hb also could be explained by other factors not included in the model.

Generalizability of the WHO criteria for anaemia

WHO modified the arbitrary cut off values for when anaemia should be considered to exist in 1968. A report from a Norwegian male population aged 15–21 yr contributed to this modification (19). Another report contributing to this modification was a population-based study from South Wales,

with random samples of male miners and non-miners aged 35–64 yr and women aged 55–64 yr (29). In this report, they arbitrarily defined anaemia as Hb below 125 g/L for men and 120 g/L for women. In total, 3.3% of the men and 13.9% of the women were defined to be anaemic. The figure for women is strikingly high compared with our study where the same age group has the lowest prevalence of anaemia (2.2%). None of the other reports contributing to the WHO criteria was based on populations comparative with our population. The WHO criteria were based on a limited number of reports where especially the elderly of both genders and the younger non-pregnant women were not investigated.

Are the WHO criteria for anaemia appropriate in our population?

Mean BMI was above the WHO classification of overweight in both genders (30). We did not measure iron stores, but in 2001, 8130 subjects (78% of the invited) were reinvestigated. The subset consisted of those who attended a more extended examination of the 1994–95 survey (all men born 1925–39, all women born 1925–44 and a 5–10% random selection of the other age groups, in total 78% of the invited), in addition, all inhabitants born 1971, 1961, 1956 and 1941 were invited in 2001. The mean transferrin saturation (serum iron/total iron-binding capacity percentage) was 26.8% and 25.2% in men and women respectively (A. R. Broderstad, personal communication). Although our population is mainly well-fed, anaemia was relatively prevalent, especially among fertile women and in the elderly. By using the WHO criteria in our study, 16% of males above 75 yr were anaemic, and 8% of females between 35–44 and 75+ yr were anaemic. In men, the difference between the WHO criteria and the 2.5 percentile was small and not practically important. In women, however, the WHO criteria gave a two to three times higher prevalence of anaemia compared with the 2.5 percentile. If we exclude subjects with MCV below the gender-specific 2.5 percentile, the 2.5 percentile of Hb would be 130 g/L and 117 g/L, men and women respectively. In women, the crude prevalence of anaemia would then be 4.7% according to the WHO criteria, compared with 2.4% according to the 2.5 percentile of Hb. Although the central 95% interval is a common method for defining reference intervals, the 2.5 percentile in our study might also not be valid as criteria for anaemia. Our material is not sufficient to decide this matter.

Our clinical evaluation of severely anaemic women confirms that the dominating cause of anaemia among women is iron deficiency (31). The high prevalence of anaemia among older men is well-documented and often due to chronic disease, inflammatory conditions or reduced haematopoiesis rather than iron deficiency (12, 31–33). In our study, six subjects above 74 yr had severe anaemia because of iron insufficient diet or gastrointestinal bleeding.

The question 'How would you evaluate your own overall health?' is previously evaluated according to coronary risk profile in our population (34). Both self-rated health and Hb have in separate studies demonstrated to be independent predictors of mortality (33, 35). Salive *et al.* (14) found that self-rated health was not a strong independent correlate for neither anaemia nor Hb. Self-rated health in our study was associated with the Hb level among the oldest subjects only. This could be explained by comorbidity other than anaemia. We compared the age-specific prevalence of self-rated poor and not so good health among anaemic subjects and subjects with normal Hb. In women, there was no significant difference in poor and not so good health between the two groups. In men, there was a significant association between poor self-rated health and anaemia in some age groups (35–44 and 65–74 yr). Our findings support that the WHO criteria for anaemia is probably too high in women.

Elevated haemoglobin

The definition of elevated Hb varies from 169 to 180 g/L for men and 150 to 165 g/L for women (36). Normal values are often defined as the mean ± 2 SD, representing approximately the 2.5–97.5 percentile. In this study, the 97.5 percentile was 166 g/L for men and 152 g/L for women. The predefined criteria for further evaluation after the screening were Hb ≥180 g/L (men) and ≥170 g/L (women). Despite of this high level, none of the evaluated subjects suffered from undiagnosed severe haematological disease.

Conclusion

In a free-living and well-fed population, the WHO criteria for anaemia and the 2.5 percentile for Hb corresponded well for Norwegian men, but not for women. The association between self-rated health and anaemia was weak. The WHO criteria of anaemia may result in medicalization of healthy women.

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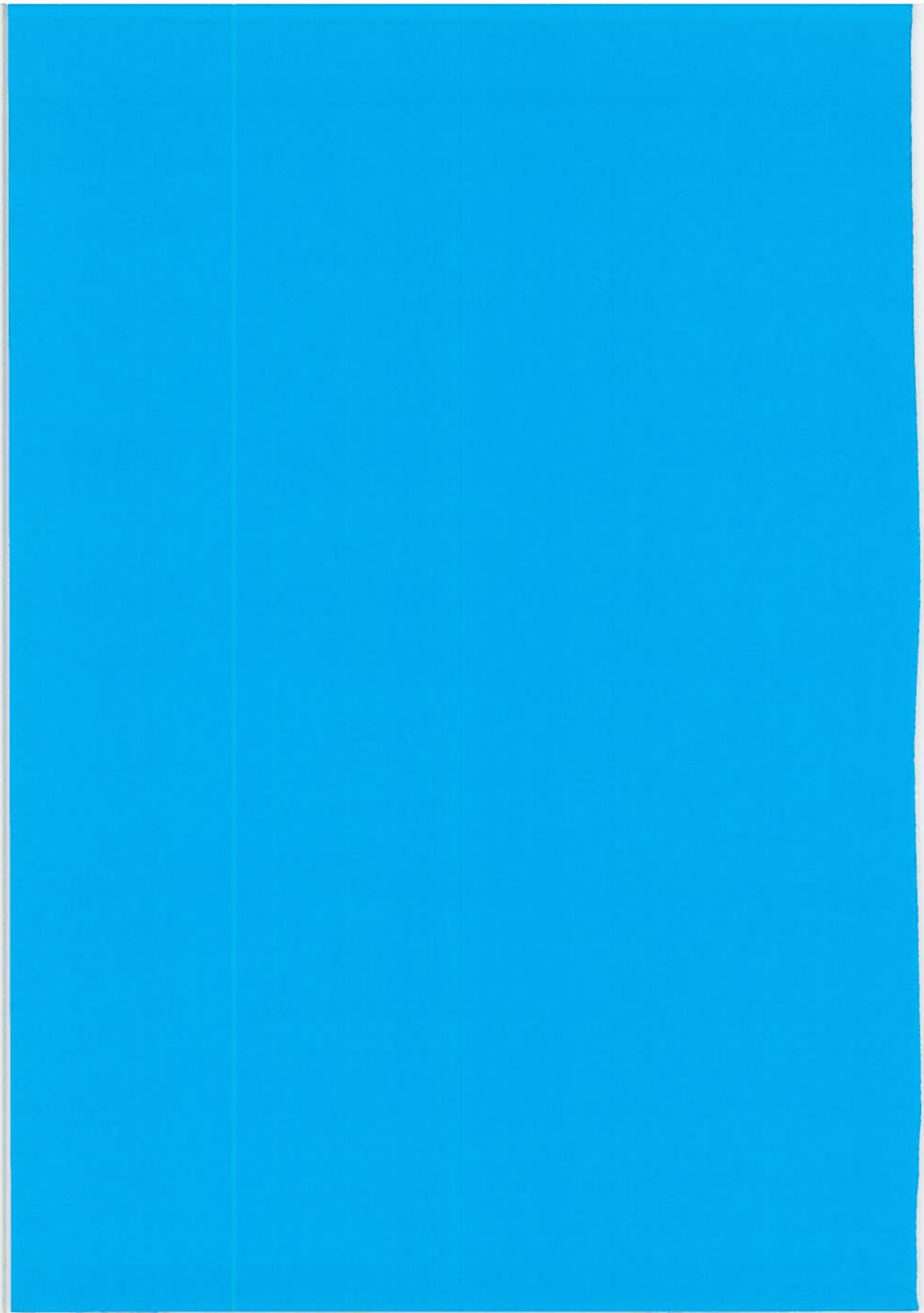
Paper II



Changes in lifestyle influence change in haemoglobin levels in men in a general population.

The Tromsø Study 1974-1995.

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Abbreviations: BMI = body mass index; CI = confidence interval; SD = standard deviation

ABSTRACT

Haemoglobin declines with increasing age in cross sectional studies. Little is known about the longitudinal changes of haemoglobin. Because both high or low haemoglobin levels increase mortality and morbidity we examined how changes in lifestyle factors like body mass index (BMI) and smoking habits influence changes in haemoglobin level. In all, 4159 men aged 20-49 years at baseline were examined in 1974 and 1994-95 in a longitudinal, population based study from the municipality of Tromsø, Northern Norway. Mean haemoglobin was 148 g/L. There was no difference in mean haemoglobin between the two surveys in any strata of age. Mean BMI increased 2.1 kg/m^2. The prevalence of smokers decreased 20.1 percentage points. In a multiple regression analysis increase in BMI was positively associated with haemoglobin change. Smoking cessation lowered mean haemoglobin 1.6 g/L compared to never smokers. This effect was attenuated in men who put on weight. Haemoglobin increased 0.8 g/L in smoking quitters whose BMI increased >2.5 kg/m^2 compared to a decrease of 6.7 g/L in weight reducers. There was a positive dose response relationship between cigarettes smoked per day and change in haemoglobin among consistent smokers. In conclusion, in contrast to cross sectional studies, mean haemoglobin did not change during 20 years ageing of relatively young men. This could be explained by higher BMI and less smoking. The increase in BMI affected haemoglobin change to such an extent, that the haemoglobin reduction due to smoking cessation was counteracted. Prospective studies are needed to address the health implications.

INTRODUCTION

Haemoglobin levels predict morbidity and mortality. Some previous studies have found that high haemoglobin increases mortality from heart disease [1]. Others have found that low haemoglobin is a risk factor for cardiovascular disease [2], and chronic diseases [3, 4]. A change in haemoglobin may thus have health implications.

In cross sectional studies, haemoglobin declines with increasing age [5-7]. There are only a few longitudinal studies on the cohort changes of haemoglobin with ageing. Two studies including men aged 13 to 80 years [8] and 20 to 45 years [9], have found an increase in mean haemoglobin up to men's forties. Cohorts of healthy 70 to 81 years old subjects showed a decline in haemoglobin with advancing age [10].

Body mass index (BMI) and smoking are positively associated with haemoglobin [7, 11-13], as well as risk factors for cardiovascular disease [14, 15]. Nutritional status and smoking habits have changed in the past decades in the developed world. The prevalence of obesity is increasing [16], whereas the prevalence of male smokers is decreasing [17]. Smoking cessation has previously demonstrated to be associated with a decrease in haemoglobin level in male industrial workers [18].

No previous studies have presented prospectively how changes in different lifestyle factors can predict changes in haemoglobin in a general population. The aim of the present study was to assess the effect of these changes in a cohort of young and middle-aged men in a general population followed for 20 years. We evaluated these associations in different categories of change of smoking status and in strata of baseline age and BMI.

METHODS

Subjects

Tromsø is situated at sea level in the northern part of Norway. The population is predominately middle-class of Norwegian, Finnish or Sami origin. The Tromsø Study is a multipurpose, population-based, prospective study of total birth cohorts, initiated in 1974 with repeated surveys in 1979-80, 1986-87 and 1994-95. In 1974, the survey was conducted by the University of Tromsø and called the Tromsø Heart Study. All men aged 20-49 years were invited (n=8867) [19]. Of these, 6542 (74 %) attended and had their haemoglobin analyzed. In 1994-95, the Institute of Community Medicine, University of Tromsø, conducted the survey in co-operation with the National Health Screening Service. All inhabitants aged 25 and above were invited. A total of 4159 men were from the first cohort of 1974, 64% of the men who attended the screening in 1974. The total population of the 1994-95 study has been described earlier [20].

The Committee for Medical Recearch Ethics was not established during the first three Tromsø studies, but has recommended the Tromsø Study 1994-95.

Measurements

The procedures and questionnaires at each survey have been described in details elsewhere [19, 21, 22]. The Department of Clinical Chemistry, University Hospital of North Norway analysed all blood samples.

The cyanomethaemoglobin method was used for haemoglobin determinations from a venous blood sample. In 1974, the analyses and standardisations were performed manually (Drabkin's method) [23], whereas an automated blood cell counter (Coulter Counter ®) was used in the 1994-95 analyses. Height and weight were measured with participants wearing

light clothing and no shoes. Body mass index was calculated as weight in kilograms divided by the square of height in meters. The results did not change if subjects with increased height of more than three cm (n=34) or decreased height of more than five cm (n=26) between the surveys were excluded.

The smoking question in 1974 was: "Do you smoke daily at present?" (Yes/no). In 1994-95 the question was: "Do you yourself smoke: Cigarettes or cigars/cigarillos or pipe daily?" (Yes= yes to any of these three questions, No= no to all of these three questions). Consistent smokers were those reporting to be smokers both in 1974 and in 1994-95. Both surveys asked: "How many cigarettes do you smoke per day?", of which 95 answers were missing among consistent smokers. The question about leisure time physical activity changed between the two surveys. However, the questions were identical in the 1974 and 1986-87 surveys. Consequently we used change between these two surveys as our estimate of change in physical activity. Leisure time activity was graded from sedentary; moderate; hard; to very hard. There was no information on coffee consumption or alcohol habits in the first survey. Consequently, to include these variables, we used changes between the 1979-80 and the 1994-95 survey. The questions were: "Are you a teetotaller?" (Yes/no) and: "How many cups of coffee do you drink daily?" Coffee consumption was categorized as: <1, 1-4, 5-8, and ≥ 9 cups per day.

Statistical analysis

Tests for differences between 1974 and 1994-95 were performed with t-tests or chi-square (Mc Nemars test) for paired data. Cross sectional comparisons were made using two-sample t-tests. Multiple linear regression analyses were used to investigate the impact of the various variables on haemoglobin change. Changes (Δ) were the differencs between two surveys (e.g., ΔBMI= BMI [1994-95]) – BMI [1974]). Baseline refers to the survey in 1974. Change in

haemoglobin was the dependent variable. Baseline age (5 year age groups), ΔBMI, and changes in; smoking habits, leisure time physical activity, alcohol and coffee consumption were possible predictors. Mean haemoglobin of the 1974 and 1994-95 surveys, and baseline BMI were included as covariates. The categorisation of smoking habits was based on the changes in the variable current daily smoker (yes/no) from both surveys (non-smoker [reference group], consistent smoker, started smoking and stopped smoking). Two-way interactions were modelled as the products between age and ΔBMI, or change in smoking habits, and products between baseline BMI and ΔBMI.

Analyses of covariance were used in order to estimate mean haemoglobin change in subgroups adjusted for different covariates. ΔBMI was divided into 5 categories (cutpoints: 0, 1, 2, 3).

Owing to missing data, the number of subjects included in the analyses varied slightly. The data were processed using the SAS software package (SAS Institute Inc, Cary, NC; Version 8.2).

RESULTS

Table 1 presents baseline characteristics by age and the change in the characteristics compared to the follow up study in 1994-95. Mean haemoglobin decreased with age in both surveys (p for trend < 0.0001). There was no significant difference between mean haemoglobin in 1974 and mean haemoglobin in 1994-95 in any age strata. At baseline, BMI increased with age. Between 1974 and 1994-95 mean BMI increased 2.1 kg/m^2 (data not shown), most pronounced among the youngest. At baseline, 55-60 % of the population smoked daily. During the 20 years of follow up, the prevalence of daily smokers decreased for all age groups, more so among the oldest (24.6 percentage points). Among the youngest consistent smokers, the daily number of cigarettes was on average 0.9 cigarettes higher in 1994-95 than in 1974. In contrast, there was a decrease in number of cigarettes among those aged 30-49 years. There were more teetotallers in all age groups in 1994-95, and fewer who carried out regular or hard physical activity.

Figure 1 demonstrates the age specific mean haemoglobin in the 1974 and in the 1994-95 surveys (for men < 70 years). Mean haemoglobin of men aged 25-49 years was higher in 1994-95 compared to the 25-49 years old in 1974 ($p < 0.0001$). The result did not change if those who did not attend the follow-up in 1994-95 were included. In total, 47% of the 40-69 year old men in 1994-95 were from the cohort who attended both surveys (20-49 years old in 1974). The curve from the 40-69 years old that attended both surveys was concurrent with the curve from all attended 40-69 years old in 1994-95.

Table 2 presents the association between change of haemoglobin and baseline age, ΔBMI and smoking status. Both age and ΔBMI were positive predictors of haemoglobin change. A significant decrease in haemoglobin change (1.56 g/L) was demonstrated in men who stopped smoking compared to never smokers. There was no evidence of interactions or that the covariates confounded the variables of interest. Changes of physical activity, alcohol

consumption and coffee drinking were not significant in this model, and were therefore not included.

Table 3 presents haemoglobin change stratified by change in BMI and smoking habits adjusted for several covariates. When BMI decreased between the two surveys, haemoglobin decreased for all categories of change in smoking habits, but most pronounced among those who stopped smoking (6.7 g/L). The decrease in haemoglobin after smoking cessation was weakened when BMI increased. When BMI increased more than 2.5 kg/m^2, haemoglobin increased for all categories of change in smoking habits including those who stopped smoking.

Figure 2 demonstrates age adjusted mean haemoglobin change across levels of change in number of cigarette among consistent smokers. Changes in number of cigarettes smoked per day were categorised as: Reduction of more than five cigarettes ('< -5', n=221), reduction of 1 - 5 cigarettes ('-5 - -1', n=333), no change ('0', n=316), increase of 1-5 cigarettes ('1-5', n=302), increase of more than five cigarettes per day ('>5', n=141). Among consistent smokers, there was a dose-response relationship between change in haemoglobin and change in number of cigarettes per day (p for trend 0.0035). Adjustment for ΔBMI did not change the relationship (p for trend 0.007).

DISCUSSION

To our knowledge, this is the first longitudinal study on how changes in lifestyle factors can influence haemoglobin changes in a general male population. BMI was positively associated with haemoglobin change, whereas smoking cessation compared to never smoking was negatively associated with haemoglobin change. We have shown that this effect was attenuated when BMI increased. There was a positive dose-response relationship between haemoglobin change and change in amount of cigarettes smoked.

Methodological aspects

Our study was population based, had a prospective design and included a large number of men with a relatively high follow-up rate. Any generalisation regarding women cannot be made. A comparison of baseline characteristics between the study group who attended both surveys and those who did not attend the follow up (dropout group) gave us no reason to suspect any significant selection bias. However, mean haemoglobin was 0.5 g/L higher in the dropout group compared to attendees. This difference was probably due to a 5-percentage points higher prevalence of smokers and more cigarettes smoked in the dropout group. The dropout group was also 0.7 years younger. Younger subjects are more likely to move and are known to attend health studies less often. This could explain the age difference. Chronic diseases (angina, heart attack, stroke, diabetes or gastric /duodenal ulcers) were reported by 3.3% (attendees) and 4.5% (dropouts). A significant number of subjects with chronic diseases might have confounded haemoglobin changes in the follow up group as well. Excluding the 21% participants, who in either survey reported to have had a history of chronic disease or used antihypertensive drugs at present, did not change the presented results or trends.

The cyanomethhaemoglobin method was the basis for all haemoglobin measurements. The manual Drabkin's method (1974) was the gold standard, but the automated blood cell count (1994-95) is even more precise. Others have reported the automated haemoglobin values to be lower than the manual method [24, 25]. We assume that the change in method would effect all measurements similarly, and believe that this did not effect the associations between lifestyle factors changes and haemoglobin change.

Haemoglobin

Mean haemoglobin was higher in 1994-95 compared to haemoglobin in the same age groups in 1974, more so in the youngest (Figure 1). During the same period the youngest also had the most extensive increase in BMI. This change could contribute to the mean increase in haemoglobin. However, the smoking prevalence decreased 20.1 percentage points between the two surveys, which contributes to a decrease in mean haemoglobin, less so in the youngest that stopped smoking to a lesser extent.

In the cross sectional perspective, haemoglobin decreased 1.7 g/L between 25-29 and 45-49 years old in 1974, and 2.3 g/L between 25-29 and 45-49 years old in 1994-95. The age related fall in haemoglobin is in accordance with other cross sectional studies [5, 6]. A longitudinal change in subjects aged 25-29 years in 1974 to 45-49 years in 1994-95 demonstrated however, a non-significant decrease in mean haemoglobin of 0.4 g/L. In the regression analysis, baseline age (20-49 years) was even positively associated to haemoglobin change, which is in accordance to a Japanese [8] and a Russian study [9]. If we could adjust for the possible systematic lowered automated cell count in 1994-95, the longitudinal trend in haemoglobin would probably be an increase by age, especially in the youngest. The World Health Organization (WHO) defined the cut off values for low haemoglobin (anaemia) in

1968 [26]. The last decade's possible development towards a higher distribution level of haemoglobin is not accounted for.

Lifestyle factors and haemoglobin

In 1994-95, the 25-49 years old had a BMI 1.1 kg/m^2 higher compared to the 25-49 years old in 1974. This means that a 170 cm tall man in 1994-95 would be 3.2 kg heavier compared to a man of the same height in 1974. The increasing BMI in this population is described in detail earlier [27]. Overweight and obesity lead to adverse metabolic effects. But why obese people have higher haemoglobin values than lean people is not clear. The difference is probably in the red cell mass rather than in the nutritional differences [28]. Garn and Clark [28] demonstrated that obese men had 3 g/L higher mean haemoglobin compared to lean men. We were able to confirm the cross sectional [7, 11, 12] association between haemoglobin and BMI in this longitudinal study.

Smoking increases carboxyhaemoglobin concentration [29], the oxygen delivery to the tissue decreases and synthesis of haemoglobin is stimulated. Green and Harari [18] presented a 1-4 years follow up study of 987 male industrial workers aged 20-64 years. They found in an age adjusted regression analysis that haemoglobin declined 3.7 g/L in those who quit smoking compared to never smokers. In an age-adjusted regression analysis of our population, haemoglobin declined 0.8 g/L in those who quit smoking compared to never smokers. A possible explanation for this difference could be that industrial workers smoke more cigarettes per day than men from a general population. We demonstrated a positive dose-response association between haemoglobin change and change in amount of cigarettes among consistent smokers (Figure 2). Cross sectional findings have also demonstrated a dose-response relationship between mean haemoglobin and amount of cigarettes per day [7, 29].

Our findings support the WHO's recommendation of adjustment of haemoglobin reference values for smokers [30].

In a cross sectional study from the Tromsø population of the 1994-95 survey, significant associations between haemoglobin and hard physical activity, alcohol- and coffee consumption were observed [7]. These relations were not confirmed in this longitudinal study.

Implications

A population-based increase in haemoglobin may have health implications. Increased haemoglobin levels increase blood viscosity, and this could partly explain why haemoglobin is an independent risk factor for cardiovascular events [31]. Additionally, low haemoglobin can be a predictor of chronic diseases [3]. If the definition of low haemoglobin is not reflecting the population's true distribution of haemoglobin, early signs of disease could be overlooked.

Conclusions

Mean haemoglobin did not change during 20 years of observation. This could be explained by changes in lifestyle factors. Although smoking cessation decreased haemoglobin levels, this probably healthy effect was partly counteracted by the increased prevalence of obesity. Prospective studies of mortality are needed to address the health implications of a possible population based increase in haemoglobin.

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Table 1 Baseline characteristics and the follow-up changes, by baseline age. Values are means (SD) or percentages. The Tromsø Study 1974 - 1994-95.

	Age (1974)	N	Baseline 1974	Change 1994-95	*p*-value*
Haemoglobin (g/L)	20-29	1433	149.0 (9.4)	-0.5 (9.3)	0.051
	30-39	1525	148.1 (9.2)	0.1 (9.4)	0.742
	40-49	1201	147.4 (9.3)	-0.3 (10.8)	0.318
Body mass index (kg/m^2)	20-29	1430	23.3 (2.7)	2.7 (2.5)	< 0.0001
	30-39	1523	24.2 (2.5)	2.1 (2.1)	< 0.0001
	40-49	1199	24.7 (2.8)	1.3 (2.4)	< 0.0001
Daily smoking (%)	20-29	1433	59.9	-17.3	< 0.0001
	30-39	1524	55.6	-19.2	< 0.0001
	40-49	1199	58.4	-24.6	< 0.0001
Cigarettes (n)[†]	20-29	522	13.9 (5.9)	0.9	0.0005
	30-39	454	15.5 (8.0)	-0.9	0.01
	40-49	337	14.8 (7.7)	-3.3	< 0.0001
Teetotallers (%)[‡]	20-29	1063	4.8	1.3	< 0.0001
	30-39	1224	5.6	1.8	< 0.0001
	40-49	981	9.5	4.8	< 0.0001
Regular or hard physical activity (%)[§]	20-29	1271	28.9	-2.0	< 0.0001
	30-39	1416	27.1	-2.5	< 0.0001
	40-49	1128	17.9	-1.2	< 0.0001

*) For difference between 1974 and 1994-95. [†]) Smokers both in 1974 and 1994-95. [‡]) Data from the 1979-80 and 1994-95 surveys. [§]) Data from the 1974 and 1986-87 surveys.

Table 2 Multiple linear regression analysis of how change in different lifestyle factors effect on haemoglobin (g/L) change. The Tromsø Study 1974 - 1994-95.

	Δ Haemoglobin (g/L)		
	β*	95% CI	*t*-value
Age in 1974 (5 years)	0.44	0.25 - 0.63	4.49
Δ BMI (1 kg/m^2)	0.89	0.76 - 1.03	13.06
Smoking status			
Never smoker (n=1585)	0	Reference group	
Consistent smoker (n=1405)	0.70	0.00 - 1.40	1.97
Started smoking (n=162)	1.13	-0.43 - 2.69	1.42
Stopped smoking (n=997)	-1.56	-2.33 - -0.79	-3.97
Baseline BMI (1 kg/m^2)	-0.04	-0.15 - 0.08	-0.60
R^2 (%)	4.3		

*) All listed variables are adjusted for each other and for mean haemoglobin 1974 - 1994-95.

Table 3 Adjusted*) change in haemoglobin (g/L) by change in BMI and smoking habits. The Tromsø Study 1974 – 1994-95.

		Smoking habits					
		Never	Stopped	Started	Consistent†		
					Reduced	Even	Increased
Δ BMI (kg/m^2)	n	1585	997	162	554	315	442
< 0	707	-2.1	-6.7	-3.4	-3.2	-3.3	-1.9
0 - 1	608	-2.8	-2.6	0.9	-2.3	1.7	-0.0
1.1 - 2.5	1109	-0.5	-1.5	0.5	-0.9	-0.1	1.5
> 2.5	1631	2.1	0.8	2.1	1.9	2.1	4.2
p for trend		< 0.0001	< 0.0001	0.0060	< 0.0001	0.0021	< 0.0001

*) ΔHaemoglobin adjusted for age and mean haemoglobin 1974 - 1994-95. †) Change in number of cigarettes smoked per day.

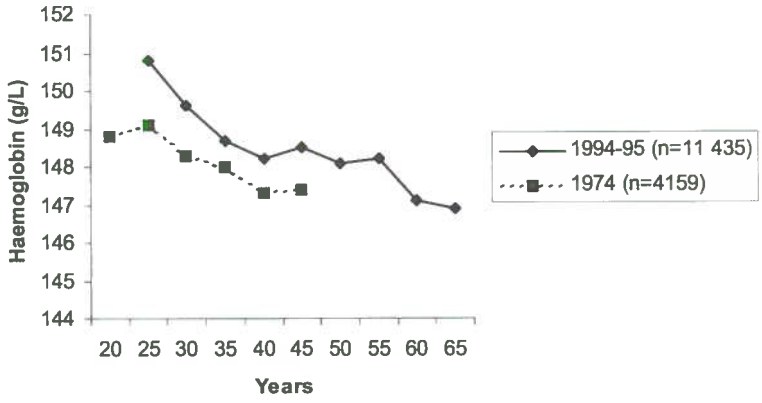

Figure 1. Mean haemoglobin by age in men. The Tromsø Study 1974 – 1994-95.

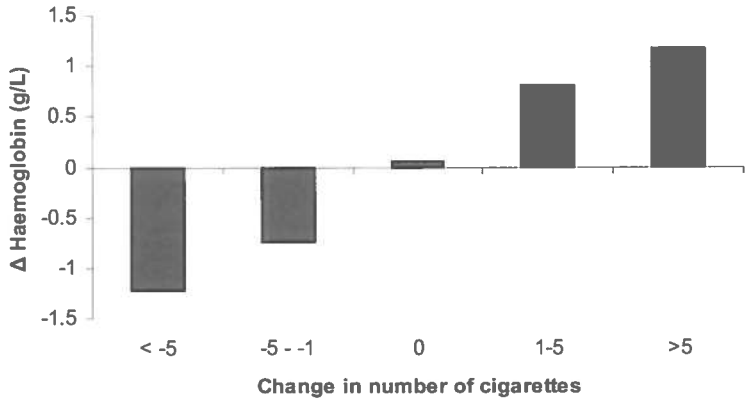

Figure 2. Mean change of haemoglobin (ΔHaemoglobin) according to change in number of cigarettes per day among those who smoked both in 1974 and 1994-95, adjusted for baseline age. The Tromsø Study 1974 – 1994-95.

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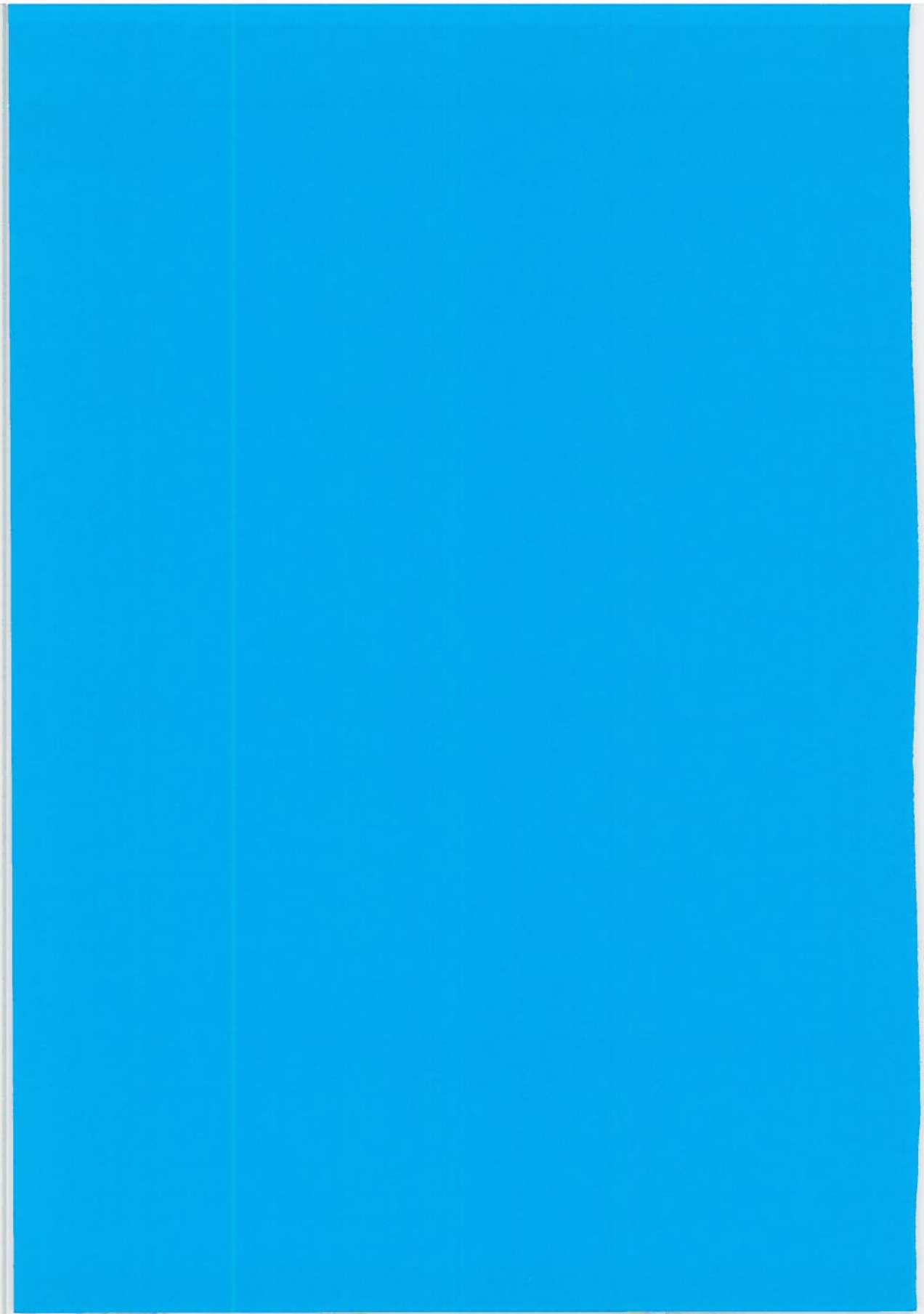

Haemoglobin predicts total mortality in a general young and middle-aged male population. The Tromsø Study.

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Abstract

Objective: The prognostic value of haemoglobin within normal references is seldom emphasized. The relationship between haemoglobin and mortality has been questioned due to possible confounding of other risk factors. We investigated the relationship between haemoglobin and total mortality, and evaluated the possible modifying effects of smoking, body mass index, total cholesterol and systolic blood pressure.

Study Design and Setting: In a population study from Tromsø, Northern Norway, 6,541 men aged 20-49 years were examined in 1974. During 20 years follow-up (127,120 person years), 495 deaths were identified.

Results: We found a U-shaped relationship between quintiles of haemoglobin and total mortality. Among the 35-49 years old the multiple adjusted hazard ratios (95% CI) were 1.83 (1.31-2.57) in quintile 1 and 1.72 (1.23-2.41) in quintile 5, compared to quintile 3 of haemoglobin. Compared to the age adjusted hazard ratios, the multiple adjustments tended to non-significantly enhance the association in the lowest quintiles and non-significantly attenuate the association in the highest quintiles. The relationship was most pronounced in smokers in a dose response manner, but also present in non-smokers.

Conclusion: Haemoglobin level had prognostic value. Smokers in quintile 1 and quintile 5 of haemoglobin were at increased risk of dying.

Key words: haemoglobin, total mortality, smoking, risk factor, predictor, epidemiology.

Running title: Haemoglobin predicts mortality

Word count: 2355

1. Introduction

Whereas the clinical significance of low and high haemoglobin is a common question in daily life medicine, the prognostic value is seldom emphasized. Haemoglobin has shown to be a predictor of mortality in some studies [1-5]. Lower death rates have been reported among subjects with haemoglobin values near the mean compared to subjects with haemoglobin one or more standard deviations (SD) from the mean [1]. High haemoglobin increases the risk for mortality from heart disease [2, 4], whereas persons with low haemoglobin are at increased risk for cardiovascular and other chronic diseases, cancer, and all-cause mortality [5-8].

Haemoglobin is positively associated with smoking, body mass index (BMI), blood pressure and total cholesterol [9-13]. These cardiovascular risk factors are therefore possible confounders in a model that addresses the relationship between haemoglobin and total mortality.

We assessed the association between haemoglobin concentration and total mortality in men in a 20-years' follow-up study. Analyses of the relationship between quintiles of haemoglobin and total mortality were performed. We stratified according to smoking habits. Other cardiovascular risk factors were assessed as confounders.

2. Materials and methods

2.1 Subjects

Tromsø is situated at sea level in the northern part of Norway. The population is predominately middle-class of Norwegian, Finnish or Sami origin. The Tromsø Study is a multipurpose, prospective population study of total birth cohorts in the municipality of Tromsø, initiated in 1974 with repeated surveys in 1979-80, 1986-87, 1994-95 and 2001. In 1974, all men who were 20-49 years of age were invited. The total number of men registered on the official census of 1 September 1973 was 8,867, of which 935 lived outside the municipality. The total number of examined was 6,595, of whom 6,542 had their haemoglobin analysed (82.5 % of the eligible population). One subject was later lost to follow-up, leaving 6,541 subjects for the following analyses.

In 1974, the survey was carried out by the University of Tromsø and named the Tromsø Heart study. The Committee for Medical Recearch Ethics was not established during the first three Tromsø studies, but has recommended the later surveys.

2.2 Measurements

Information on the procedures and questionnaires is available elsewhere [14-16]. The Department of Clinical Chemistry, University Hospital of North Norway analyzed all blood samples.

Non-fasting blood samples were taken of the participants in a sitting position. Haemoglobin was measured on venous blood samples by using the cyanomethaemoglobin method. Determination and standardization were performed according to the recommendations of the International Committee of Standardization in Haematology [17]. The minimum and maximum levels of haemoglobin were 85 and 225 g/L. The central 95%

interval was 130-166 g/L. Total cholesterol was analyzed according to a Liebermann-Burchard procedure [18]. Height and weight were measured with participants wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Systolic blood pressure was read to the nearest even number of mmHg after 4 minutes of rest. Two readings were taken at 4-5 minutes intervals with a mercury sphygmomanometer on the left upper arm with the subject in a sitting position. The lowest reading of the appearance of the first Korotkoff sound (phase 1) was used for analysis.

2.3 Case identification

The national 11-digit personal identification numbers from the study file were matched with the Registry of Death at Statistics Norway. The subjects were followed from the date of examination through 1 September 1994.

2.4 Statistical analyses

Mortality rates were based on the number of person-years calculated from date of examination until date of death, date of emigration (n=40), or the end of follow-up. Age adjustment of mortality rates was performed according to the direct method on 5-year age groups with all invited men as the standard population. Linear trends across categories were tested by linear regression or logistic regression (smoking). Tests for differences between binary variables were performed using chi-square test for cross tables. The 95% confidence intervals (95% CI) of rates were calculated according to the Poisson distribution.

We used a Cox proportional hazards model to assess the independent association between haemoglobin and mortality after adjustment for covariates. The cohort was divided into approximate quintiles on the basis of haemoglobin concentrations: <141 g/L (quintile 1), 141-

145 g/L (quintile 2), 146-150 g/L (quintile 3), 151-156 g/L (quintile 4) and >156 g/L (quintile 5). The mid quintile (quintile 3) or the three middle quintiles (quintiles 2-4) were used as reference.

The variables BMI (kg/m^2), total cholesterol (mmol/L) and systolic blood pressure (mmHg) were included as continuous covariates. Daily smoking was included as a binary variable. The question was 'Do you smoke daily at present? (Yes/no)'. Current smokers were asked' How many cigarettes do you smoke per day?'. Two-way interactions were modelled as the products between quintiles of haemoglobin and age, smoking, body mass index, total cholesterol, or systolic blood pressure. Due to missing data, the number of subjects included in the different analyses varied slightly. P-values < .05 were regarded statistically significant. The SAS statistical package version 9.1 was used (SAS Institute Inc., Cary, NC).

3. Results

Table 1 presents baseline characteristics of the participants according to quintiles of haemoglobin. Mean age decreased by increasing haemoglobin level ($p < .001$), whereas BMI, total cholesterol, systolic blood pressure, the prevalence of smokers and daily number of cigarettes, increased with increasing haemoglobin level (all $p < .001$).

During 20 years of follow-up (127,120 person-years), 495 (7.6%) deaths were identified. Total crude and age adjusted mortality rates were 3.89 and 3.69 per 1,000 person-years, respectively. The age adjusted mortality rates followed a U-shaped pattern with increasing haemoglobin level. Table 2 presents the association between quintiles of haemoglobin and total mortality by age. The effect sizes were given as hazard ratios and adjusted for age, smoking, BMI, total cholesterol and systolic blood pressure. Quintile 3 of haemoglobin was the reference group. Among 20-34 years old, there was no significant association between haemoglobin and mortality. Among 35-49 years old, a significant U-shaped relationship was observed. The hazard ratios with 95% CI in the lowest and highest quintile of haemoglobin were 1.83 (1.31-2.57) and 1.72 (1.23-2.41), respectively.

The covariates did not confound the associations. However, compared to the age adjusted hazard ratios, the multiple adjustment demonstrated a weak non-significant tendency of enhancing the association in quintile 1 and quintile 2 and attenuating the association in quintile 4 and quintile 5. There was no evidence of other interactions than the variation with age. Analyses by strata of BMI, total cholesterol and systolic blood pressure were nevertheless performed (data not shown, cut-off around median values). Compared to quintile 3 of haemoglobin, BMI ≤ 23.4 kg/m^2 or systolic blood pressure >124 mmHg tended to non-significantly increase the adjusted hazard ratio of mortality in quintile 1 of haemoglobin. BMI >23.4 kg/m^2 or total cholesterol >6.4 mmol/L tended to non-significantly increase the adjusted hazard ratio of total mortality in quintile 5 of haemoglobin.

Persons who smoked had a greater risk of dying than those who did not smoke. The age adjusted mortality rates per 1,000 person-years were 2.1 times higher in smokers (4.94) than in non-smokers (2.35). Table 3 presents adjusted mortality rates and hazard ratios for smoking habits within haemoglobin quintiles. Haemoglobin between 141-156 g/L (quintiles 2-4) was categorized as the middle group, and non-smokers within this group were set as the reference category. The association between haemoglobin levels and age adjusted mortality for non-smokers was U-shaped. The rate for non-smokers in quintile 1 was 1.30 times, and in quintile 5, 1.18 times that of non-smokers in quintiles 2-4. However, there was no significant difference in hazard ratios between non-smokers in different quintiles of haemoglobin. Smoking increased mortality rates in all categories of haemoglobin. In subjects with the lowest and highest haemoglobin concentrations, smoking predicted an approximate 2- fold increase in mortality.

Table 4 demonstrates the dose response relationship in mortality rates and hazard ratios among current smokers within haemoglobin quintiles. Number of cigarettes was categorized as low dose (1-14 cigarettes) and high dose (15+ cigarettes). The age adjusted mortality rate of high dose smokers was 1.24 times higher than that of low dose smokers within quintile 1, and 1.60 times higher than that of low dose smokers within quintile 5. Close to no differences in mortality rates were observed between high and low dose smokers within the middle three quintiles. Compared to non-smokers in quintiles 2-4, the hazard ratio for mortality increased with increasing dose of cigarettes. The increase was most pronounced in quintile 5 where the hazard ratio increased from 1.93 in low dose to 3.09 in high dose smokers.

4. Discussion

To our knowledge, this is the first population-based study on relatively young and middle-aged men that demonstrates an independent U-shaped relationship between total mortality and of haemoglobin levels.

The participation rates in this study were generally high, making selection bias due to non-participation less likely. However, in a 9-year follow-up of this survey, higher mortality rates among non-participants compared to participants were reported (3.55 versus 2.13 per 1,000 person years, respectively) [19]. A total of 4,159 (64%) of the participants were re-examined in 1994-95. We observed no significant change in mean haemoglobin over this 20-year period (unpublished data). In total, 2% of the participants reported to suffer or have suffered from heart disease, chest pain, cerebral stroke or diabetes. Excluding these subjects from the analyses did not change the presented results. Nevertheless, we cannot rule out the residual confounding with other unknown risk factors. No generalization with regard to women can be made.

Haematocrit (the volume of packed red cells) and haemoglobin are highly correlated. A number of studies report on how haemoglobin or haematocrit predict mortality and morbidity. However, most of the studies included older men than our study [1-6, 20-23]. Some studies were population based [1, 5, 20-23], and some reported on total mortality [1, 5, 6, 20-22]. Others have reported haemoglobin to be a risk factor for ischaemic vascular deaths [2-4], and that the crude death rates from myocardial infarction correlated positively to quintiles of haemoglobin [4]. More recently, the Atherosclerosis Risk in Community (ARIC) study found anaemia as an independent risk factor for cardiovascular disease and all-cause mortality in men [5]. Other studies have either failed to find any significant relationship between haemoglobin or haematocrit and mortality or morbidity, or have found the associations to disappear when other cardiovascular risk factors have been accounted for [23-25].

Some studies have found the relationship between haematocrit and mortality to be U-shaped, not linear [20-22]. This is in accordance with our study. We also entered a continuous measure of haemoglobin into the total multivariate adjusted model. There was no linear trend present. Most of the other studies on haemoglobin and mortality or morbidity used haemoglobin as a continuous variable in a linear regression model, or compared high and low levels of haemoglobin [2-6, 23]. These methods may have failed to recognise the U-shaped association between haemoglobin and mortality or morbidity.

The level of haemoglobin influences viscosity, flow and oxygen carrying capacity of the blood. Elevation of haemoglobin causes increased viscosity and low haemoglobin could cause left ventricular hypertrophia and / or ischemia. This may explain haemoglobins' role as an independent predictor of cardiovascular disease.

The population attributable risk of smoking was 36%. If the mortality rate in the total study population was held on the same level as for non-smokers, 196 deaths would not have occurred. In total, 57 deaths in quintile 1, and 62 deaths in quintile 5 would not have occurred if the mortality rates in quintile 1 and quintile 5 were the same as for non-smokers in quintiles 2-4 of haemoglobin.

Smokers have increased risk of mortality from cardiovascular diseases and cancers. Smoking increases carboxyhaemoglobin concentrations [9], decreases the oxygen delivery to the tissue and stimulates the synthesis of haemoglobin, and hence increases blood viscosity. The alterations in viscosity caused by smoking are reversible by smoking cessation [26]. It is possible that the effect of haemoglobin is secondary to the effect of smoking on mortality. On the other hand, some of the increased mortality among smokers in our study could be due to increased plasma viscosity [27, 28]. Haemoglobin could thus be an independent predictor of mortality though being associated to smoking.

Haemoglobin and smoking are positively associated in a dose response manner [9, 10, 29]. High dose smokers in quintile 5 smoked one cigarette more than those in quintile 1 (p=.01). This could explain some of the increased risk of mortality for high dose smokers within quintile 5 of haemoglobin. However, there was no difference in average cigarette consumption between high dose smokers in quintile 1 and quintiles 2-4. The World Health Organization has recommended higher haemoglobin levels for defining anaemia in smokers than non-smokers [30]. Some of the smokers within quintile 1 of haemoglobin could in fact be regarded as anaemic and this may explain some of the increased risk of mortality among smokers within quintile 1.

Overweight and obesity lead to adverse metabolic effects, and the risk of mortality increases [31]. Why obese have higher haemoglobin than lean subjects is not clear, the difference is probably in the red cell masses [11]. Total cholesterol is positively associated with both haemoglobin and body weight [12, 13, 32]. Systolic blood pressure was positively correlated with haemoglobin (Pearson correlation coefficient 0.16) and is also associated with plasma viscosity, cardiovascular disease and mortality [4, 6, 33-35]. There was no evidence of interactions between haemoglobin and any of the assessed cardiovascular risk factors. Adjusting for the risk factors did not change the relationships between haemoglobin level and mortality, suggesting that haemoglobin is an independent risk factor of total mortality.

In conclusion, haemoglobin values within normal reference values have prognostic value. This should be implicated in clinical practice. Haemoglobin values in the lowest quintile among smokers could be a marker of chronic disease, and should be followed by clinical evaluation. However, haemoglobin values in the upper quintile are even more predicative for mortality in smokers, and smoking cessation should be recommended.

Future studies should address the possible sex differences between haemoglobin and cause specific mortality. Older and larger cohorts may give sufficient power to examine these risk relationships further.

Acknowledgements

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Table 1

Baseline characteristics by quintiles of haemoglobin. Values are mean ± standard deviation (SD) or percentages. The Tromsø Study 1974-1994.

	N	Age (years)	Body mass index (kg/m^2)	Total cholesterol (mmol/L)	Systolic blood pressure (mm/Hg)	Smokers (%)	Cigarettes among smokers (n)
Haemoglobin g/L							
<141	1,260	34.6 ± 8.3	23.3 ± 2.4	6.4 ± 1.4	123 ± 14	57.9	14.6 ± 6.9
141-145	1,210	33.8 ± 8.4	23.6 ± 2.6	6.4 ± 1.4	125 ± 14	58.4	14.5 ± 7.0
146-150	1,423	33.7 ± 8.2	24.0 ± 2.7	6.6 ± 1.4	126 ± 14	58.6	15.0 ± 7.2
151-156	1,443	33.4 ± 8.2	24.2 ± 2.7	6.7 ± 1.5	128 ± 15	60.2	15.0 ± 7.6
>156	1,205	33.2 ± 8.3	24.7 ± 3.2	6.9 ± 1.5	130 ± 16	65.5	16.4 ± 8.2
Total	6,541	33.7 ± 8.3	24.0 ± 2.8	6.6 ± 1.5	127 ± 15	60.1	15.1 ± 7.4

Table 2

Association between quintiles of haemoglobin and mortality by age. The Tromsø Study 1974-1994.

	Total		20-34 years			35-49 years		
			Cases			Cases		
	HR[a]	95% CI[b]	(n)	HR[a]	95% CI[b]	(n)	HR[a]	95% CI[b]
Haemoglobin g/L								
<141	1.43	1.07-1.90	17	0.68	0.38-1.24	92	1.83	1.31-2.57
141-145	1.06	0.78-1.44	12	0.49	0.25-0.96	65	1.36	0.95-1.95
146-150	1.00	Ref	31	1.00	Ref	57	1.00	Ref
151-156	1.20	0.91-1.60	23	0.74	0.43-1.27	86	1.47	1.05-2.06
>156	1.41	1.06-1.87	23	0.86	0.49-1.49	89	1.72	1.23-2.41
p-value[c]		.028			.276			.004

[a] Hazard ratios (HR) adjusted for age, smoking, body mass index, total cholesterol and systolic blood pressure.

[b] 95% confidence interval (CI)

[c] Overall test for equality between haemoglobin quintiles.

Table 3

Association between mortality and smoking habits within quintiles of haemoglobin (Hb). The Tromsø Study 1974-1994.

Smoking habits	Person -years	Cases (n)	Rate per 1,000[a]	95% CI[b]	HR[c]	HR[d]	95% CI[b]
Quintile 1 (Hb <141 g/L)							
Non smokers	10,373	30	2.76	1.86-3.94	1.30	1.38	0.89-2.13
Current smokers	13,993	79	4.67	3.70-5.82	2.33	2.65	1.89-3.72
Total	24,366	109	3.87	3.18-4.67	1.91	2.08	1.53-2.85
Quintiles 2-4 (Hb 141-156 g/L)							
Non smokers	32,842	70	2.13	1.66-2.69	1.00	1.00	Ref
Current smokers	46,645	204	4.12	3.57-4.73	2.02	1.96	1.49-2.58
Total	79,487	274	3.31	2.93-3.73			
Quintile 5 (Hb >156 g/L)							
Non smokers	8,188	21	2.52	1.56-3.85	1.23	1.04	0.64-1.71
Current smokers	15,079	91	5.95	4.79-7.31	2.93	2.59	1.89-3.56
Total	23,267	112	4.77	3.93-5.74	2.32	2.04	1.50-2.77

[a] Per 1,000 person-years. Age adjusted with total invited population as standard population.

[b] 95% confidence interval (CI).

[c] Hazard ratios (HR), adjusted for age (Cox's proportional hazard model).

[d] Hazard ratios (HR), adjusted for age, body mass index, total cholesterol and systolic blood pressure.

Table 4

Association between mortality and cigarettes per day within quintiles of haemoglobin (Hb). The Tromsø Study 1974-1994.

Smoking habits	Person -years	Cases (n)	Rate per 1,000[a]	95% CI[b]	HR[c]	HR[d]	95% CI[b]
Quintile 1 (Hb <141 g/L)							
1-14 cigarettes (day)	6,461	32	4.14	2.83-5.84	2.06	2.58	1.67-4.00
15+ cigarettes (day)	6,894	42	5.13	3.70-6.93	2.61	2.91	1.95-4.33
Cigars, pipes or unknown	638	5					
Quintiles 2-4 (Hb 141-156 g/L)							
Non smokers					1.00	1.00	Ref
1-14 cigarettes (day)	20,237	91	4.23	3.41-5.19	2.07	2.01	1.47-2.75
15+ cigarettes (day)	23,885	108	4.39	3.60-5.30	2.15	2.07	1.53-2.81
Cigars, pipes or unknown	2,523	5					
Quintile 5 (Hb >156 g/L)							
1-14 cigarettes (day)	5,441	23	4.45	2.82-6.68	2.20	1.93	1.20-3.16
15+ cigarettes (day)	8,677	63	7.11	5.46-9.10	3.56	3.09	2.18-4.37
Cigars, pipes or unknown	961	5					

[a] Per 1,000 person-years. Age adjusted with total invited population as standard population.

[b] 95% confidence interval (CI).

[c] Hazard ratios (HR), adjusted for age (Cox's proportional hazard model).

[d] Hazard ratios (HR), adjusted for age, body mass index, total cholesterol and systolic blood pressure.

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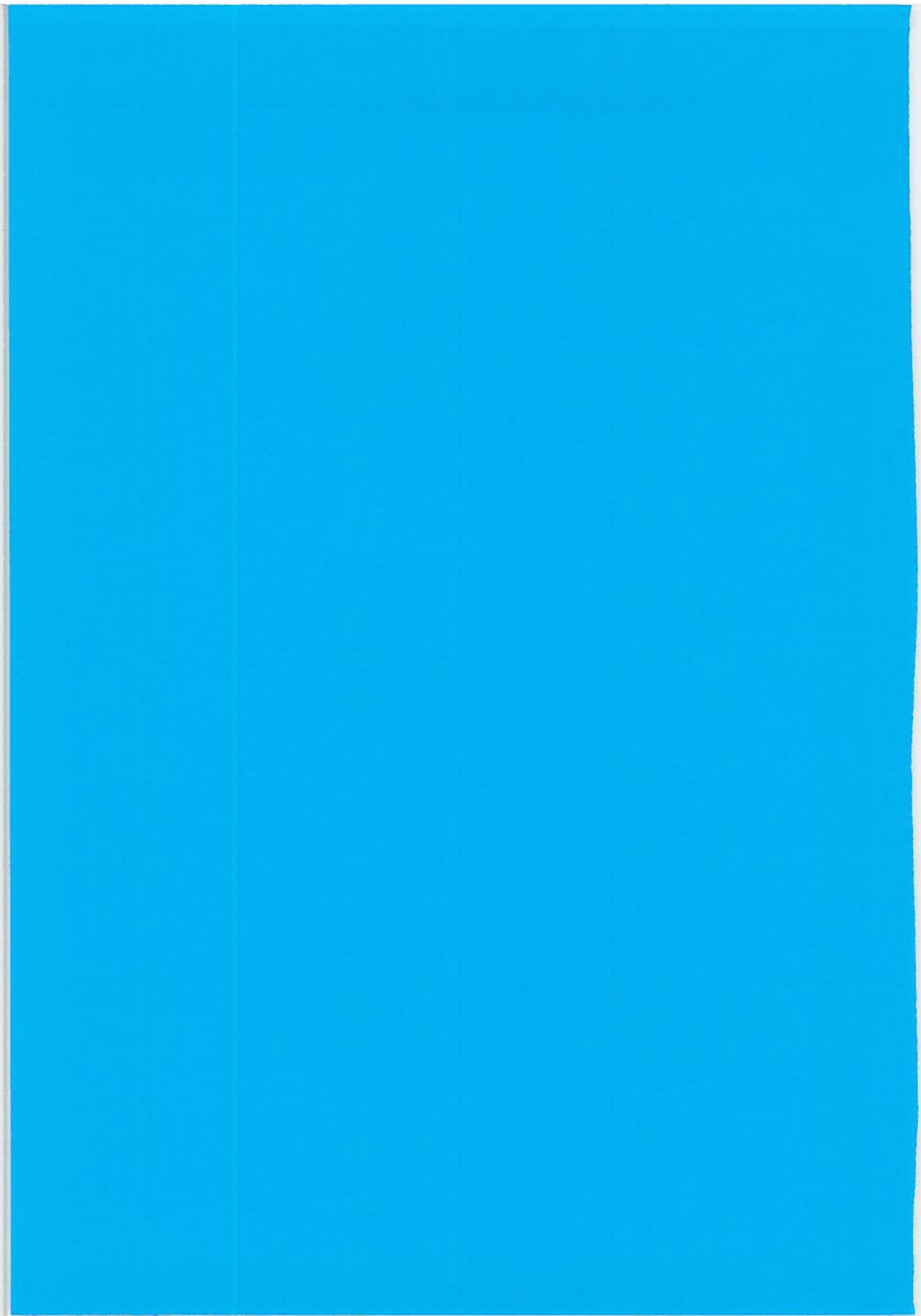
Paper IV



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Haematological malignancies in a general population, based on information collected from a population study, hospital records, and the Cancer Registry of Norway

The Tromsø Study

Skjelbakken T, Løchen M-L, Dahl IMS. Haematological malignancies in a general population, based on information collected from a population study, hospital records, and the Cancer Registry of Norway. The Tromsø Study.
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Abstract: *Objectives*: To investigate the prevalence and incidence of haematological malignancies, and to compare the rates found with those reported from the Cancer Registry of Norway. *Methods*: Three sources of information were used: (1) automated blood cell counts from 27 145 persons older than 24 yr (72% of those invited), participating in a population study (the Tromsø Study 1994–95); (2) patient medical records at the University Hospital of Tromsø during 1991–96; (3) the Cancer Registry of Norway. *Results*: (1) In the population study, 13 new cases of haematological malignancies were diagnosed. For five of these the early detection was probably beneficial. (2) From the hospital records another 59 participants and 36 non-participants to the population study were found to have haematological malignancies. (3) Additionally, six cases were identified from the Cancer Registry. Totally, we thus identified 114 period prevalent cases, of which 86% had been reported to the Cancer Registry. Age-adjusted period prevalence of haematological malignancies was 4.7‰ in men and 2.9‰ in women. The prevalence increased with age. There were 84 cases with leukaemia, lymphoma, or multiple myeloma diagnosed at any time and still alive at 31 December 1996 (point prevalence 2.2‰). Our estimated incidence of haematological malignancies did not differ significantly from that reported from the Cancer Registry. *Conclusion*: We found approximately the same rates of haematological malignancies as the Cancer Registry, although an underreporting of 14% to the Cancer Registry was detected. The point prevalence of leukaemia, lymphoma, and multiple mycloma was 2.2%.

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Key words: epidemiology; haematology; malignancies; population study; prevalence, incidence, men, women, cancer registry

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Haematological malignancies comprise a heterogeneous group of conditions originating in the blood and lymphatic system. There are three major groups of haematological malignancies: leukaemia, lymphoma, and plasma cell neoplasm. These diseases represented 6–7% of all new malignancies in the adult Norwegian population during 1982–91 (1). We have been unable to find any report on distribution of haematological malignancies within the setting of a population study.

The aim of our study was to investigate the prevalence and incidence of haematological malignancies in a general population of both sexes. To achieve as complete data as possible, the following sources of information were used: automated blood cell counts from persons taking part in a large population-based study, hospital records from the

only hospital serving this area, and the Cancer Registry of Norway.

Material and methods

Diagnostic groups

We used the diagnostic criteria and the categories of disease currently in use by clinical haematologists. The lymphomas were included, according to WHO's definition of haematological malignancies (2). The diagnostic groups were as follows: acute leukaemia, subdivided into acute lymphatic leukaemia and acute myeloid leukaemia; chronic leukaemia subdivided into chronic lymphatic leukaemia and chronic myeloid leukaemia; non-Hodgkin lymphoma; Hodgkin's disease; plasma cell neoplasm, including multiple myeloma, solitary plasmacytoma and Waldenström's macroglobulinemia; myeloproliferative disorders including essential thrombocythemia, polycythemia vera and myelofibrosis; myelodysplastic syndromes.

Design of the population study: the Tromsø Study

The Tromsø Study was initiated in 1974 with repeated surveys in 1979–80, 1986–87, and 1994–95. The study is a single-centre population-based prospective study of total birth cohorts in the municipality of Tromsø, Northern Norway. Epidemiological and clinical methods are used to investigate the distribution and determinants of chronic diseases. The aim of the Tromsø Study is to identify potentially modifiable causes of disease in order to develop preventive or therapeutic strategies.

The fourth survey of the Tromsø population started 5 September 1994 and was completed 30 June 1995. The Institute of Community Medicine, University of Tromsø, in co-operation with the National Health Screening Service, conducted the survey. All inhabitants older than 24 yr were invited, and 27 145 subjects (72%) participated. A protocol similar to that used during previous surveys in this population was followed (3, 4). The Regional Board of Research Ethics approved the study. Each subject gave written informed consent.

Identification of haematological malignancies from the population study

Five ml of blood were drawn from a cubital vein into vacutainer tubes containing disodium EDTA as anticoagulant (K_3-EDTA 40 μL, 0.37 mol L^{-1} per tube). The blood samples were analysed with an automated blood cell counter (Coulter Counter®) within 12 h. Experienced staff conducted the analyses, under the supervision of a specialist in clinical chemistry at the Department of Clinical Chemistry at the University Hospital of Tromsø. For ethical reasons, the population was given further evaluation and follow-up, in case of pathological findings. The following predefined levels of haematological variables were absolute criteria for further evaluation by one of three experienced haematologists: haemoglobin <100 or ≥180 g L^{-1} for men, <90 or ≥170 g L^{-1} for women; leukocytes $<3.0 \times 10^9$ or $\geq 14.9 \times 10^9$ L^{-1} for both sexes; platelets $<100 \times 10^9$ or $>500 \times 10^9$ L^{-1} for both sexes.

In addition, samples selected due to minor combined criteria, such as mild pancytopenia, mild anaemia combined with distinct hypochromia, microcytosis or macrocytosis, and mild increase or decrease in cell count combined with pathological leukocyte differential count, were evaluated. No diagnoses were established due to Coulter Counter® results alone.

Identification of cases from the hospital records

Through the patient administrative system for inpatients and outpatients, the University Hospital of Tromsø's records of all subjects invited to the population study were searched for haematological disease. The geography of this region and the organisation of its health services ensure that virtually all residents with chronic or serious disease will attend the hospital for medical care. The records of patients with ICD-9 (International Classification of Diseases, ninth revision) codes 200–208.9, 238–238.9, 273–273.9 or 280–289.9, as one of the three first-mentioned diagnoses at any hospital consultation, were further evaluated. In order to establish the degree of completeness of the diagnoses of the hospital records, we also conducted a computer search for missing codes in the hospital's patient administrative system. We searched for missing codes of outpatient consultations in the 6-yr period 1991–96.

Identification of cases from the Cancer Registry

The Cancer Registry of Norway is based on compulsory reporting of all new cases of cancers. The reports consist of clinical forms, copies of cytology, biopsy, and autopsy reports from pathology laboratories, and death certificates from Statistics Norway.

All cases of haematological malignancies among those invited to the population study were matched against the existing data of the Cancer Registry. We used the national 11-digit personal identification number for the matching. The cases with

haematological malignancies registered in the Cancer Registry were also matched against the cases found by the population study and in the hospital records. The medical records were checked when discrepancies were found.

Calculation of prevalence and incidence

Occurrence of a disease may be defined both as period prevalence and point prevalence. Period prevalence refers to the number of persons who had the disease at any time during a specified time interval. Period prevalence thus includes point prevalence at the beginning of the interval plus the incidence during the interval (5). The observational interval for hospital records was chosen from 1 January 1991 to 31 December 1996. Nine cases who died during the screening period, and 15 additional cases who died before the end of the observational interval, were included in the period prevalence. Patients with Hodgkin disease, high-grade non-Hodgkin lymphomas, or acute leukaemia in complete remission for more than 5 yr before 1 January 1991 were defined to be cured from cancer and excluded from the period prevalence (14 cases). Point prevalence is usually defined as the number of persons in a defined population having a specific disease at a specific point in time. The Cancer Registry of Norway presents prevalence as the number of cases still alive and ever diagnosed with malignancies (6). We therefore also present point prevalence for patients ever diagnosed with leukaemia, lymphoma, or multiple myeloma and still alive at 31 December 1996.

Incidence rates of haematological malignancies for the municipality of Tromsø and for Norway were estimated from reported cases diagnosed during and after the period of the population study (1994–96), as provided by the Cancer Registry of Norway (unpublished data). The incidence rates from the Cancer Registry were then compared to the incidence rates estimated from the population study and the hospital records during the same period. The data provided from the Cancer Registry contained the same age categories as in our study, except for the oldest age group, where the Cancer Registry merged all age groups older than 65 yr.

Statistical analyses

Age adjustment of the crude rates was performed according to the direct method, using both the European standard population and the World standard population. The Mantel–Haenszel chi-square test was used for analysing differences between participants and non-participants. Analysis was performed with age group stratification (age 25–54, 55–64, 65–74, 75–84, and 85 +) in the Statcalc procedure of the Epi Info statistical package (7). The Mantel–Haenszel chi-square test was also used for stratified analysis of age by haematological malignant disease. The test was performed with the Proc freq procedure of the SAS software package (8). In order to test for any interaction among age group, sex, and participation, a logistic regression model was used for analysing each sex separately and together, with occurrence of malignant haematological disease as the dependent variable. Interaction was assessed by the following terms: sex * participation and age group * participation. The 95% confidence intervals (95% CI) of rates were calculated according to the Poisson distribution (SAS). Results were considered statistically significant with a *P*-value of 0.05 or less.

Results

Participation in the population study

Sex- and age-specific participation rates for the population study are summarised in Table 1. Worthy of note are the higher participating rates among women in all age groups up to 74 yr. The rates increased from 55% and 62% among the youngest men and women, respectively, to a maximum of 86% and 91% in the age group 55–64 yr, after which they decreased. For both sexes, participation was lowest in the oldest age group, and among these, 7.8% points higher in men.

Identification of new cases from the population study

Following the automated blood cell count, further evaluation was carried out on haematological variables from 303 subjects; 136 (1.1%) of 12 858 men and 167 (1.2%) of 14 287 women (Fig. 1). Of these, samples from 170 subjects (56%) were selected by the predefined absolute criteria, and samples from 133 subjects were selected due to the

Table 1. Frequency distribution of total population, and sex- and age- specific participation rates)The Tromsø Study 1994–95)

	Total population		Participants	
Age (yr)	Men *N*	Women *N*	Men %	Women %
25–34	5571	5819	55.1	61.7
35–44	4798	4497	69.4	78.5
45–54	3689	3430	78.9	85.8
55–64	1983	1880	86.4	91.2
65–74	1543	1794	83.1	86.9
75–84	732	1245	67.6	66.8
85+	165	413	36.4	28.6
Total	18 481	19 078	69.6	74.9

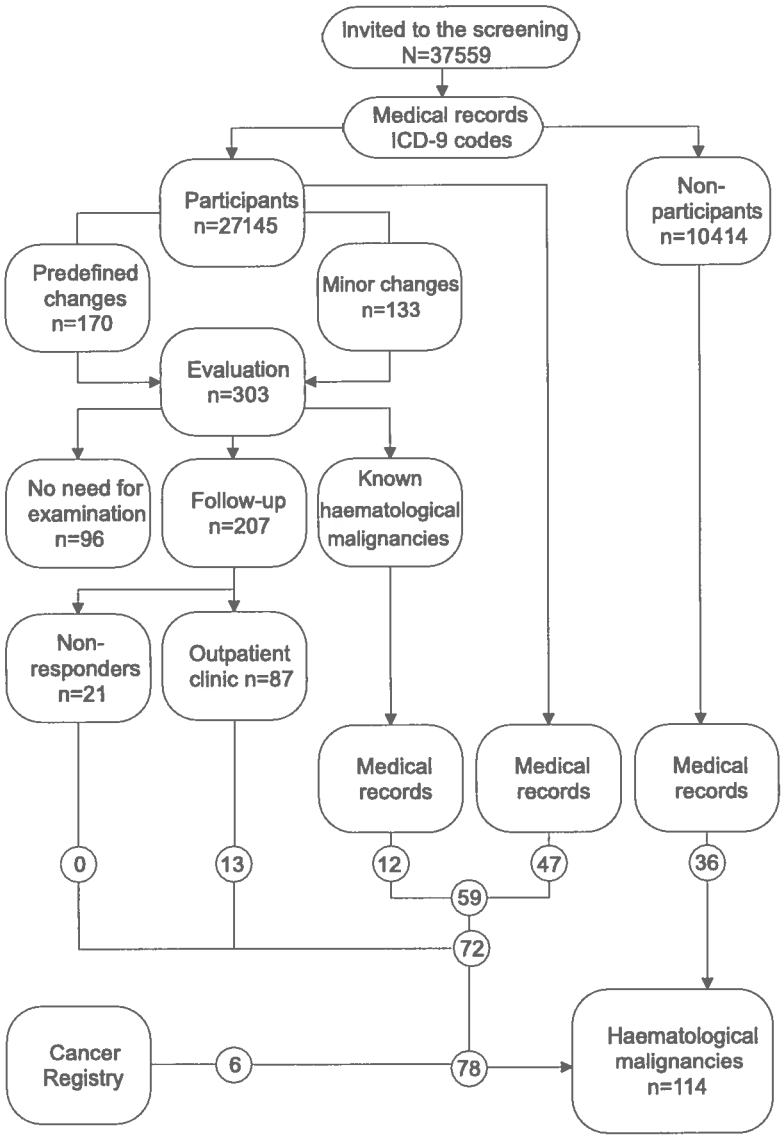

Fig. 1. Flow chart of the identification of haematological malignancies in Tromsø 1 January 1991 to 31 December 1996. The cases positively identified in each group are represented by encircled figures.

minor combined criteria. Further evaluation was considered necessary for 207 (68%) of the 303 subjects. Of these, 87 were examined at the Outpatient Department. Thirteen of the cases (eight men and five women) that were found as a result of the population study had not been diagnosed previously. Table 2 presents the sex and age distribution of new haematological malignancies discovered among participants in the population study. No subjects were younger than 40 yr of age.

Identification of cases from the hospital records

The automated blood cell counter identified 12 additional cases with previously diagnosed malignant blood disease, for whom medical records

Table 2. Frequency of new haematological malignancies among participants to the population study, according to sex and age (The Tromsø Study 1994–95)

Age	All		Frequency of new malignancies	
	Men *N*	Women *N*	Men (‰) *n*	Women (‰) *n*
25–34	3068	3591	(0) 0	(0) 0
35–44	3330	3528	)0.6(2	)0(0
45–54	2909	2944	(0.3) 1	(0.3) 1
55–64	1713	1715	(0.6) 1	)1.2(2
65–74	1283	1559	(1.6) 2	(0.6) 1
75–84	495	832	(4.0) 2	)0(0
85+	60	118	(0) 0	)0.8(1
Total	12 858	14 287	(0.6) 8	)0.3(5

already existed (Fig. 1). From the medical records, 47 additional cases with haematological malignancies were found among the participants in the population study. For these 47 patients, the results of the automated blood cell analysis were within the predefined limits. Furthermore, 36 cases were found from hospital records among the non-participants.

In about 7% of the 689 manually coded hospital records, we found obvious miscoding of the disease, and we found that 18% of the Outpatient Department consultations did not have a diagnostic code.

Identification of cases from the Cancer Registry

There were six cases among participants to the population study which were found in the Cancer Registry (five lymphoma and one chronic leukaemia), but not identified through the population study or the search in the hospital records (Fig. 1). Three of these cases were not coded according to our ICD-9 search criteria. Due to lack of histopathological confirmation of lymphoma, one case was not classified as haematological malignancy during our classification of medical records. Two of the cases with lymphoma were coded with one of the ICD-9 search-criteria codes, but were not recognised by the computer search.

In total, we found 114 prevalent cases from the three different sources. Of these cases, 16 (14%) had not been reported to the Cancer Registry (seven cases of myeloproliferative disorders, six cases of chronic lymphatic leukaemia and three cases of Waldenström's macroglobulinemia).

Diagnostic categories

Table 3 presents the number of cases of haematological malignant diagnoses derived from the population study, the hospital records, and the Cancer Registry, and as age-group-specific observed numbers. During the population study five of 22 cases with chronic leukaemia (all chronic lymphatic leukaemia) were recognised for the first time. The

Table 3. Cases of haematological malignant diagnoses derived from the population study, the hospital records and the Cancer Registry, and presented as age group-specific observed numbers

Diagnosis	Population study *N(n)*[a]	Hospital records *N*	Cancer Registry *N*	Age (yr)			
				25–54	55–74	75 +	Total
Acute leukaemia	0	4	4	0	3	1	4
Chronic leukaemia	5(3)	16	16	5	6	11	22
Non-Hodgkin lymphoma	0	41	46	15	24	7	46
Hodgkin's disease	0	2	2	0	2	0	2
Plasma cell neoplasm	1(0)	24	22	1	11	13	25
Myeloproliferative disorders	6(6)	6	5	2	7	3	12
Myelodysplastic syndromes	1)0(	2	3	0	1	2	3
Total	13(9)	95	98	23	54	37	114

[a] Number of subjects evaluated due to predefined absolute criteria in parentheses.

hospital records and Cancer Registry contained information of altogether 46 patients with non-Hodgkin lymphoma and two patients with Hodgkin's disease, representing 40% of the patients with haematological malignancies. In contrast, no lymphomas were found during the population study. Only one (Waldenström's macroglobulinemia) of the 25 cases with plasma cell neoplasms was recognised for the first time during the population study. Among the myeloproliferative disorders, six of the 12 cases (all six with essential thrombocythemia) were recognised during the population study.

Prevalence

Table 4 presents the sex- and age-specific period prevalence of haematological malignancies according to participation in the population study. Among the 114 period prevalent cases of haematological malignancies, 78 cases were participants and 36 were non-participants in the population study. There was no significant difference in period prevalence of haematological malignancies between participants (2.9‰) and non-participants (3.5‰). As presented, the overall age-adjusted period prevalence was 50% higher among men compared to women. Period prevalence increased by age in both sexes ($P = 0.001$). Analysing the data separately according to participation did not change this *P*-value. The period prevalence of haematological malignancies increased significantly after the age of 54 yr for both sexes.

In a logistic regression model, age and sex were the significant independent predictors of malignant haematological disease (data not shown). When analysed separately, adjustment for participation did not substantially change the estimates for men or women.

Table 4. Sex- and age-specific period prevalence (‰) of haematological malignancies in 18 481 men and 19 078 women according to participation to the population study (The Tromsø Study 1994–95)

	Period prevalence					
	Total population		Participants		Non-participants	
	Men	Women	Men	Women	Men	Women
N	18 481	19 078	12 858	14 287	5623	4791
Age (yr)	(‰) *n*	(‰) *n*	(‰) *n*	(‰) *n*	(‰) *n*	(‰) *n*
25–34	(0.5) 3	(0) 0	(0) 0	(0) 0	(1.2) 3	(0) 0
35–44	(1.7) 8	(0) 0	(1.8) 6	(0) 0	(1.4) 2	(0) 0
45–54	(1.9) 7	(1.5) 5	(1.0) 3	(1.0) 3	(5.1) 4	(4.1) 2
55–64	(4.5) 9	(6.9) 13	(4.1) 7	(6.4) 11	(7.4) 2	(12.1) 2
65–74	(13.6) 21	(6.1) 11	(13.3) 17	(4.5) 7	(15.4) 4	(17.0) 4
75–84	(21.9) 16	(11.2) 14	(28.3) 14	(9.6) 8	(8.4) 2	(14.5) 6
85 +	(24.2) 4	(7.3) 3	(16.7) 1	(8.5) 1	(28.6) 3	(6.8) 2
Crude	(3.7) 68	(2.4) 46	(3.7) 48	(2.1) 30	(3.6) 20	(3.3) 16
Age adjusted						
European standard	4.7	2.9	4.6	2.5	5.5	5.7
World standard	3.9	2.5	3.7	2.1	4.9	5.0
P-value[a] for differences in prevalence relative to:						
Age	0.001	0.001	0.001	0.001	0.001	0.001
Sex	0.001		0.03		0.4	
Participation	0.79	0.07				

[a] From Cochran-Mantel-Haenszel chi-squares statistics.

Through combining the results of the population study, searches in the hospital records and the Cancer Registry, we found 49 men and 35 women ever diagnosed with leukaemia, multiple myeloma, or lymphoma and still alive at 31 December 1996. This gives a crude point prevalence of 2.2‰ (95% CI 1.8–2.8), and a male to female ratio of 1.4.

Incidence

Table 5 shows the age adjusted incidence rates for all haematological malignancies. The table presents both the rates from the present study, including the cases identified by the population study, and the incidence rates from Tromsø and Norway as provided by the Cancer Registry of Norway. The incidence rates were higher in men as compared to women. There were no significant differences between participants and non-participants (data not shown). The rates from the present study were age-adjusted both according to the age groups defined in the present study, and then according to age groups provided from the Cancer Registry, where the age groups above 65 yr were merged. In our study, the age-adjusted incidence rate according to the European standard was 1.6‰ (World standard 1.4‰). The incidence rates from the Cancer Registry were not significantly lower for Norway and for Tromsø than for the present study, when we used the same age-adjustment method.

Table 5. Crude and age adjusted incidence rates (‰) with 95% confidence intervals (CI), of all haematological malignancies diagnosed from 1 January 1994 to 31 December 1996, in the present study, and in Norway and Tromsø as reported by the Cancer Registry of Norway

		Incidence rates				
			Age-adjusted			
			European[a]		World[a]	
	Cases *N*	Crude ‰	‰	95% CI	‰	95% CI
The present study						
Men	39	2.1	2.5	1.8–3.4	2.2	1.6–3.0
Women	18	0.9	0.9	0.6–1.5	0.9	0.5–1.3
Total population[b]	57	1.5	1.6	1.2–2.1	1.4	1.1–1.8
The Cancer Registry of Norway						
Norway	4698	1.6	1.4	1.4–1.5	1.2	1.2–1.3
Tromsø	52	1.4	1.7	1.2–2.2	1.4	1.1–1.9
The present study[c]	57	1.5	1.8	1.3–2.3	1.5	1.2–2.0

[a] European and World standard population. [b] Age-adjusted with the same age categories as the data from our study. [c] Age-adjusted with the same age categories as the data provided from the Cancer Registry of Norway.

Discussion

To our knowledge, this study is the first on the prevalence and incidence of haematological malignancies in a general population. The population-based approach and the high participation rate in the population study strengthen our results. The selection of variables to be analysed in this population study was made to assess their distribution and their predictive power for the development of various serious diseases. This strategy allowed us to use data from the Tromsø Study, in addition to medical records and Cancer Registry files, to make

a comprehensive assessment of the prevalence and incidence of haematological malignancies.

Prevalence and incidence

The exact date for being cured from cancer is difficult to estimate. Comparing incidence or prevalence of haematological malignancies in different populations presents well known methodological problems arising from comparison data sources, different coding systems, different spectra of diseases, and different registry rules and analyses (9, 10). We have not been able to find prevalence rates comparable to our rates in the literature.

Based on rates from the publications of the International Agency for Research on Cancer (IARC), we found the total annual crude incidence rate for leukaemia, lymphoma, and multiple myeloma in Norway to be about 7.8 per 100 000 persons at risk (age 15 yr and above) (11). This corresponds to other Northern European countries, but is higher than in Asia, particularly in Japan. In Norway the incidence of Hodgkin's disease is about five times higher compared to Japan, whereas non-Hodgkin lymphoma, multiple myeloma, and leukaemia are about 1.5 times as frequent in Norway compared to Japan. Our findings support the result that haematological malignancies occur more frequently among adult males than among females (12), and that the incidence increases with age (13, 14).

By choosing period prevalence, our observational period includes time before, during, and one and a half years after the end of the screening. This gave us the opportunity to identify, as completely as possible, all cases in this well defined population.

For age adjustment, we have used both the World standard and the European standard as the standard populations. In the World standard population, almost half of the population is less than 25 yr old, whereas our study population is 25 yr or older. For comparison with other studies, we present age-adjusted rates according to the World standard population. The age distribution of the Norwegian population is comparable to the European population. The European Network of Cancer research (EUCAN) uses both the European standard population and the World standard population (15). To avoid underestimation of cancer in this study's adult population, and for comparison between cancer registries in the European Union, we have also used the European standard population.

Population studies of this nature, previously performed for cardiovascular diseases and serious psychiatric disorders, have shown that those not taking part have a higher morbidity and mortality than those who do (16, 17). In our study, no significant difference in occurrence of haematological malignancies between participants and non-participants in the population study was found. However, it is difficult to compare participants and non-participants, because the latter consist of selected cases from the hospital records. Actually, we do not know the complete number of cases with undiagnosed haematological malignancies among the participants, and particularly not among the non-participants, in the population study, even though the observation period probably was sufficiently long for latent cases to be diagnosed.

The Cancer Registry

The Cancer Registry of Norway is known to have a completeness of almost 100% for solid tumours (18, 19), but there is a tendency to under-reporting of haematological malignancies (6, 20). The same finding is reported from other cancer registries (10, 21, 22). In 1981, Lund evaluated the completeness of the Cancer Registry of Norway, and demonstrated an under-reporting, especially for myeloma, where only 78.6% of cases were reported to the Cancer Registry (20). Among the leukaemia cases, 91.8% were reported. Cancers of the lymphatic and haematopoietic tissues altogether were reported in 93.5% of cases. In the present study, all the cases of multiple myeloma and plasmacytoma were reported to the Cancer Registry. The leukaemias were reported in about 80.5% of cases. Altogether, the haematological malignancies were reported in 86% of cases. Our result is strengthened by the time delay between the end of the observational period and the matching.

Are haematological malignancies suitable for screening?

To be suitable for screening programmes, the condition should be serious and cause considerable morbidity and mortality, and as such be a public health problem (5). Detection and treatment in a pre-clinical phase should lead to treatment that is able to reduce morbidity and mortality. In terms of change in management, routine complete blood count of all patients at an outpatient clinic has been found to be of only 0.5% benefit (23). Mates *et al.* evaluated ambulatory abnormal blood counts encountered routinely at a clinical laboratory (24). Major new haematological abnormalities were found in 0.24% of all blood counts, and 0.04% were new cases of haematological malignancies. In comparison, we found that 0.05% (13 cases) were new haematological malignancies after screening of a free-living population. Altogether we detected, however, only 32% (25 cases) of the 78

participating subjects with haematological malignancies. A majority of the patients with a haematological malignant disease, taking part in the population study, had been diagnosed earlier. They had already received treatment, and thus their blood counts were probably normalised.

A screening test should be cheap and acceptable for the population. The automatic blood cell examination fulfils these criteria. However, the test is not conclusive for diagnosis alone, and major groups of haematological malignancies such as the lymphomas, would not be recognised. Among the new cases, all without symptoms, the majority had essential thrombocythemia and chronic lymphatic leukaemia [all in Binet stadium A (25)], with extreme blood cell counts and a recognisable early stage. Three subjects with essential thrombocythemia were probably at high risk of developing thrombohaemorrhagic complications due to old age and high platelet count (26, 27). One patient diagnosed with myelodysplastic syndrome and one with hairy cell leukaemia were offered treatment. Thus, for five subjects only, the early diagnosis of haematological malignancies might have reduced morbidity. Detection of these diseases at an asymptomatic stage does not improve the prognosis. Regular hospital supervision and the awareness of having a potentially serious disorder might even reduce quality of life for these patients.

Automated blood cell count is probably not suitable for early detection of haematological malignancies in a general population.

Conclusion

The prevalence of haematological malignancies in this general population is low. It is higher in men than women, and increases with age. Our rates are comparable to the rates of the Cancer Registry, although an underreporting of 14% to the Cancer Registry was detected.

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