MEDICAL AND SOCIAL CONDITIONS IN THE ELDERLY
GENDER AND AGE DIFFERENCES
The Umeå longitudinal study

Per Olov Österlind

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ABSTRACT

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Per Olov Österlind, Dept. of Geriatric Medicine, University of Umeå.

In 1981, no representative study of the medical and social conditions among elderly persons in northern Scandinavia was performed. Nor was there such a study in a smaller Swedish town than Gothenburg. This study was initiated to fill that knowledge gap. The aim of the study was to evaluate gender and age differences in medical and social conditions among elderly people, including the reference intervals of clinical chemistry parameters and characteristic features of the 24-hour electrocardiogram (ECG) in healthy elderly. By way of longitudinal design with birth cohorts stratified by gender, it was assumed that the effects could be demonstrated. Also, the death risk of various social and medical variables was to be assessed.

During the study period 1981 to 1990, the subjects were between 70 and 88 years of age. The proportion of persons living in private housing decreased from almost all at the age of 70 to slightly more than half at 88 years of age. The number of socially active persons decreased considerably during the period. The need of help increased from almost none to 60 % of the persons.

The proportions of persons with normal sight and hearing decreased from two thirds to around one tenth The most frequent symptoms were general tiredness, pains, dyspnoea, constipation and dryness of the mouth. Cardiovascular diseases were the most frequent. Hypertensive disease became less, and congestive heart failure more frequent with age. The frequency of dementia increased steeply among the oldest persons; at 88 years of age, 40 % were demented.

Drug consumption increased; the oldest persons in both age cohorts used 5 different drugs or more per person regularly. The consumption increase was mainly due to the increasing morbidity accompanying age. The most common drugs taken were cardiovascular preparations, psychoactive agents, drugs to alleviate gastrointestinal symptoms, and analgesics. Drug intake and symptom prevalence were generally higher in women, despite the fact that there was no gender difference in the number of diseases.

The reference intervals of many blood components in healthy elderly were shown to be broader than those of younger persons. The intervals of P(lasma)-folate and P-potassium were on a lower and those of the erythrocyte sedimentation rate, P-creatinine and, in women, S(erum)-cholesterol, were on a higher level than among younger persons.

Several features of the 24-hour ECG, e.g. the number of episodes of supraventricular tachycardia as well as supraventricular and ventricular premature beats in healthy elderly were more frequent than among younger persons.

Between 80 and 88 years of age, many functions crucial to the chances of living a rich and vital life were found deteriorating in the elderly persons. High age, male sex, dementia, congestive heart failure, and low values of S-creatinine were shown to be independent factors connected with an increased death risk.

Key words: Population study, elderly, diseases, social situation, drug consumption, prognostic factors, reference intervals, blood components, electrocardiogram.
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To Birgitta, Mattias and Ann
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Medical conditions
  Mortality
  Anthropometric measurements
  Vision
  Hearing
Subjective health
  Perceived health
  Symptoms
Diseases
  Cardiovascular diseases
  Gastro-intestinal diseases
  Eye diseases
  Metabolic and endocrine diseases
  Pulmonary diseases
  Urogenital diseases/dysfunctions
  Malignant diseases
  Musculoskeletal and joint diseases
  Psychiatric diseases
Drug consumption
  Total drug use
  Cardiovascular drugs
  Drugs used for gastrointestinal symptoms
  Psychoactive drugs
  Analgesics
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Between 80 and 88 years of age, many functions crucial to the chances of living a rich and vital life were found deteriorating in the elderly persons. High age, male sex, dementia, congestive heart failure, and low values of S-creatinine were shown to be independent factors connected with an increased death risk.

Key words: Population study, elderly, diseases, social situation, drug consumption, prognostic factors, reference intervals, blood components, electrocardiogram.
ORI GINAL PAPERS

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals:


INTRODUCTION

DEMOGRAPHICS AND ITS IMPLICATIONS ON HEALTH CARE COSTS

During the last decades the demographic pyramids describing age distribution in the industrialised countries have changed, now looking more or less like houses. In 1992, 17.7 per cent of the population in Sweden was 65 years of age or more (65+), and 4.5 % was 80 years or over (80+) (1). The estimated proportion of inhabitants in these two segments of the Swedish population for the next 32 years is shown in figure 1. In the year 2025 the proportion of inhabitants being 65+ years will be 20.4 %, that is, an increase from 1,526,000 to 1,938,000 persons. The proportion of very old persons, those 80+ years, will increase to 5.7 %, that is, an increase from 370,000 to 537,000 persons.

The average life expectancy is expected to increase from 74.8 to 76.4 years in men and from 80.6 to 82.1 years in women during the next two decades (1).

The implications will be considerable, since the health care cost for the elderly is high. In 1983, it was estimated that 47 per cent of the health care costs in Sweden was paid for the 65+ age group, which totalled less than 18 % of the population. Persons over 80 years accounted for 23 % of the total costs, while their share of the population was only 3.5 % (2). In the year 2005, health care cost for the 80+ age group is expected to in-
crease to more than 31 per cent of that of the total population. In 1983, the yearly health care cost per capita in this age group was 45,000 SEK, while in the group less than 65 years of age it was only 5,000 SEK (2).

**REPRESENTATIVE STUDIES OF ELDERLY POPULATIONS**

Diseases, disorders, and other infirmities of old age constitute the individual basis of dependency, and of drug consumption among the elderly. All together, the existence of these items is the main reason why there are medical and social services for the elderly. They are all connected and depend on each other. When interfering with either a person's or group's diseases or drug consumption, we change the other parts of the network. To be able to predict the coming changes, we need to know not only the individual's medical and social pattern but also that of the group of elderly.

Representative studies of the medical and social conditions of elderly populations have to be restricted to defined, rather small, geographical areas. This is because of economical reasons, in order to make them sufficiently detailed, and to make possible comparisons to detect differences between parts of countries or the world.

Such studies of persons aged 70 years or over, especially those with longitudinal design, are few. Some of the largest outside the Nordic countries are the Framingham, Massachusetts, USA, study (3, 4) and the Tecumseh Community Health study in Michigan, USA (5, 6). Both these studies include broad age intervals of the populations, but also a sufficient number of elderly persons. There are also a few studies following selected segments of the elderly, often non-institutionalised persons. Examples are The Florida Geriatric Research Program (7), the Baltimore Longitudinal Study of Aging (8), and the Duke Longitudinal Studies (9, 10). Finally, a couple of rather large-scale surveys of medical and social conditions in the elderly have been performed. Some have been reviewed by Svanborg et al. (11).

In the Nordic countries, among the largest representative longitudinal population studies of elderly people is the "Glostrup" study, covering nine Copenhagen suburbs in Denmark, including birth cohorts of 40, 50, and 70 years of age, some of them re-examined 10 to 20 years later (11-13). A study of a representative sample of the persons aged 75, 80, and 85 years in Copenhagen (14) was performed in 1978/79, but no follow-up examination was made. In Sweden, the largest study is the "H70" prospective population study of 70 to 90-year-old persons in the city of
Gothenburg, including four age cohorts, born 1901/02, 1906/07, 1911/12, and 1915/16. The oldest cohort has been followed since 1971/72 (15, 16).

Another Swedish project is the Dalby prospective study of people born 1902 and 1903, beginning in 1969 with follow-ups bi- or triannually up to the age of 83 (17). The Lundby study investigated only mental diseases, following the persons in all ages in a rural district in southern Sweden in 1947, 1957 and 1972 (18, 19). The OCTO project, concerning functional capacity and related factors, began in 1987. In this study, a population aged 84 years and over in Jönköping, Sweden, is followed (20). In Finland, the study of all people over 85 years of age (born 1892 or earlier) in Tampere in 1977/78 was repeated in 1982 (21, 22). Also in Finland, a sample of the inhabitants of Turku aged 65+ was studied in 1963, and again in 1968 (23, 24).

In 1981, no representative study, longitudinal or at one point in time, of the medical and social conditions among elderly persons in northern Scandinavia was performed. Nor was there such a study in a smaller Swedish town than Gothenburg. Thus, there were gaps in the important knowledge of age and gender differences in high age. The intention of this study, designated "U70", was to be a contribution to that knowledge and to shed light on the planning of the care of the elderly.

**AIM OF THE STUDY**

The aim of this study is to evaluate gender and age differences in medical and social conditions in elderly people, and to establish reference intervals of clinical chemistry parameters and features of the 24-hour electrocardiogram in healthy elderly

**STUDY DESIGN**

The municipality of Umeå in 1991 had around 92,000 inhabitants, out of which 63,000 lived in the town, and 28,000 in the town parish (25). The ratio women/men was approximately 1.03/1. Situated at the Gulf of Bothnia in northern Sweden, the town of Umeå is oriented towards education and trade. There are no large factory plants in the town. Mean temperature is between -8 and +16°C. Fifteen per cent of the municipality, 11.7 % of the town, and 12.1 % of the town parish inhabitants were 65+ years of age. The ratio women/men in the municipality was 1.4/1. The corresponding figures for those aged 75+ were 6.5, 4.7, and 5.0 %.
The women/men ratio was 1.6/1 (25). Compared to the whole of Sweden, the structure is one of a young population in which there are many students and schools, relatively few industry workers, and almost no farmers.

The U70 is a descriptive prospective study with age and gender stratified, systematic samples from an elderly population. The samples were obtained in the following way. Lists of the total population used (i.e. all persons in the town of Umeå or the town parish) were obtained from the official population registers. The male and female names in each age group were separated and sorted according to birth date. The desired number of persons was then picked in order (each, every other, every third person, etc.) from the sorted lists and invited. The study subjects were born in 1902, 1906, 1911, and 1920. Those born 1902 and 1911 were examined in 1981, 1984, 1987, and 1990. Those born 1906 were examined in 1981, and those born 1920 in 1990 only (table I).

Before every examination from 1984 on, both the earlier participants and non-responders were invited.

In 1981, there was no intention to perform a longitudinal study. To be able to reach sufficient precision in the estimated parameters in each age and gender group, it was necessary to choose a design assuring enough persons in each group. It was not possible to use a sample which was strictly representative of the population. This would have resulted in too few men in each age group and too few persons in the oldest cohorts. Consequently, the sample design was one of age and gender groups of approximately equal size.

In 1984, it was decided to make the study longitudinal. It was estimated that the number of persons in the oldest birth cohorts would subsequently become too small to generate meaningful statistical descriptions and inferences. Because of the limited resources available, a major change in the populations sampled was made. The cohort born 1906 was excluded and the cohort born 1902 was expanded, now including all persons born 1902 in the town of Umeå and being representative of the population of that age.

Since those born 1906 were examined only in 1981, that birth cohort will mainly be used in certain cross-sectional descriptions in the following. The main cohorts described will be those born in 1902, 1911, and 1920.
MATERIAL AND METHODS

SAMPLES STUDIED

General

In 1981, there were approximately 16,000 inhabitants in a specified central area (the town parish) of Umeå. 494 of those were 70, 75, and 79 years old, i.e., born in 1911, 1906, and 1902. All males and every second female born 1902 as well as every other male and every third female born in 1906 and 1911 were invited.

Table I: Number of persons taking part in the U70 study by examination year. The numbers in brackets are those taking part for the first time.

<table>
<thead>
<tr>
<th>Born 1902</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>35</td>
<td>45 (22)</td>
<td>31 (-)</td>
</tr>
<tr>
<td>Women</td>
<td>30</td>
<td>79 (54)</td>
<td>60 (4)</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>124 (76)</td>
<td>91 (4)</td>
</tr>
<tr>
<td>Born 1906</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Born 1911</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>32</td>
<td>27 (1)</td>
<td>23 (1)</td>
</tr>
<tr>
<td>Women</td>
<td>30</td>
<td>31 (4)</td>
<td>27 (-)</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>58 (5)</td>
<td>50 (1)</td>
</tr>
<tr>
<td>Born 1920</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>62</td>
</tr>
<tr>
<td>TOTAL</td>
<td>187</td>
<td>182</td>
<td>141</td>
</tr>
</tbody>
</table>

In 1984, the cohort born 1911 consisted of the survivors from 1981, with some small alterations between the earlier participants and non-responders. The cohort born 1902 was expanded; all 152 persons born 1902 and living in the town of Umeå were invited.
Table II. Differences in 1984 between two groups born 1902, one from the town parish (examined for the first time in 1981), the other from Umeå town (examined for the first time in 1984).

<table>
<thead>
<tr>
<th></th>
<th>Town parish</th>
<th>Umeå town</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males (%)</td>
<td>24 (47.1%)</td>
<td>21 (28.8%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Females (%)</td>
<td>27 (52.9%)</td>
<td>52 (71.2%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Married</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>14 (58.3%)</td>
<td>14 (66.7%)</td>
<td>0.331</td>
<td>0.57</td>
</tr>
<tr>
<td>Women (%)</td>
<td>6 (23.1%)</td>
<td>11 (21.6%)</td>
<td>0.038</td>
<td>0.85</td>
</tr>
<tr>
<td>Living in private housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>19 (79.2%)</td>
<td>17 (81.0%)</td>
<td>0.022</td>
<td>0.88</td>
</tr>
<tr>
<td>Women (%)</td>
<td>22 (81.5%)</td>
<td>36 (69.2%)</td>
<td>1.367</td>
<td>0.24</td>
</tr>
<tr>
<td>Feeling healthy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>16 (69.6%)</td>
<td>12 (63.2%)</td>
<td>0.192</td>
<td>0.66</td>
</tr>
<tr>
<td>Women (%)</td>
<td>15 (55.6%)</td>
<td>33 (68.8%)</td>
<td>1.306</td>
<td>0.25</td>
</tr>
<tr>
<td>Daily pains</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>7 (30.4%)</td>
<td>7 (35.0%)</td>
<td>0.102</td>
<td>0.75</td>
</tr>
<tr>
<td>Women (%)</td>
<td>16 (59.3%)</td>
<td>31 (64.6%)</td>
<td>0.209</td>
<td>0.65</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (mean ± SD)</td>
<td>149 ± 23.3</td>
<td>148 ± 28.6</td>
<td>-</td>
<td>0.90</td>
</tr>
<tr>
<td>Women (mean ± SD)</td>
<td>159 ± 12.8</td>
<td>153 ± 29.2</td>
<td>-</td>
<td>0.36</td>
</tr>
<tr>
<td>Number of drugs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (mean ± SD)</td>
<td>2.9 ± 1.9</td>
<td>3.8 ± 4.1</td>
<td>-</td>
<td>0.35</td>
</tr>
<tr>
<td>Women (mean ± SD)</td>
<td>3.9 ± 3.2</td>
<td>3.3 ± 2.1</td>
<td>-</td>
<td>0.41</td>
</tr>
<tr>
<td>Cardiovascular diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>16 (66.7%)</td>
<td>13 (61.9%)</td>
<td>0.111</td>
<td>0.74</td>
</tr>
<tr>
<td>Women (%)</td>
<td>12 (44.4%)</td>
<td>34 (66.7%)</td>
<td>3.60</td>
<td>0.06</td>
</tr>
<tr>
<td>Dementia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>5 (20.8%)</td>
<td>3 (14.3%)</td>
<td>0.328</td>
<td>0.57</td>
</tr>
<tr>
<td>Women (%)</td>
<td>1 (3.7%)</td>
<td>14 (27.5%)</td>
<td>6.41</td>
<td>0.01</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>4 (16.7%)</td>
<td>3 (14.3%)</td>
<td>0.048</td>
<td>0.83</td>
</tr>
<tr>
<td>Women (%)</td>
<td>5 (18.5%)</td>
<td>8 (15.7%)</td>
<td>0.102</td>
<td>0.75</td>
</tr>
<tr>
<td>Hypertension (&gt;195/100 mm Hg or treatment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men (%)</td>
<td>4 (16.7%)</td>
<td>3 (14.3%)</td>
<td>0.048</td>
<td>0.83</td>
</tr>
<tr>
<td>Women (%)</td>
<td>8 (29.6%)</td>
<td>18 (35.3%)</td>
<td>0.255</td>
<td>0.61</td>
</tr>
</tbody>
</table>

SD = Standard deviation.
In 1987 and 1990, the cohorts born 1911 and 1902 consisted of the survivors from the previous examination, again with some small alterations as mentioned above. In 1990, a new group, born 1920, was included. The same procedure as before was used again: The 179 men and 214 women born 1920 and living in the town of Umeå were stratified according to gender. Then, every fifth male and every sixth female from lists sorted according to birth date were invited.

In 1984, a major change in the populations sampled was made, when the cohort born 1902, previously drawn from among the inhabitants of the town parish of Umeå, was expanded to include all persons born 1902 in a larger district, the town of Umeå. Both the group from the town parish and the one from other parts of Umeå were living in the same town, and there was no reason to believe that they would differ except from the proportion of men and women. In a comparison of the two groups in 1984, covering background variables, subjective health, blood pressure, and number of drugs and diseases (Table II) a statistically significant difference was detected in the proportion of women suffering from dementia.

In 1981, 66 per cent of the studied persons had lived in the town for more than 30 years and 77 % for more than 20 years. In 1991, these figures were 68 and 85 %, respectively.

Paper I-V

Paper I: The population used for sampling consisted of the 494 persons born in 1902, 1906, and 1911 and living in the town parish of Umeå in 1981. The names of these persons were stratified according to gender and representative systematic samples of 117 men and 114 women were drawn as indicated above. The non-response rate was 19 %; thus 97 men and 90 women remained. After exclusion of those not healthy (i.e. using drugs or suffering from diseases that could interfere with the laboratory results) 25 men and 27 women with a mean age of 74.3 and 74.6 years, respectively, remained for the study.

Paper II: The same stratified sample as before the exclusions in paper I was used; i.e. 97 men and 90 women. The mean age was 74.8 and 74.7 years, respectively.

Paper III: Those invited to the general examination were the whole population of persons born in 1902 and living in the town of Umeå in
1984 (49 men and 101 women) as well as the survivors from 1981 to 1984 among the systematic sample of persons born in 1911 with the small alterations mentioned above between participants and non-participants (31 men and 37 women). The non-response rate was 17 %; thus 71 men and 110 women remained for general examination. After exclusion of those with no complaints of or signs of cardiovascular disease or dysfunction or drugs against cardiovascular diseases, there remained 18 men and 21 women. Seven persons did not participate. Thus 16 men and 16 women with a mean age of 77.7 years were studied.

**Paper IV:** The names of all persons born 1902 and living in the town parish of Umeå in 1981 were stratified according to gender. Out of those, all 41 males and a representative systematic sample of every other woman (41 persons) were drawn and invited. In 1984 (the second examination), the group was expanded and all persons born in 1902 in the town of Umeå were invited. The survivors of that cohort, with some small alterations between participants and non-participants, were invited also in 1987 and 1990. The non-response rates for the different examination years varied between 16.3 and 20.7 %; the participating group, thus, consisted of 35 men and 30 women in 1981, of 45 men and 79 women in 1984, of 31 men and 60 women in 1987, and of 48 men and 72 women in 1990.

For a specific purpose, namely the use in a multiple linear regression analysis, the stratified representative systematic samples of persons born in 1911 and 1920 and described above were also used.

**Paper V:** Only those examined for the first time were used in this paper, which means that all persons examined in 1981, more than half of those born 1902 and examined in 1984, and a very small part of the rest was included for this study.

In 1981, the 97 men and 90 women born 1902, 1906 and 1911 and mentioned above (paper I and II) were used. In 1984, the group born 1902 was expanded as described above. Twenty-two men and 54 women were examined for the first time, and thus included in the study. From 1984 to 1990, additionally eighteen persons (4 men and 14 women) participated. These were previously non-responders.
NON-RESPONDERS

The non-response rate varied between 4.8 and 26.8 per cent in the different gender and age groups (table III). \( \chi^2 \) and Mann-Whitney U tests were used as significance tests of differences between the responders and the non-responders. There was an over-representation of women, though statistically significant only in 1990, among the non-responders. There was also a statistically significant difference in 5 year survival between female responders and non-responders in 1984. Among the other background variables studied, in-patient care occasions or days and 5 year survival, there were no statistically significant differences between responders and non-responders in any of the examining years (table IV).

Table III. Number of non-responders and all invited persons; proportion of non-responders.

<table>
<thead>
<tr>
<th></th>
<th></th>
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Table IV: Characteristics of non-responders (NR) and responders (R).

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* = p<0.05
METHODS

General

February to April every third year the study subjects were examined at the department of Geriatric Medicine in Umeå. A letter was mailed to every person drawn from the lists. Additionally, the registered nurse administering the practical parts of the examination made two telephone calls to the persons. The subjects were requested to bring with them all their prescriptions and current medication, prescribed or not. The necessity of a fasting state 10 hours before the examination was stressed. Information was given that immediately after the blood sampling, breakfast was to be served. In the examining room standardised questionnaires with questions about the social situation, previous diseases and present health of the subjects were used. In 1981, most of the questions were the same as in the "H70" study in Gothenburg. During the examination years, some of the questions were discontinued. Questions about other items were added. The wording of almost all the remaining questions was unchanged.

Those who needed assistance were accompanied by a relative or a member of their institutional staff. Home visits were made when a person could not or did not want to come to the department, but wished to be examined.

The examination consisted of the following parts:

• Medical examination and interview concerning medical history and symptoms by a physician.

• Physician's interview to assess the Katz' index of ADL (Activities of Daily Living) (26, 27) from 1984 on. This interview was made with the person or (in the case of moderate or severe dementia) with a relative or member of the institutional staff.

• Examination of the subjects' case records at the Umeå hospital, and a number of general practitioners' records by the examining physician and, from 1983 on, by myself.

• Measurements of body length, body weight, vision, hearing, and arterial blood pressure by a registered nurse.
• ECG, recorded after 10 min rest in the lying position, by a registered nurse.

• Blood samples drawn by a registered nurse. Using a tourniquet, the venous blood samples were drawn between 7.30 and 8.00 a.m. after five minutes rest in the supine position, with the subjects in a fasting condition (at least 10 h).

• Interview concerning social conditions by a registered nurse or a psychologist.

• Mini-Mental State Examination (28), by the examining physician.

• Establishment of drug consumption by means of interview, prescriptions, drug packages, and case records. This was done by the examining physician and then checked by myself against the available case records.

Included in the examination were also the following three items, the results of which are published elsewhere (29-31)

• Examination, including photography, of oral state and function by a dentist.

• Assessment of dietary intake according to the dietary history method (32) by a dietist.

• Tests of memory by a psychologist.

The examination methods pertaining to the various variables presented in this study have been continuously monitored. Thus, apart from a few analysis methods of blood components it has been possible to keep the same methods through the four examination years.

In 1981 and 1984, comparisons of the results of various items between the members of the examining staff were made. Several persons examined the same subject and the results were compared. During joint discussions, the reasons of different results were examined and there was a strive of consensus. No quantitative validation techniques were used. The questions were constructed to minimise the possibility of the interviewer to influence the answer. During the last two examination occasions, the extent of comparisons was much smaller. It has not been possible to keep the same examining staff during the nine years covered. No physicians or
registered nurses have participated in all examination years since 1981 but three physicians and two nurses have been the same since 1984. The dentist was the same through all years. The dietist and the psychologists differed in most of the examination years. The person responsible for planning, administering, training of the examinators, and carrying out of the examinations, however, has been the same since 1984.

Drugs were classified according to the Anatomical Therapeutic Chemical (ATC) Classification System, which is recommended by the World Health Organisation (33). Both prescribed and non-prescribed drugs were recorded.

**Statistical methods:** The $\chi^2$ test, Fisher's exact test, Student's t-test, standard analysis of variance, linear regression, Mann-Whitney U test, and confidence intervals based on the binomial distribution were used where appropriate. The limit of statistical significance was set at $p=0.05$. No adjustment of significance level was used to compensate for multiple testing. In order to avoid cluttering of the figures, measurements of spread were generally omitted. All statistical computations and analyses in the last three papers and the rest of the thesis were made by means of SYSTAT (34). The statistical program used in the first two papers was SPSS (35).

**Paper I-V**

**Paper I:** The values of the blood components were measured from venous blood samples drawn in the morning after at least 10 hours fasting and in the supine position.

To calculate the reference intervals and the medians of the blood components, the concentrations of these components were plotted against the cumulative frequency of study subjects on a normal distribution paper, as described by Winkel et al. (36). For each blood component a curve was drawn, smoothing the single values as well as possible. The reference interval was taken to be the range between the concentrations of the 2.5 and 97.5 percentiles.

**Paper II:** The methods used were the physical examinations and interviews described in the "general" methods paragraph above. On the basis of the interviews, the examination and the laboratory tests, the examining physician classified the subjects into those healthy, those not healthy but having adequate maintenance therapy, and those requiring further treat-
ment and/or investigation. Furthermore, to be able to compare the results with the "H70" study in Gothenburg, the diseases were diagnosed according to the criteria used by Landahl et al. (37).

**Paper III:** The inclusion criteria are mentioned above. All ECGs, except for five, were recorded for 24 hours on a Medilog cassette tape recorder. Three recordings were 18 hours and two were 12 hours long. Primary computer analyses of the QRS complexes, heart rate, R-R interval, premature beats and blocks were performed on a PDP 11/34 computer. These analyses were then manually edited and corrected.

**Paper IV:** The study subjects were requested (by letter and telephone call) to bring with them all their prescriptions and drugs with packages, prescribed or not, to the examination. Those who needed assistance were accompanied by a relative or a member of an institutional staff. If the person couldn't or did not want to come to the examination, home visits were made.

All case records available at the hospital in Umeå, and a number of general practitioner's records, were examined every examination year. The study persons' statements were checked against the case records.

Drugs were classified according to the Anatomical Therapeutic Chemical (ATC) Classification System mentioned above.

**Paper V:** The recording of death dates and causes of death was made possible through a continuous follow-up of the town death records and, if any, autopsy results for the dead subjects.

To take into account both those who died during the study period and those who did not, life-table technique (38) was used to describe the death risk as a function of time. The Cox proportional hazard's regression model (39) was used to estimate the importance of the different risk factors of death.

Some of the analysis methods of blood components changed during the study period. Components in which the change in analysis methods changed the values were not analysed as risk factors.
RESULTS AND DISCUSSION

SOCIAL CONDITIONS

Employment

Classification of employment was made according to the Swedish socio-economic classification (40). At the time of examination, all the studied persons were retired. The occupational structure was that of an urban population. Both among the men and the younger women most persons had been workers or clerks. Many women in the older birth cohorts had been housewives, while all the women born 1920 had been employees. Among those born in 1920 no one had been a farmer or farmers' wife (figure 2).

Fig. 2. Proportion of persons having had different types of employment.

Educational level

The educational level is shown in figure 3. There was no gender difference, but there were proportionally more persons having only elementary school education in the cohorts born earlier. Thus higher education was more frequent among those born later.
The proportion of persons with more than 12 years of full-time education has been surveyed in selected areas in eleven, mostly European, countries. Around 1980, 1 to 38% of the men and 0 to 12% of the women aged 70-74 years had such education (41). The frequencies were highest in predominantly urban samples.

Fig. 3. Educational level of persons in the different birth cohorts.

Housing

Housing conditions (for the elderly) can be classified according to service level. In Sweden, there are at least four such levels, here named in order of the amount of help provided.

1. Private housing.
2. Senior citizen buildings /sw. servicehus/.
3. Old age homes.
4. Nursing homes.

With increasing age, there was a distinct trend that persons moved to places with higher service levels (figure 4). At the age of seventy, almost
all persons still lived in their own homes. At 88 years of age, about half of the persons were provided with a higher service level. Almost 20 per cent of these lived in nursing homes, where the patients need help with most of their ADL functions. No gender difference could be detected. There was a difference indicating that the 79-year-old men possibly had become less dependent during the study period. This difference, however, was not statistically significant.

Fig. 4. Proportion of persons living in different housing categories.
The results are consistent with those of the studies in Gothenburg and Glostrup in showing that up to the age of 80, 90-100% of the persons are still able to live in their own home (42-44). From that age on, however, an increasing proportion has to move away from their homes. Figures reported from the Nordic countries show that from 84 to 90 years of age, the proportion of the population still living at home decreased from 76 to 51%. The proportion living in nursing homes varied from 8 to 25% during the same ages (12, 20, 24, 43, 45, 46).

In a review of epidemiological studies on social and medical conditions of the elderly, Svanborg noted that available data indicate that severe disability to the degree that makes institutional care necessary occurs in 3% of the 70-year-olds and 5% of the 75-year-olds (11).

There was a strong association between the functioning level and living in one of these housing categories. In 1990, the Spearman correlation between housing category (treated as an ordinal scale) and the Katz' index of ADL was .678.

**Marital status**

The grossly divergent average life expectancies for men and women (74.8 years for men and 80.6 years for women in Sweden in 1991) are well reflected in figure 5. The proportion of widowed men increased from around 10% at 70 years of age to 46% at the age of 88. The figures for women were far beyond that, increasing from around 25 to almost 70 percent in the same years. As expected, there were few divorced people in these ages, with the exception of the women in the cohort born 1920. The proportions of unmarried, married, divorced and widowed persons in different ages corresponded fairly well to those of the whole of Sweden (47).
Generally, the proportion of married persons in all ages, both men and women, again with the exception of the women in the cohort born 1920, were greater in Umeå than in Glostrup, Turku and Jönköping (12, 20, 23, 48). This could partly be a function of the longer life expectancy in Sweden or of the increasing mean life length, since the Glostrup and Turku studies were performed before this one. The difference from the Jönköping study, however, can not be explained in that way. In other parts of Europe, the percentage of married men and women aged 70-74 years was 68-91 % and 18-56 %, respectively. Corresponding figures for
men and women aged 85-89 years was 40-75 % and 0-25 %, respectively (41).

Social activities and contacts

To get on well when retired, it is most likely that life must be filled with some reasonably regular activity. Below is described a couple of activities and the frequency of elderly persons in Umeå practising them.

The proportion of persons reading newspapers or having the text read for them daily decreased from around 90-95 % at 70 years of age to around 75 % at the age of 88. No gender or cohort difference could be traced (figure 6). In Turku, 89 % of those aged 65+ in 1963 read newspapers (23). In Gothenburg, 94 % of those aged 70 read at least one newspaper (49). Evidently most persons still follow the news regularly in high age. There was, however, no measure of the amount of text read.

Fig. 6. Proportion of subjects reading or having the newspapers read for them daily.
The frequency of **magazine reading** showed a slight tendency to decrease with high age. There was also a gender difference: 35 to 65 % of the men and 55 to 75 % of the women read magazines at least weekly (figure 7). In Gothenburg, 67 % of those aged 70 read periodicals at least once a week (49), a figure quite similar to that in Umeå.

Fig. 7. Proportion of subjects reading magazines at least weekly.

![Graph showing the proportion of subjects reading magazines at least weekly.](image)

Figure 8 shows the proportion of persons practising a hobby. As could be expected, with increased age, there were fewer active persons. There was also a gender difference tendency, especially in the cohort born 1902: The proportion of women practising a daily activity decreased from around 55 % at the age of 70 to 22 % at 88 years of age. The corresponding trend among the men was a decrease from around 45 to 18 %. In Glostrup, 57 % of then men and 53 % of the women aged 80 years had a weekly hobby (50).
Figure 9 shows the proportion of persons participating regularly in meetings of associations of which they are members. There was no general gender difference. Among the women born 1902, there was a clear participation decrease with age. Among the men, there was a difference between the cohorts; 20-30 % among those born 1911 and 5-12 % among those born 1902 went to the meetings at least weekly.

In Gothenburg, almost 50 % of those aged 70 were members of a society, and 60 % of those went to society meetings at least once a month (49). In Copenhagen, less than 30 % of both sexes aged 75, 80, and 85
years had contacts with a society (51). Thus, it seems as the elderly in Umeå were more active in associations than those in Gothenburg and Copenhagen.

Fig. 9. Proportion of subjects participating in meetings of an association.

Fifty to sixty per cent of the subjects had children whom they met with more than once a week. The contact frequency did not differ substantially with age or gender (figure 10). It seems that the encounter frequency with children was a bit lower in Umeå than in Gothenburg and Glostrup. 72 % of the men and 82 % of the women aged 70 and having children in
Glostrup had met with their children the last week (48). 75 % of the men and 84 % of the women aged 80 years had weekly, and 95 and 97 % of the men and women, respectively, had monthly contact with family or friends (43). 53 % of those 85 years of age had been in contact with their children or grandchildren during the week before examination (52).

Fig. 10. Frequency of contact with the subjects' children.
In Gothenburg, 80% of those aged 70 had met their children within the last week (49). In Jönköping, two thirds of those 70 years and having children met with them at least once a week (20).

**FUNCTIONAL LEVEL**

The lower the functional level, the more persons in this study lived in residence types with a high provision of help. Two specific measures of functional ability are described below, namely, the walking and dressing abilities. The proportion of persons being able to walk without an aid was decreasing from around 90% or more at 70 years of age to around 50% at the age of 88 (figure 11). There was no gender difference.

![Fig. 11. Proportion of men and women being able to walk without an aid.](image)

The walking abilities were comparable in the other Nordic cities studied: In Turku, 13% of the women and 15% of the men aged 65+ used walking aids (23). In Gothenburg, 15% of those 70 years of age used some kind of walking aid (44). 69% of those aged 85 in Glostrup (12), and 54% of the men and 42% of the females aged 85+ with a mean age of 88 in Tampere (53) were able to walk without support or assistance.

The ability to dress is one of the most important functions required for an independent living. With increasing age, this ability too was much impaired, though not as much as the ability to walk independently. Only a few persons needed help at 70 years of age, while almost one third of those 88 years of age required help (figure 12). There was no gender difference.
In Melton Mowbray, England, 3-7 % of those 75-79 years, 4-8 % of those aged 80-84, and 13-23 % of those aged 85+ needed help with dressing (54). In Glostrup, 2 % of the men and 1 % of the women aged 70, 2 % of those aged 80 and 13 % of those aged 85 needed help with dressing (12, 50, 55). Among the non-institutionalised in Framingham, 1 % of the men and 0 % of the women aged 65-74 years and 3 % of the men and 2 % of the women aged 75-84 years needed help with dressing (56). All these figures indicate a lower niveau of help than in Umeå. The Melton Mowbray and Glostrup figures, however, are based on interviews, and those from Framingham are from a selected population. I therefore consider the figures from Umeå, based on observations of persons in the actual situation, as the most relevant of a population. A figure similar to that in Umeå was reported from Jönköping, Sweden, where 28 % of those aged 84+ needed help with dressing (20).

One of the most widely used assessment scales of functional level is the Katz' index of ADL (26, 27, 57). The index measures performance of bathing, dressing, going to toilet, transferring to and from bed and chair, continence, and feeding. The functional ability is coded by letters. From A to G, the need of help is increasing. Code "Other" represents those not matching the scale but needing some help (i.e. worse than code A). In this study, there was no rating comparable with the Katz' index in the 1981 and 1984 examinations. As can be seen from figure 13, there was a rather steep impairment of the functional level between 79 and 88 years of age, the women needing somewhat more help than the men in every age category. The gender difference was not statistically significant. However,
the consistent difference in all age groups and cohorts probably means that the difference detected was not only by chance.

In Gothenburg, 31% of the women and 27% of the men aged 70 were classified as ADL-reduced, i.e., they didn't accomplish at least one of the items in the Katz' index without difficulty (44). Among those 76 years of age, 11% of the women and 16% of the men were "dependent in instrumental and personal ADL", a somewhat wider concept (42).

Fig. 13. Katz' index of ADL: Proportion of persons in different functional categories.

Provision of help

Help can be provided in different ways; by relatives or friends, by municipality employees, or by living in an institution (a nursing home or a home for the elderly) with scheduled daily help. During the last years, the absolute and relative number of persons in Sweden receiving municipality home-help service has decreased in all ages except for persons older than 85 years (58). In 1978, 24% of those 65+ years in Sweden received municipality home help. In 1983, 46% of those 80+ years received municipality home help (59). Thereafter, the number and proportion of persons receiving help has diminished. The number of helping hours per person, however, has increased. Below 90 years of age, proportionately more women than men received help. In 1990, 11% of the men and 15% of
the women aged 75-79, 22 % of the men and 29 % of the women aged 80-84, and 35 % of the men and 40 % of the women aged 85-89 years received help (58). The share of the help given to the oldest persons has increased. In 1990, 51 % of all persons receiving home-help services were over 80 years of age (58).

Figure 14 shows that the conditions in Umeå could well be in accordance with the total Swedish situation. The proportion of persons receiving municipality home help among those born 1911 was increasing from 12 to 18 % from 73 to 79 years of age. The corresponding proportion among those born 1902 increased from 40 to 46 % from 82 to 88 years of age. There was no gender difference. Comparing with the proportions of persons being able to walk and dress independently (figures 11 and 12), the large gap between those 79 years old in the cohort born 1911 and those 82 years old in the cohort born 1902 could well imply that provision of help, holding the need constant, has decreased. This hypothesis is further strengthened by comparing the cohort born in 1920 with those born in 1911.

According to a survey in Jönköping, a Swedish town of approximately the same size as Umeå, most of the help provided consisted of domestic work (cleaning, 34 % of the time, cooking, 23 %, shopping, 16 %, washing clothes, 7 %). Only 6 % of the time was used for personal hygiene and 1 % for help with dressing (60).

Fig. 14. Proportion of persons receiving municipality home-help.

The proportion of people receiving help of any kind (from relatives or friends, communalty employees or by institutional living) was assessed
by adding those answering positively to the question: "Is someone providing you with regular help?" as well as those living in old age homes or in nursing homes (figure 15). Seventy to 80% in the 80+ age group received help, compared to 20 to 30% among those born 1911 and 15% in the youngest age cohort.

Fig. 15. Proportion of persons receiving regular help of any kind.

In Turku, the proportion of persons receiving home help or being institutionalised increased from 17 to 73% in men and from 14 to 74% in women between the ages of 65 and 80+ (23). In Jönköping, the corresponding proportion among those aged 84+ was 79% (20). In Gothenburg, 9% of those aged 70 received municipal help and 10% received help from close relatives and friends (44). In Glostrup, 12% of both men and women aged 70 received home help. Forty-two per cent of the men and 41% of the women aged 80 received municipal help. The total proportion of people aged 80 receiving help was 49% of the men and 57% of the women. Forty-eight per cent of those aged 85 and living at home in 1982 received municipality home help (12, 50, 61). In Tampere, 84% of those aged 85+ were receiving regular home help (53).

Evidently, during the 8th and 9th decade of life the need of and provision of help in the Nordic countries increase from almost zero to more than three fourths of the population.
MEDICAL CONDITIONS

The Gothenburg study showed that, in many respects, the elderly have become more healthy (54). In general, the results of this study do not support such a conclusion. On the contrary, the mean number of definable diseases per person at 79 years of age increased between 1981 and 1990 among both men and women and was almost constant among those 70 years old during the same period (figure 16).

Fig. 16. Mean number of diseases with 95 % confidence intervals.

In both age cohorts, the number of diseases increased with age with 75% or more during the nine years. The cohort effect could well mean that at 79 years of age, those born 1911 were in fact less healthy than those born 1902. There is also a possibility that this effect is spurious, i.e. that with consecutive examination years of the same persons, previously unknown diseases became known. The persons were followed for nine years and almost all of their case records were examined by me. When a disease became known, the possibility that the person had this disorder during the previous examination years was investigated by retrospective checks of case records and previous assessments. If positive, the disease was added to the persons’ list for that previous year. This procedure reduced the risk of that effect.

The possibility that the number of diseases in 1981 among those born 1902 and dying early (before 1984) was less than that among those dying later would also point to the spurious effect. One could also suspect that these people were less healthy than those dying later, which would make
a no-difference even more convincing. This analysis showed that the mean number of diseases among those 18 persons dying early was 3.7 compared to 2.0 among those dying later. The result does not support the possibility of the spurious effect. Those dying early, however, could have been so sick that their real number of diseases was so high as to preclude the possibility of showing an effect.

We must therefore rely on other variables to examine the potential spurious effect. The number of diseases was higher among those who did not feel healthy as well as among those feeling generally tired (T-test, p=.002 and .004, respectively). These variables show the same pattern as the number of diseases, i.e. at 79 years of age the cohort born 1902 felt more healthy and less tired than the those born 1911 (the chapter "Subjective health"). There was no possibility of the spurious effect here. The results therefore support the assumption that the real number of diseases among the cohort born 1911 was higher than among those born 1902, at the same age.

This does not mean that elderly people in general have been less healthy during the last decade. The sample is too small to support such a conclusion and is only representative of the men and women in those ages in Umeå. The assumption is of importance, however, when interpreting the effects to be shown below.

**Mortality**

Ten year mortality among those examined in 1981 and born 1911 was 41% among the men and 10% among the women. Corresponding figures for those born 1906 were 63% and 50%, respectively. Sixty-nine per cent of the men and 47% of the women born 1902 died during these ten years. Survival curves according to Kaplan-Meier (62) for the three birth cohorts are shown in figure 17.
The major causes of death were cardiovascular diseases (78 persons, 58 %), malignancies (28 persons, 21 %), and acute infections (12 persons, 9 %). These figures are consistent with the reports that cardiovascular diseases account for more deaths in the elderly than all other causes (63) and that cardiovascular diseases and malignancies are the major causes of death in Sweden also between 70 and 90 years of age (47). According to the official death statistics of Sweden in 1988, 57 % of the men and 60 % of the women died from cardiovascular diseases, and 18 % of the men and 14 % of the women from tumours (64).

**Anthropometric measurements**

During these nine years, there was a slight, but statistically insignificant, loss in mean body length in both age cohorts. The mean weight loss, however, was more pronounced, despite the decreasing number of smokers. Smoking has been shown to be a major confounding factor (65). Consequently, there was a substantial fall in the mean Body Mass Index (BMI). The BMI (66) is calculated as the weight in kilograms divided by the squared body length in meters and is used as a measure of obesity. The steep decline of the mean BMI in the oldest cohort was very pronounced. Slight, but statistically insignificant, period effects were seen: The length, weight and BMI increased during the nine years both at 70 and 79 years of age. The weight and BMI of 70-year-old women, however, showed a tendency to decrease (figure 18).
Fig. 18. Mean body length, body weight and BMI with 95% confidence intervals among the studied men and women.

The mean body length and weight measures were in good accordance with the Swedish standards up to 75 years of age except for the body weight of 70-year-old women born 1911 (67). These standards are based on a pooling of three representative population studies in Gothenburg. Above 75 years of age there are no standards yet. Figures for body length, weight, and BMI among persons 79 to 86 years old have been presented from the population studies in Gothenburg, Glostrup, and Tampere (46, 68, 69). Generally, the mean values of body weight and BMI in this study were a little lower than the ones mentioned above.

**Vision**

Many elderly people say that among the most important things in late life is to have good eyes, ears and brain, i.e. that the sensory system is in
good shape. We all know that these organ systems do fail to a large extent in high age.

Fig. 19. Visual acuity of the study subjects with their own glasses.

![Fig. 19](image)

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Fig. 20. Visual acuity of the subjects without glasses.

![Fig. 20](image)

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Figures 19 and 20 show the results of the vision tests with and without the subjects' own glasses. No attempts to correct the visual acuity were made. The tests were performed by means of a luminated letter chart (Kifa) at a distance of 5 m. To score a certain visual acuity, the person must name all the letters on the line in question.

Since there were no statistically significant differences between visual acuity (VA) among men and women, the figures show both genders pooled. Vision was steadily declining from 70 years of age, when 70-80 per cent had full or almost full vision with their own glasses, to the age of 88, when the corresponding figure was only 8 per cent. There was, however, a large number of persons who did not participate, either because of dementia or lack of facilities (home or institutional visits).

Hence, an analysis of the VA among persons who participated in the test was performed. The results of that analysis probably were more correct, but theoretically could be biased if the non-participants should have had inferior vision than the rest. The general picture was almost the same; a linear fall with age of VA with glasses on.

Measuring the VA without glasses, the age effect disappeared; vision in each birth cohort did not drop at all. Two explanations could be proposed. First, the elderly did not buy new glasses as often as they should have, and secondly, several persons' bad vision was due to diseases for which glasses did not help, e.g. eye cataract, glaucoma or senile degeneration of the macula.

Many representative studies have included measures of VA. Because of the various age intervals used, however, it is not easy to compile the results. The following results were with glasses. At around 70 years of age, 70-90 % of populations had got a VA of 0.8-1.0 and 90-98 % a VA of ≥0.5 with glasses (70-73). At around 80 years of age, 40 to 70 % had a VA of 0.8-1.0 and 80-90 % a VA of ≥0.5 (70, 71, 74). Around 85 years of age, 48 % had "normal vision", 70 % a VA of ≥0.5, and 7-10 % 0.1 or less (52, 70, 75). The Gothenburg study has shown that with best correction instead of the subjects' own glasses, 87 % instead of 69 % of 70-year-old people could reach a VA of 0.8-1.0 (72).

What do these results imply concerning sight problems in the daily life? We did not do practical tests, but in interviews of a representative population, 9 % of the men aged 75-84 years and 24 % of those aged 85+ years said that they had difficulties in reading the normal text in a daily paper. Corresponding figures among women were 13 and 35 %, respec-
tively (64). These figures probably could improve, considering the result of the glass correction made in Gothenburg and mentioned above. Among ambulatory 82-year-old persons in Gothenburg, 90 % could watch TV and read newspapers and books, but only 65 % could read the text and figures in the telephone book (74).

Hearing

It is well known that the hearing ability diminishes with age, especially among males. The hearing loss, called presbyacusis, is of sensorineural type and is characterised by a lowering of the highest audible frequency. Hearing ability is often measured by way of audiometry. We chose, however, to use a method that reveals the functional disability in a better way. The tests were made in a standardised way. The subjects were allowed to use their own hearing aid, if that would improve their hearing. At distances of 5 and 1 meters, respectively, the subject was sitting on a chair turned away from the female registered nurse, who either whispered or said an easy four- or five-letter, two-syllable word in an ordinary conversational tone.

The hearing ability showed a distinct decline with age. Testing was not performed in 1981, but there were no signs of cohort effects. At 88 years of age, no man and only 12 % of the women had normal hearing, while at 70 years around 85 % of the women and 80 % of the men could hear what the nurse whispered at 5 m distance (figures 21 and 22).
Fig. 21. Hearing ability of the study subjects.

**Men**

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- No result
- Conversation 5m
- No conversation 1m
- Whispering 5m
- Conversation 1m

**Women**

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Fig. 22. Proportion of persons with normal hearing ability (whispering at 5 m distance).

![Graph showing the proportion of persons with normal hearing ability (whispering at 5 m distance) for different birth years.]

Obviously, these two decades of life are very important concerning the functioning of the sensory systems. Only a few papers on hearing in representative populations of the elderly have been published (76). The method has mostly been tone audiometry, but a few of the results are comparable with those from Umeå.

In a representative interview study, 38 % of the men aged 75-84 and 61 % of those aged 85+ years said they had difficulties in hearing while talking to a couple of persons. Corresponding figures among women were 28 and 52 % (64).

In Gothenburg, 60 % of the men and 86 % of the women aged 70 could hear whispering at 5 m, 29 % of the men and 10 % of the women at least ordinary conversation at 5 m. 1.3 % of the men and 0.4 % of the women could not hear ordinary conversation at 1m (49). The women's results were similar to those in Umeå, while the hearing of the men seemed to be somewhat better in Umeå. In Turku, the frequency of those deaf or almost deaf increased from less than 1 % to 18 % from 65 to 80+ years of age. Surprisingly, the number of females with bad hearing ability was equal to the men (23). In Copenhagen, 7 % of those 75 years of age and 16 % of those 85 years old could not hear "a speaking voice" at a distance of one meter with or without hearing aids (77). In Glostrup, 20 % of those aged 85 had "normal" and 56 % "moderately reduced hearing" (52).
Subjective health

Perceived health

What makes a person feel healthy? Obvious parts of this complex mix are the diseases he suffers from, but there is much more to it. The psychological base, the social situation, the activities performed, the social network with family and friends, ailments and infirmities, drug use and functional disabilities are often very important. In a comprehensive literature review of research on subjective well-being of elderly people, Zautra et al. (78) found a strong direct relationship between health and well-being, controlling for many possible confounding factors. Larson, in a similar literature review concerning older Americans (79), found that subjective well-being was most strongly related to health, followed by socio-economic factors and degree of social interaction. On the contrary, age, sex, and employment showed no independent relation to well-being. In Israel too, the strongest correlates with self-rated health were found to be the health status, while the impact of social contacts and leisure activity variables were unclear. The weakest correlates with self-rated health were with the demographic variables (80). Again, in Jönköping, Sweden, health status was shown to be the factor most connected to perceived health (20).

To be able to assess subjective well-being, the question "Do you feel healthy?" was administered to the subjects (figure 23).

Fig. 23. Proportion of the study subjects feeling healthy.
There was no distinct age trend of subjective healthiness. There was, however, a tendency for the men to feel more healthy than the women in most age groups. The differences were not statistically significant.

In Gothenburg, the same question (Do you feel healthy?) was asked. The proportions aged 70 and feeling healthy in a cohort born 1901/02 were 67 % among men and 64 % among women (81), corresponding extremely well with the 69 and 67 %, respectively, found in this study among those born 1911. In Umeå, the cohort born 1920 showed even higher figures; 75 % of the men and 80 % of the women felt healthy. Among those 79 years of age, the figures in the two studies differ considerably. Following a birth cohort, the feeling of well-being from 70 to 79 years of age increased to 78 % in men and 71 % in women in Gothenburg, but decreased in Umeå to 55 % among men and 42 % among women. The cohort born 1902, that is, nearly the same birth year as the Gothenburg subjects, was somewhat better off, with 66 % of the men and 47 % of the women feeling healthy at 79 years of age.

Thus, while the feeling of well-being increased in Gothenburg from ages 70 to 79, it decreased in Umeå. The reason could be that in Gothenburg, the answers reported to the question were only "yes" or "no". In Umeå, some persons did not know what to answer. The proportion of such persons increased with age because of the increasing dementia prevalence.

In Turku in 1963, 74 % of the men and 67 % of the women aged 65+ felt healthy. There were no age differences (23). Twenty years later, 68 % of the men and 62 % of the women over 65 years of age felt healthy (82). In Edinburgh, Scotland, 52 % of those 62-90 years of age regarded their health as good (83). In Glostrup, as many as 91 % of the men and 92 % of the women aged 80 said that they had a good or very good health (43). In other parts of Europe, the proportion of those aged 70-74 years not feeling healthy has been reported to vary between 22 and 82 % in men and between 32 and 91 % in women. Corresponding figures among those aged 85-89 years were 14-89 % in men and 17-94 % in women. Generally, the figures were higher among the women but no major differences between the age groups were noted (41).

There have been some efforts of assessing the "accuracy" of self-ratings of health (78). Some studies (81, 85) have shown a statistically significant association with mortality, but not all (86). In this study, the association of subjective healthiness with mortality was examined with log-rank test (paper V). There was a tendency for those not feeling healthy to die
earlier, but the difference was not statistically significant \((p = .233)\). Nor did separate analyses for men and women reveal any statistically significant differences.

**Symptoms**

What symptoms and ailments, then, did the elderly suffer from? Diseases are frequent among the elderly, but so are symptoms that are not necessarily due to diseases. These symptoms, however, could be very serious, badly complicating the living of the elderly.

Two of the symptoms, general tiredness and constipation, were clearly age related, while the age patterns of the others were more obscure. The women complained more than the men of all kinds of symptoms, but the sex difference in prevalence of several symptoms generally became less pronounced in high age.

Most studies show that women complain more of symptoms than men \((23, 43, 49, 52, 69, 87)\). In a standardised survey of the elderly in eleven countries, mainly in Europe, where persons in representative samples were asked about 24 signs and symptoms, the same observation was made. There was also a slight increase in the prevalence of symptoms with age. The most frequent symptoms were joint and back trouble, tiredness, and nervousness \((41)\).

Fig. 24. Prevalence of general tiredness and daily pains.
General tiredness (figure 24), the most frequent of the symptoms asked for among the oldest persons, was defined as a positive answer to the question "Do you feel generally tired?" This symptom was very clearly age related. The proportion of persons from 70 to 88 years of age feeling generally tired increased from around 10 to 55 % among men and from around 30 to 55 % among women. In Turku, 37 % of the men and 41 % of the women aged 65+ complained of fatigue (23). In Gothenburg and Glostrup, complaints of general tiredness increased from 18 to 24 % among the men and from 25 to 31% among the women 70 to 85 years of age (43, 49, 52).

Twenty to 35 % of the men and 35 to 55 % of the women suffered from daily pains (figure 24). There were no age effects. In Turku, 23 % of the men and 31 % of the women aged 65+ suffered from headache, and 42 % of the men and 48 % of the women from other pains (23). In Tampere, the prevalence of aches and pains was 24 % among those 85+ years (mean age 88) living at home or in old age homes (21). In Eslöv, Sweden, 34 % of those 80+ years had daily pains (45).

Fig. 25. Prevalence of dyspnoea.

Dyspnoea

Fifteen to 30 % of the men and 20 to 55 % of the women suffered from dyspnoea (figure 25). The definition of dyspnoea was a positive answer to the question "Do you feel breathless when walking two flights of stairs or the equivalent as fast as other persons of your age?" No age or cohort effects were found.

The prevalence of dyspnoea among those 70 years of age in Gothenburg (with exactly the same definition as in Umeå) was 31 % in men and 36 % in women (88). A comparison with other studies is impeded by the lack
of uniformity of definitions. In Turku, 41 % of the men and 37 % of the women aged 65+ complained of exertional dyspnoea (89). In Glostrup, 14 % of the men and 22 % of the women aged 70 complained of shortness of breath when walking on level ground. The corresponding figures for 80-year-old men and women were 18 and 23 %, respectively (69). In Dunedin, Florida, from 65 to 84+ years of age, the prevalence of shortness of breath with less than normal exercise increased from 11 to 25 % in men and from 19 to 26 % in women in an ambulatory population (87).

Fig. 26. Prevalence of constipation and the passing of flatus.

The prevalence of constipation in a population is of course very dependent of the definition of the symptom. When defined as a frequency of evacuation ≤4 times a week (as in figure 26), the proportion of constipated persons in Umeå increased very clearly with age, from 10 to over 30 % in men and from around 20 to 45% in women aged from 70 to 88 years. When defined as the proportion of people taking laxatives regularly (not shown in the figure), the age difference was a little less pronounced, but the pattern was quite like the one given by the definition above.

In Turku, 23 % of the men and 24 % of the women aged 65+ complained of constipation (23). In an ambulatory population in Dunedin, Florida, from 65 to 84+ years of age, the prevalence of recurrent constipation increased from 9 to 23 % in men and from 24 to 35 % in women (87). In Glostrup, it was reported that only 2 % of those 85 years of age suffered from chronic constipation (52).
Twelve to almost 60% of the subjects said that they were "embarrassed by passing of flatus" (figure 26). There were no age or cohort effects but, as also concerning the other symptoms, more women than men in most age groups were embarrassed. In Glostrup, 9% of those aged 85 suffered from "stomach rumbling" (52).

Fig. 27. Prevalence of daily mouth dryness and daily dizziness.

Between 20 and 40% of the persons, except for the 70-year-old men born 1911, complained of a daily feeling of mouth dryness (figure 27). There was a slight tendency of an increasing proportion with age. This symptom was found related with statistically significance to the number of drugs taken (T-test, p<0.001 in 1990).

Four to eleven per cent of those aged 70 to 79 and 10 to 20% of those aged 85 to 88 years suffered from daily dizziness (figure 27). In an ambulatory population in Dunedin, Florida, from 65 to 84+ years of age, the prevalence of dizziness increased from 4 to 20 % in men and from 9 to 18 % in women (87). In Turku, 41 % of the men and 40 % of the women aged 65+ suffered from dizziness (23). In Tampere, 22 % of those aged 85+ and non-institutionalised (mean age 88) suffered from vertigo (21). In Gothenburg, between 25 and 33 % of those 75 years of age suffered from dizziness at least every month. Five per cent had constant dizziness (46).
Diseases

The number of definable diseases (figure 16) increased from around two to four from 70 to 88 years of age. The increase was statistically significant among both men and women and in both ageing cohorts. There were no statistically significant sex differences. At 88 years of age, 8% of the men and 4% of the women had no definable disease at all. As shown previously, the persons in the cohort born 1911 at the same age were more ill than those born 1902. The difference, however, was statistically significant in the women only. In Tampere, the mean number of diseases among those 85+ years was 2.7 among men and 2.8 among women. Only one man (1%) and 6 women (1%) had no disease at all (53).

Cardiovascular diseases

The most frequent disease group among these elderly people was by far the cardiovascular. Fifty to 70 per cent of the persons were suffering from one or more cardiovascular diseases (figure 28). The more strict definition of hypertension (see below) was used. There was no statistically significant gender or age difference. At the age of 79, more females born 1911 than 1902 had cardiovascular diseases. At the age of 70, however, those born 1920 had fewer diseases than those born 1911. Thus there was no trend of cardiovascular illness becoming more frequent among elderly women during the last decade. Mortality from all cardiovascular diseases, ischaemic heart disease and cerebrovascular diseases among both men and women in Sweden during the 1970's and especially the 1980's actually decreased in most age groups (90, 91).

Fig. 28. Prevalence of cardiovascular diseases.
The most frequent cardiovascular disease around 70 years of age was hypertension, while at 88 years of age it was congestive heart failure (figures 29 to 34).

There is no generally accepted definition of hypertension in these age groups. Consequently, it is impossible to give exact prevalence figures of the disease. Two definitions of hypertension were used in this study. Both include all persons treated with blood pressure-lowering drugs prescribed for hypertension. The first definition is based on the limits of systolic blood pressure (SBP) >160 or diastolic blood pressure (DBP) >95 mm Hg. The second used the higher limit of SBP >195 or DBP >100 mm Hg. The blood pressure (BP) reading was based on a casual measure. It has been shown that such measurements are both highly reproducible and correlate strikingly to cardiovascular morbidity (92). Note that the scale in figure 29 is not the same as that in the other figures showing prevalence rates of cardiovascular diseases.

In both birth cohorts, the prevalence of hypertension decreased during the period (figure 29). The lower frequency of hypertension with increasing age and successive examination years could partly be due to an age effect, but there were also signs of a period or cohort effect, especially concerning the men and the prevalence rates of those having BP >160/95 or treatment. This effect, however, was statistically significant only between the 70-year-old women in 1981 and 1990. Using the lower limits of hypertension, the prevalence decreased from 80 to 40 per cent among the women, and from 60 to 15 per cent among the men.

In Framingham, using the same definition, cross-sectional prevalence rates increased from 44 to 59 % among women and were constant around 40 % among men aged from 65 to 94 years (93). In Denmark, the prevalence of hypertension (160/95 mm Hg and over at one occasion) among those aged 70 was 22 % in men and 17 % in women. At 80 years of age, corresponding figures were 4 % among men and 3 % among women (94). In Gothenburg, the prevalence, defined as a DBP >110 mm Hg or treatment, was 14 % and 22 % among men and 34 % and 41 % among women aged 70 and 75, respectively (95). In Tampere, Finland, the prevalence among those 85+ (mean age 88) was 3 % in men and 8 % in women (53). The definition was a repeated DBP >110 mm Hg, an anamnesis from the subject of a diagnosis of hypertension or use of drugs prescribed for hypertension. In Turku, the corresponding figures among those aged from 65 to 80+ years decreased from 17 to 4 % in men and from 23 to 15 % in women. The definition was SBP >180 and/or DBP >110 mm Hg and a typical ECG (23). In Glostrup, using the definition of a DBP ≥100 mm
Hg or treatment, 25 % of the 70-year-old men suffered from hypertension in 1967, while in 1984 only 18 % had the disease. Among women, the corresponding figures were 28 and 25 % (55).

The various definitions of hypertension make comparisons between different studies difficult. It has, however, been possible to adjust the definitions in this study according to each one of those mentioned above. In every comparison, the figures in Umeå were higher than those of the other study. This difference can be explained in various ways. The blood pressure in Umeå was measured in the supine position, while a sitting blood pressure is the practice in many other parts of the world. Disparate indications of treatment may have been used, both geographically and with time. Lastly, since the cardiovascular morbidity is higher in northern than in southern Sweden (96), the possibility of real differences cannot be excluded.

Fig. 29. Prevalence of hypertension, using two different definitions.

![Graph showing prevalence of hypertension](image)

The prevalence of congestive heart failure (CHF), a highly malignant syndrome (84, 99, paper V) increased from less than 10 % at 70 years of age to almost 40 % at the age of 88. There was a definite, steep and statistically significant increase with age. No distinct gender difference was demonstrated (figure 30).

There is no generally accepted definition of CHF (97). A person was considered to have CHF if he or she had leg oedema and basal lung rales with dyspnoea and electrocardiographic signs of cardiac insufficiency or a history, documented by case records, of relief from relevant symptoms by drugs against CHF. This definition is rather strict and excluded the

55
early cases of the disease. The age prevalences found in other studies have been remarkably similar to those in the Umeå study. In Gothenburg, prevalence among those aged 70 was 11% among men and 8% among women. The definition of the disease, however, differed somewhat (95). In Turku, the prevalence of the disease among those from 65 to 80+ years increased from 5 to 29% in men and was 18% among the women (23). In Tampere, the prevalence among those 85 years and older (mean age 88 years) was 43% in men and 42% in women (98). A definite sex difference, with the men worse off, was shown in the Framingham study (99). In Tecumseh, Michigan, USA, prevalence of CHF was lower than in the previously mentioned studies: among those 70-79 years of age it was 4% in men and 11% in women. The rates among those aged 80+ were 15% in men and 14% in women (100).

Fig. 30. Prevalence of congestive heart failure.

The "lifetime prevalence" of myocardial infarction, defined as a history of infarction, documented by case records, or major ECG Q-waves, showed a statistically significant increase with age among men. There were no significant birth cohort or gender effects (figure 31).

The prevalence in a birth cohort in Gothenburg increased from 11% at age 70 to 19% at age 79 among men and from 5 to 12% among women of the same ages (101). In Denmark, the corresponding figures in a birth cohort followed between 70 and 80 years of age were 5-7% in men and 3-10% in women (102). In Edinburgh, Scotland, electrocardiographic signs of previous infarction occurred in 8% of the men and 6% of the women 70-90 years of age (103). Thus, a history of myocardial infarction was more frequent among the elderly persons in Umeå than in the places reviewed outside Sweden.
The prevalence of angina pectoris, defined according to Rose (104), was between 15 and 35 per cent (figure 32). It is probable that the prevalence of coronary ischaemia was still higher, since it has been shown that anginal pain as a sign of coronary ischaemia is often absent in older patients (95). No statistically significant sex difference or increase with age was shown.

In Turku, 12 % of the men and 10% of the women aged 65+ suffered from effort angina (89). The prevalence among 70-year-old men in Glostrup in 1967 was 8 to 10 % . Among women, the corresponding figures were 3 to 5 % (55). In Gothenburg, the prevalence in a birth cohort was also lower than in Umeå; decreasing from 13 % at 70 to 7 % at 79 years of age among men and being constant at 10 % among women (101). In Denmark, the prevalence in a birth cohort was constant at 10 %
among men 70-80 years of age, while it increased from 5 to 9 % among the women (102). In Glostrup, 10 % of the men and 5 % of the women aged 70 and 9 % of those aged 85 suffered from angina pectoris, responding to nitro-glycerine (52, 105). In Edinburgh, Scotland, 12 % of both men and women aged 70-90 years had angina pectoris according to Rose (103).

No representative study has demonstrated statistically significant age or gender differences among the elderly. All studies reviewed show lower prevalences of angina pectoris than the present. It has previously been shown that the frequency of cardiovascular disorders is higher in northern Sweden than in the southern part (96).

The prevalence of atrial flutter was between 0 and 21 %, increasing in both birth cohorts, though not statistically significant (figure 33). The low prevalence rates and small samples make it impossible to establish a possible gender difference.

In Gothenburg, the prevalence among 70-year-old men was 4 % and among women of the same age 2 % (49). In Turku, the prevalence of atrial fibrillation was 8 % among those aged 65+ years (23). In Tampere, the proportion of men and women aged 85+ years (mean age 88) and having atrial fibrillation was 19 and 17 %, respectively (53). In Glostrup, the corresponding figure among those aged 85 was 20 % (52). A thorough review of the literature (106) on ECG in persons aged 70+ showed a prevalence of 8 % in partly selected subjects. Thus, the frequency is generally under 10 % up to around 80 years of age, after which more than 10 % of a population have got this symptom. The Umeå figures conform well with those of the other studies.

Fig. 33. Prevalence of atrial flutter.
Between 0 and 12% had a history of transitory ischaemic attacks (TIAs). The proportion of persons with a history of a completed stroke was slightly higher, between 0 and 20%. There were no gender or age differences (figure 34).

In Turku, the prevalence of cerebrovascular disease among those aged 65+ was 9% in men and 5% in women (36). In Tampere, 3% of the men and 4% of the women aged 85+ had a history of cerebral thrombosis (53). In Gothenburg, 2% of the men and 1% of the women among those 70 years of age had a history of cerebrovascular disease (49). Thus, the prevalence in these ages generally is below 10% of the population.

**Blood pressure**

Arterial blood pressure was measured on the subject's right arm after 10 min in the lying position. The diastolic pressure was measured at Korotkoff's phase V.

Statistically significant cohort or period effects were seen among most sex and age groups, the mean systolic and diastolic pressure decreasing during the study period both among those 70 years and those 79 years of age (figure 35). Among men, the mean SBP decreased from 166 to 145 mm Hg in the cohort born 1911, and from 168 to 136 mm Hg in the cohort born 1902. Among women, the corresponding decrease was from
167 to 158 mm Hg, and from 174 to 155 mm Hg, respectively. The mean DBP of men decreased from 92 to 80 mm Hg in the cohort born 1911, and from 87 to 73 mm Hg in the cohort born 1902. Corresponding values among women were from 87 to 83 mm Hg and from 91 to 81 mm Hg, respectively.

Fig. 35. Mean systolic and diastolic blood pressure with 95 % confidence intervals.

The tendency of diminishing pressure in the last decade demonstrated above is in accordance with several other studies (16, 55, 107, 108).

In the Framingham study, mean SBP in a birth cohort was steadily increasing up to 74 years of age (when it was around 152 mm Hg) in both men and women. Mean DBP in the same cohort increased up to around 65 years of age (males 85, women 82 mm Hg), after which it declined in both sexes (93). In Gothenburg, a pooling of three major population studies showed that the mean SBP in persons without anti-hypertensive drug treatment increased up to 70 years of age (when it was 159 mm Hg in men and 168 mm Hg in women), and then began to decrease. The mean DBP in women also increased up to around 70 years of age, while that of men was unchanged up to the same age. It was then slightly above 90 mm Hg in both men and women, then beginning to decrease (110).

In Turku, mean systolic and diastolic pressures among women aged 72 to 80+ years decreased from 190 to 182 mm Hg and from 102 to 96 mm Hg, respectively, while the corresponding figures in men were 163 to 161 mm Hg and 91 to 90 mm Hg (89). In Bergen, Norway, a representative
population study in 1963/64 showed that both mean systolic and diastolic blood pressure in men and women increased to a peak around 75 years of age, then they decreased. The diastolic pressure in women began decreasing even earlier; around 65 years of age. Mean systolic pressure was 157 mm Hg in men between 70 and 79 years of age, and 171 mm Hg in women of the same ages. The diastolic pressure (phase V) was 82 mm Hg in both females and males aged 70-79 years (111). In the 85+ age group (mean age 88) in Tampere, mean sitting systolic and diastolic (phase IV) pressures were 144 and 83 mm Hg among men and 154 and 84 mm Hg among women (112).

Thus, the representative population studies performed indicate

1) that the mean blood pressure in many industrialised countries has decreased during the last decade, and

2) that the SBP increases with age up to around 70-75 years, then it begins to decrease. The DBP seems to peak a little earlier, at around 60-70 years (93, 110, 111, 113). The height of the peak pressures differs considerably between the studies. The reasons could be manifold, e.g. technical differences or the year when the study was performed.

In some isolated cultures, blood pressure increased very little, did not increase or appeared to fall with age (114-116). This suggests that the increase is not a necessary physiological consequence of ageing, but also that it is difficult to avoid.

Gastro-intestinal diseases

In this study, 30-46 % of the females (except for those born 1920) had gone through gall bladder surgery, compared to only 7-22 % of the men (figure 36). The group of women born in 1920, however, was an exception: only 13 % had been operated on. On the contrary, almost no women but 7-12 % of the men had undergone ulcer operations. The prevalence of dyspeptic symptoms at examination was low and somewhat higher among the women (figure 37).

The discrepancy between definable gastro-intestinal diseases and symptoms were considerable. Constipation was among the most frequent of all symptoms registered.
A survey of prevalence studies of gallstone disease almost unanimously showed an increase of the frequency of the disease with increasing age (117). In Gothenburg, the "lifetime prevalence" of gall bladder operations between 70 and 81 years of age among those born 1901/02 increased from 22 to 26 % among women and from 11 to 14 % among men. Corresponding figures among those born 1906/07 at 70 and 75 years of age were almost the same and at 77/78 years of age 24 % (118, 119). It thus seems as if the frequency of operations among men has been almost the same in Gothenburg and Umeå, but among women markedly higher in Umeå. In Glostrup, 10 % of the women and 7 % of the men aged 70 and 17 % of those 85 years of age had been operated on for gallstones (52, 120), prevalences much lower than in Umeå.

The prevalence differences may be explained in various ways. The criteria of diagnosis and methods of examination may be divergent. The indications of surgery may differ. Lastly, there may be real geographical variations in the prevalence of gallstones.

What, then, is the true prevalence of gall bladder disease among the elderly? In urban populations in Sweden, especially among women, it is high. An autopsy study showed that 63 % of both 70-79-year-old and 80-89-year-old women had gallstones or had been cholecystectomized. The corresponding figures among men were lower, 36 and 45 %, respectively (121). Autopsy studies are of course of limited value to assess the true prevalence, since the subjects were probably more diseased than those who were not dead but of the same age. The prevalence of roentgenologically verified gallstones in a population is also an inadequate measure of the total prevalence of gallstones, since more than half of those with gallstones are not aware of it (117).

Fig. 36. History of gallstone surgery.
The only true prevalence figures come from roentgenological studies of representative population samples. In Gothenburg, 51% of 77/78-year-old women had been operated on or had gallstones as verified by ultrasonography (119). In Copenhagen, the corresponding figures were 30% of 70-year-old women and 19% of men of the same age (120). Among Mexican Americans, prevalence among women aged 60-74 was 44%, and 16% among men of the same age (122).

Fig. 37. History of peptic ulcers and prevalence of dyspeptic symptoms.

The anamnestic "lifetime prevalence" of peptic ulcers tended to increase with age and to be higher among the men, though the differences were not statistically significant (figure 37). In Turku, it was 16 and 8% in men and women over 65 years of age, respectively (82). In Glostrup, the corresponding figure among those aged 85 was 15%, and 6% had undergone surgery for peptic ulcers (52). In Gothenburg, 25% of the men
and 10% of the women aged 70 had a history of symptoms of peptic ulcer (49).

Eye diseases

There are at least three frequent ophthalmologic conditions among elderly persons, namely, senile degeneration of the macula (SDM), eye cataract, and glaucoma (123). Since there was no ophthalmologist participating in the study, the diagnoses were made by way of the persons' anamnestic information and physicians' case reports. Persons who had undergone cataract or glaucoma surgery were also counted. The true prevalence of SDM and eye cataract therefore was certainly underestimated, because the persons' complaints of bad sight had been the basis when diagnosing these conditions.

There was a statistically significant increase in the prevalence of both eye cataract and glaucoma with age and there was a tendency, though statistically significant only concerning glaucoma at the age of 82 and 85, for both conditions to be more frequent among men, at least in high age (figure 38). At 88 years of age, at least 36% of the study subjects had been operated on for cataract or were still suffering from it, the corresponding figure for glaucoma being 19 per cent. The proportion of persons who had gone through cataract surgery was 2% at 70 and 15% at 88 years of age.

The prevalence of cataract in most representative studies where the subjects have been examined by ophthalmologists has been shown to increase from 18-30% at the age of 70 to over 65% at the age of around 90 years (70, 71, 123-125). A couple of studies, however, have reported much lower prevalence figures (49, 53, 126).

The prevalence of glaucoma (defined as a history of operation and/or diagnosis by an ophthalmologist) increased from 5% or below to 30% among men and from 0 to 15% among women (figure 38). The gender difference (statistically significant in 1984 and 1987 only) has not been shown in previous studies. The prevalence at 70 years of age is compatible with those figures found in previous studies (49, 70, 71), while that at older ages is not. At 85 years of age and over, prevalences reported have been 4 to 7% (53, 70, 123).

The prevalence of SDM was low, 0-5% except for the oldest women in both age cohorts. The low proportion of persons with a diagnosis of SDM
and the cohort difference probably is mirroring the difficulty for non-specialists in making this diagnosis. Prevalence rates increasing from 0-13 % at the age of 70 to 30-50 % at 85 years of age and older have been reported (49, 70, 71, 123-125, 127).

Fig. 38. Prevalence of eye disorders.

**Metabolic and endocrine diseases**

Diabetes mellitus was defined as a history of repeated measurements of a fasting B-glucose ≥7 mmol/l as revealed by visits to the geriatric outpatient clinic, and/or treatment with oral anti-diabetic drugs or insulin. The prevalence of diabetes mellitus in most age and gender groups was between 10 and 20 per cent (figure 39). The figures in this study are in the upper part of the previously reported prevalence interval of 2 to 17 % over the age of 70 years. No significant increase with age or gender dif-
ference has been reported previously (23, 52, 55, 82, 128, 129-131), nor was such a difference shown in this study.

Changes in thyroid structure are frequent, they increase with age and are more common in women than in men (132). In an autopsy study, 45 to 50 % of all thyroid glands from women over 70 years of age showed thyroiditis (132). In this study, 7 to 26 per cent of the women and 0 to 8 % of the men (figure 39) had thyroid diseases, either a history of thyroid surgery, treatment for hypo- or hyperthyreosis or goitre without clinical or laboratory signs of function derangement. With the same definition, the corresponding figures in Gothenburg among women from 70 to 81 years of age increased from 10 to 14 % (133), while the prevalence among 79-year-old men was only 2 % (134) and among 85-year old men and women 5 and 15 %, respectively (135).

Fig. 39. Prevalence of metabolic and endocrine diseases.

Diabetes mellitus  Thyroid diseases

Pulmonary diseases

The differential diagnosis between the obstructive diseases of the lungs is sometimes difficult to make. Also, they often coexist. The diagnosis of bronchial asthma in this study was made by way of anamnesis (by the persons or case records) of repeated visits at a physician for obstructiveness. Chronic bronchitis was diagnosed according to Fletcher et al. (136). The prevalence of bronchial asthma was between 3 and 13 per cent with no significant gender difference, while the men were suffering from chronic bronchitis much more than the women in all ages (figure 40).
Representative population studies of lung sickness are scarce. Without exception, they show the well-established gender difference of chronic bronchitis but no prevalence difference with age has been shown in the elderly. The prevalence of chronic bronchitis in Umeå was lower than in Gothenburg and Glostrup, where it was 11-18% among men and 2-9% among women aged 70, but higher than in Tampere, where the figures were 8% of the men and 0% of the women aged 85+ (49, 53, 55). The prevalence of chronic bronchitis with emphysema among the men and women aged 65+ in Turku in 1963 was 18 and 3%, respectively. In 1983 it was 10 and 1%, respectively (23, 82).

A separate analysis was made of the total prevalence of chronic obstructive diseases of the lungs (figure 41). As can be seen from the figure, the increasing lung sickness during the period could be due to period as well as age effects. It was much more common among the men than the women.
Smoking habits

Considering the association between lung diseases, at least lung cancer and chronic bronchitis, and smoking, it is convenient to comment also on the smoking habits of the study subjects (figure 42) in this paragraph.

Concerning the men, the proportion of current smokers at each examination occasion decreased in both the older birth cohorts. The most striking feature in the figure is the fact that the proportion of current smokers among 70- and 79-year-old men decreased with each birth cohort. Both these trends could be reflecting the intense propagation against and the general reduction of smoking among men in Sweden during the last decades (137). The number of female smokers was too low to allow any conclusions, but we can see that there were more 70-year-old women smoking in the youngest cohort than in the one born 9 years earlier.
Between 1976 and 1987, the proportion of daily smokers in Sweden decreased from 43 to 27 % among the men and from 34 to 27 % among the women (137, 138). The proportion of men and women in Sweden aged 65-74 years and smoking daily in 1980/81 was 32 and 13 %, respectively. In 1988/89 it was 24 and 14 %, respectively. Among those 75-84 years, 26 % of the men and 5 % of the women smoked in 1980/81, while 20 % of the men and 6 % of the women smoked in 1988/89 (139, 140). The study subjects, thus, except for the men born 1902 in 1981, smoked less than the Swedish population in the same ages during the examination period.

The proportions of smokers in the other representative studies were much higher but most interviews were made before those in Umeå: In Glostrup, smoking in a cohort born 1897 decreased from 76 to 54 % among the men and from 39 to 26 % among the women from 1967 to 1977 (69, 141). In Gothenburg, 50 % of the men and 12 % of the women aged 70 in 1971/72 were smokers; in 1976/77, 36 % of the men aged 70 were smokers. Forty per cent of the men aged 75 in 1971/72 were smokers. In 1985, 34 % of the men and 16 % of the women aged 70 and 14 % of the men and 7 % of the women aged 80 were smokers (49, 65, 142). In Turku, only a few women but 73 % of the men aged 65+ smoked in 1963 (23). In Tampere only 2 % of those aged 84-88 and living at home were smokers in 1981-84 (68).

Urogenital diseases/dysfunctions

There is one typical male and one female problem here. One of the most prevalent medical problems among elderly men is symptoms due to hypertrophied prostatic glands. Between 15 and 45 per cent of the men in this study suffered from such symptoms (difficulties to begin, weak urinary stream, post-mictionary dripping). They were also operated on to a great extent. At 88 years of age, 38 per cent had gone through prostatic surgery (figure 43). Surgery was somewhat more frequent in the younger cohorts at the same ages, indicating a period effect. The frequency of men having either surgery or symptoms was between 34 and 58 %. There are no compatible prevalence figures in other population studies. In Gothenburg, prevalence of prostatic enlargement among 70-year-old men was 46 % (49). In Turku, it was increasing from 3 to 24 % of the men from 65 to 80+ years (23).
The female problem is urinary incontinence (UI). The causes are manifold, e.g. muscular weakness, urinary infections, stroke and dementia. While the prevalence of urge and/or stress urinary incontinence "often" or "always" among the men was relatively constant at five per cent, it was much higher in women, varying from 10 to 35 per cent (figure 43). Among the women, the prevalence tended to increase with age and, concerning those born 1902 and 1911, there was also a cohort effect, which was not statistically significant and thus can be explained by chance. It could also be that women born later have less difficulty in talking about things that are more or less taboo.

There are very few studies of urinary incontinence in representative populations, especially concerning men. In Gothenburg, 44 % of 70-year-old and 41 % of 75-year-old women "reported problems" due to urinary incontinence (143). Among Gothenburg women aged 70, 75, and 79 years, 8, 9, and 5 % "often" and 35, 38, and 44 % "sometimes" had urinary incontinence (144). From 15 to 25 % of women aged 70 to 84 years had UI, two thirds of whom had problems at least 2-3 times a week (145). 24 % of the men and 43 % of the women aged 85 had at least occasional UI (146). Noting that the Umeå figures concern those with problems at least "often", the Gothenburg women reported less incontinence problems. In Glostrup, prevalence of "chronic and intermittent" urinary incontinence among those 85 years of age was 13 %, mainly women (52).

Fig. 43. Prevalence of urogenital states.
Malignant diseases

While the proportion of persons having a history of malignant tumours was constant around 15 % in the younger age cohort, it increased with age from 8 to 18 % among those born 1902 (figure 44). In Glostrup, the corresponding figure among the 85-year-old persons was 15 % (52). The prevalence of malignancies is difficult to assess. Often, one cannot say with certainty if a tumour is cured. The incidence, therefore, is a better measure. Figures from a national register in Sweden show a very age-dependent incidence of cancers. In ages over 60, the incidence was higher in men than in women (11).

Fig. 44. History of malignant diseases.

Musculoskeletal and joint diseases

The accordance between clinical and roentgenological signs of osteoarthritis (OA) is not considered especially good (147), though there are reports of the contrary (148). Also, there is no general agreement on diagnostic criteria of osteoarthritis (149). The diagnosis in this study has been given to persons complaining of characteristic joint symptoms and having roentgenological signs of the disease or those operated on for the disease. Thus, there was most certainly an underestimation of the prevalence. OA is a frequent and age dependent disease (150). The prevalence in this study was between 10 and 25 % except for the oldest women in both cohorts and the 88-year-old men (figure 45). There was no gender difference.

In north-western England, around 60 % of the men and slightly less than 80 % of the women aged 65+ were affected by OA (150). In Turku, the
prevalence of OA ("when the subject had considerable disability") among those 65+ years was 6 % in men and 8 % in women (23). In Tampere, 9 % of the men and 21 % of the women aged 85+ (mean age 88) were judged to have OA (53). In Gothenburg, 33 % of the women and 21 % of the men aged 85 had radiographic OA of the knees (147). The prevalence of OA of the knee joints in Gothenburg among those 70, 75, and 79 years of age was 15, 12, and 9 % in men and 26, 16, and 15 % in women (151). In a re-evaluation of the results, based on new roentgenological criteria, the prevalences among those 70, 75, and 79 years old were 54, 55, and 50 % (152). Thus, it is obvious that the reported prevalences of osteoarthritis depend very much on the criteria used. Secondly, it seems as if prevalences increase with age, but Bagge et al. (152) has shown that at ages above 70, there was no further increase of the prevalence of osteoarthritis of the knees.

Fig. 45. Prevalence of osteoarthritis and rheumatoid arthritis.

Rheumatoid arthritis (RA) was much less frequent with a prevalence between 0 and 10 per cent (figure 45). All persons had been diagnosed by a specialist in rheumatic diseases. In Gothenburg, the prevalence of RA among those 70, 75 and 79 years of age was 3, 6, and 8 % in men and 15, 17, and 17 % in women (151). In Turku, the prevalence of RA was 4 % among both men and women aged 65+ years (23).

Hip fracture is the most frequent diagnosis among in-patients at orthopaedic wards (153). An incidence increase, both with age and time, has been found in several epidemiological studies in northern Europe (153-156). In this study, 26 % of those aged 88 had gone through hip fracture surgery, compared to less than 10 % of the 70-years-old persons.
There was no statistically significant gender difference (figure 46). In Tampere, 3% of the men and 8% of the women aged 85+ had suffered a femoral neck fracture (53); figures much lower than those in Umeå.

The lack of gender difference in this study is unusual. In Gothenburg, the ratio of women to men was over 2:1 (153). In a study of all cervical and trochanteric hip fractures in northern Sweden during three years (157), the women/men ratio, too, was approximately 2:1. Considering the sample sizes, the possibility of gender similarity by chance in this study is not excluded. The registration of hip fractures should be almost complete because of the longitudinal design of the study and the examination of almost all the persons' case records at the hospital.

Fig. 46. History of hip fracture surgery.

Psychiatric diseases

Because of the lack of psychiatrists participating, the total psychiatric morbidity has not been examined in this study. Internationally, it appears to be between 20 and 30% of the population over 65 years of age (158). In Gothenburg, it was 22, 24, and 31% in a birth cohort at 70, 75, and 79 years of age (159).

In this study, the mental diseases by far most prevalent were the dementias, followed by depression. There was made no attempt to classify dementia into subgroups (i.e. Alzheimer, multi-infarct or other types) in this study. The diagnosis of dementia was made by way of the DSM-III (160, 161) characteristics, anamnesis, and a Mini-Mental State Examination (MMSE) score of 23 points or less. A cut-off value of 23/24 points has been recommended in most publications on the MMSE (162). At this cut-
off point, the sensitivity and specificity for delirium and/or dementia is 86-89% and 81-92%, respectively (162-164).

The prevalence of dementia in Umeå increased with age from a few percent at 70 years of age to 29% in men and 46% in women at the age of 88 (figure 47). The female preponderance in the oldest age was not statistically significant.

Fig. 47. Prevalence of dementia.

Jorm et al., in a review of 22 studies of dementia prevalence from 1945 to 1985, found that the age prevalences were remarkably constant, with estimated prevalence rates doubling every 5.1 year, till the age of about 95. The "baseline" prevalence of all studies reviewed increased logarithmically from 0.7% at 62.5 years to 38.6% at 91.5 years of age (165).

In Gothenburg, the prevalence of dementia among those 70, 75, and 79 years old was 7, 11, and 24% in men and 3, 7, and 14% in women (46, 166). Among those 70 years of age in Glostrup, 8% of the men and 2% of the women were demented (167). In Newcastle, the prevalence of dementia among those aged 65+ was 5% (168). In a nation-wide representative sample of the Finnish population, the prevalence of severe dementia was estimated to be 7% of all persons aged 65+ years, and 17% of those 85+ years (169). In Melton Mowbray, the prevalence of persons aged 75+ with MMSE scores less than 24 was 31% (163). In Jönköping, 54% of those aged 84+ scored less than 24 points. The dementia prevalence was increasing from 16 to 32% between those 84 and 90 years of age (20). In Tampere, 13% of those aged 85+ were demented (22). Among those aged 85 in Glostrup, 15% were mildly, 8% moderately, and 5% severely demented (52). In Stockholm, the prevalence increased between the age groups 75-79 and 90+ years from 7 to 30% in men and
from 8 to 39% in women (170). The risk of becoming demented before 90 years of age has been calculated to 50% (19).

The MMSE (28) is one of the most widely used assessment tests of cognitive capacity. It consists of eleven subtests, the sum of which is calculated. The range of the scale is 0-30 points, the higher the better cognitive ability. The MMSE was not performed in 1981. From 1984 on, however, the median results in the group born 1911 were 26-29 points. It was not until between 85 and 88 years that the median MMSE result was clearly deteriorating (figure 48).

Fig. 48. Median scores of the Mini-Mental State Examination.

The gender differences were not statistically significant in any of the years of examination. Concerning the subtests, time orientation, memory, shutting the eyes, writing and spatial abilities were most affected by age. The last three tests are not only affected by cognition but also by vision. The number of persons with a very low visual acuity (0.1 or less) was very small and did not increase with age. However, they performed worse than those with better sight on these three subtests. Consequently, they biased the apparent deterioration of cognitive function with age somewhat.

Since there was no psychiatrist participating in this study, no systematic examination was made that aimed at the diagnosis of psychiatric diseases other than dementia. Persons with recurrent diagnoses of depression in their case records and those with symptoms of major depression at examination were counted as depressives. These were chronic cases; all had been treated repeatedly in hospital for their diseases. The huge dementia
prevalence over 85 years probably biases the prevalence of some other psychiatric diseases which often cannot be detected through the dementia syndrome. Presumably, this is why the number of persons suffering from chronic depression was almost zero between 79 and 88 years of age.

The prevalence of depressive states has been around 5% among the men and very discrepant, from 2 to 22% among the women in the reviewed studies (46, 83, 166, 167, 171-173). These are probably not true prevalence differences but a mirroring of the variable diagnosis criteria. No studies show significant age differences in the prevalence of depression among the elderly.

**Drug consumption**

The magnitude of drug consumption was defined as the number of different drugs each person used regularly (i.e. at least once a week) but most of the medicines were actually used on a daily basis. The indications for prescription were recorded. Concerning certain drugs, mainly salicylic acid preparations, benzodiazepines and antihypertensive drugs, the case records were also used to help in the recording of the cause of prescriptions.

Drug use among those born 1902 is described in paper IV. The mean consumption in that age group increased from 2.5 to 5.2 drugs per man and from 3.3 to 5.3 per woman during the study period. By means of multiple linear regression, using also the other birth cohorts, it was shown in the paper that the number of diseases was the main factor behind the increase. Age in itself had no effect at all. Female gender was an important factor, and there was also a slight, statistically significant, period effect.

The most common drugs were shown to be cardiovascular preparations, analgesics, psychoactive substances and drugs used to alleviate gastrointestinal symptoms.

In order to complete the description of the drug consumption, the following chapter will include also those born 1911 and 1920.
Total drug use

The total consumption of regular drugs per person is shown in figure 49. The figure shows three obvious trends.

1) The pattern follows that of the number of diseases (figure 16) quite well. Accepting the assumption that figure 16 shows the real number of diseases, the cohort effect is mainly a consequence of the worse health state among those born 1911. The multiple regression analysis in paper IV confirms that conclusion.

2) Accepting the cohort effect, there was also an age and/or period effect, which, according to the paper IV analysis, is based mainly on the greater morbidity accompanying age.

3) The women in all age groups used more regular drugs than the men. Their morbidity, however, was not higher than that of the men. Some possible reasons for the higher female drug consumption are discussed in paper IV. The female preponderance tended to decrease with age.

Fig. 49. Number of regular drugs per person.

As a consequence of the increasing number of diseases with age, the possibility that some of the elderly persons are prescribed a bizarre number of drugs is real. In Umeå, one 88-year-old man took 18 different drugs, 13 of which were for daily use. In Tampere, two of the women aged 85+ regularly took 20 tablets a day (53). In Gothenburg, one 70-year-old woman had been prescribed 24 different drugs, 17 of which were for daily use (49). A review of some unwanted effects of polypharmacy is available in paper IV.
The proportion of men taking no regular medication at all decreased from 34% at 70 to 8% at 88 years of age. Corresponding figures among the women showed a decrease from 13-20% at 70 to 2% at 88 years of age (figure 50). The cohort difference at 79 years of age between those born 1911 and 1902 was probably mostly a result of the previously mentioned difference in illness between the two cohorts.

In Gothenburg, the proportion of men taking no drugs at all decreased between 70 and 82 years of age from 39 to 10%, and among women of the same ages from 23 to 3% (174). The figures are remarkably close to those in Umeå. In Glostrup, 46% of the men and 30% of the women aged 80 used no prescribed drugs daily (43), and 17% of those aged 85 took no medicine (52). In Tampere, 17% of those aged 85+ used no regular medication (53). In Copenhagen, 33% of those aged 75 and 22% of those aged 80 and 85 took no medicine daily. In Jönköping, 13% of those aged 84+ took no regular drug (20). These figures all showed a higher consumption than in Umeå or Gothenburg.

Fig. 50. Proportion of subjects taking no regular drug at all.

The most common drugs taken were cardiovascular preparations, psychoactive agents, drugs to alleviate gastrointestinal symptoms, and analgesics (figure 51). The increase in utilisation mentioned previously (figure 49) affected most drug groups, a noteworthy exception being cardiovascular drugs, the consumption of which was constant among those born 1902 during the study period.
As could be expected from the high prevalence of cardiovascular diseases, the use of cardiovascular drugs was the highest of any drug group. In the cohort born 1911, the proportion of persons using cardiovascular drugs increased from 48 to 60% among the men and from 57 to 73% among the women. Consumption was stable at around 55% in the older cohort (figure 52). For comparison, the figure also shows the proportion of persons suffering from cardiovascular diseases. Between 80 and 100 per cent of those having cardiovascular diseases were treated with drugs against their disease.

In Jönköping, around 60% of both men and women used cardiovascular preparations regularly (20), a figure similar to those in Umeå.
The use of digitalis preparations was increasing from less than 10 to over 20% from 70 to 88 years of age (figure 53). From 70 to 85 years of age, the use of digitalis in the Nordic countries increased from 5-10 to 25% of the population (23, 43, 52, 55, 89, 105, 174, 175), figures consistent with those in Umeå. A remarkable exception was a figure from Tampere, where the regular use of digitalis among those 85+ years (mean age 88) in 1977 was 56% (53).

The use of diuretics was between 19 and 40% in men and around 35-50% in women, an exception being the 70-year-old women born 1920, the consumption of which was only 13%. In almost all age and gender groups, the female consumption was higher than that of the men. The share of the different subgroups changed considerably during the period (figure 54). The use of thiazides, the most frequent diuretic compounds in 1981, decreased to nearly zero in 1990. Instead, the consumption of loop diuretics increased from 5 to 30% in the group born 1911 and from 12 to 31% in the older cohort. Both among thiazides and loop diuretics, distinct cohort differences were seen, indicating a period effect.
Diuretic use among the elderly in the Nordic countries was quite varying, but all studies show a higher female consumption. In Glostrup, the use of diuretics among 70-year-old men in 1967 was 7%, while in 1984 it had increased to 16%. Among women of the same age, it was 13% in 1967 and 24% in 1984 (55). The consumption of diuretics between 70 and 82 years of age in Gothenburg increased from 15 to 26% in men and from 29 to 42% in women (174). In Copenhagen, the use of diuretics among those 75, 80, and 85 years of age was 34%, with a female preponderance (175). In Glostrup, the use of diuretics among 80-year-old men was 28%, and among women of the same age 36% (94). The figure
among those aged 85 was 42 %, mainly women (52). The use of diuretics in Tampere among those aged 85+ in 1977 was 45 % (53).

The use of beta-blocking agents was much higher in the younger age cohorts, possibly reflecting the negative attitude towards treating very old persons with these compounds. The pattern of vasodilating agents followed that of the prevalence of angina pectoris quite well in the younger cohort. Considering the stable prevalence of angina among those born 1902, doctors' prescriptions seem to have become somewhat more liberal with the age of their patients (figure 55).

The use of salicylic acid preparations was below 15 % among both men and women. There was a tendency of cohort differences, indicating that the use in Umeå during the decade did increase.

Fig. 55. Proportion of persons using selected cardiovascular drugs.

In the cohorts born 1902 and 1911, the most frequent cardiovascular drugs in 1990 were loop diuretics. Nine years earlier, digitalis preparations were most common among those born 1902, while the cohort born 1911 mainly used beta-blockers. The basis could be the decreasing prevalence of hypertension and the increasing number of persons with congestive heart failure with age.

The consumption of beta-blocking agents among those 70 to 82 years old in Gothenburg increased from 5 to 12 % in men and from 7 to 19 %
in women (174). The figures were lower than those in Umeå. This is possibly because of the increasing use of beta-blockers during the last decade - the Gothenburg study was performed before that in Umeå.

The consumption of vasodilators between 70 and 82 years of age in Gothenburg was approximately constant between 11 and 17 % among both men and women (174), figures lower than those in Umeå. Consumption of nitro-glycerine among those aged 70 in Glostrup was 6 % (105). Among those 65 years and older in Turku, it was 8 % (23).

**Anti-hypertensive drugs**

The proportion of persons using drugs specifically prescribed for hypertension was much higher among the women and steadily declining with age during the study period (figure 56). At 70 years of age 28 % of the men and 53 % of the women born 1911 were treated with such drugs. At the age of 88, the corresponding figures among men and women were 0 and 15 %, respectively. The cohort effect among subjects 70 years of age is at least partly explained by the lower SBP among those born 1920 (figure 35).

Fig. 56. Proportion of subjects treated with drugs prescribed for hypertension.

In Gothenburg, the proportion of men treated with blood pressure-lowering drugs because of hypertension in a cohort born 1901/02 between 70 and 79 years of age increased from 13 to 19 % between 1971 and 1981. Corresponding figures for women were 30 to 39 % (110). In another 70 year old cohort, born ten years later, 23 % of the men and 30 % of the women were treated for hypertension (176). Those figures were much lower than the corresponding figures in Umeå. No other represen-
tative study concerning anti-hypertensive medication recording the indication of drug prescribing was found.

Total treatment with blood pressure-lowering drugs, including beta-blocking agents, diuretics, and other anti-hypertensive drugs in the same Gothenburg group, increased from 19 to 37 % in men and from 39 to 61 % in women (110). In Glostrup, 6 % of those 85 years of age and 8 % of the men and 14 % of the women aged 80 took antihypertensives other than diuretics (43, 52). In Copenhagen, 6 % of those 75, 80, and 85 years of age (mean age 80) used antihypertensives (175).

Concerning the difference in anti-hypertensive medication between Umeå and Gothenburg, similar explanations as proposed previously regarding hypertensive disease can be put forward. Differences in the measurement of the blood pressure and different treatment indications geographically and with time can be responsible, but there is also a possibility of real geographical differences in medication against hypertension.

Drugs used for gastrointestinal symptoms

The consumption of drugs in this group was much higher among the women than among the men. Women in all ages and the older men in both age cohorts had a high consumption (figure 51). There was a pronounced consumption increase, especially marked between 1987 and 1990. As can be seen from figures 57 and 58, almost all the consumption increase was due to laxatives, especially the osmotic and stimulant subgroups. Laxative use among those aged 88 was 43 %.

The use of laxatives among those 70 years of age in Gothenburg and Glostrup was around 5 % among men and 5-20 % among women. Around the age of 80 the consumption was reported to be 17-28 % (55, 174, 175). At 88 years of age it was only 12 % in Tampere (21).
Psychoactive drugs

The total use of drugs in this group was increasing with age in both cohorts (figure 51). The women had a higher use than the men in all age
groups. Almost all the consumption in the cohort born 1911 consisted of benzodiazepines, taken by 40% of the men and 50% of the women aged 79. The use of neuroleptics among those born 1902 amounted to 10-16 per cent, but also in this age cohort benzodiazepines were the major compounds. The main prescription indication for the benzodiazepines was sleep disorders; only around 20% were prescribed for general anxiety. Figure 59 shows the use of different psychoactive drugs. Some of them had sleep disturbances as prescription indication. These drugs have been recorded also as sleeping pills, thus they can be shown twice in the figure.

Fig. 59. Proportion of subjects using different psychoactive drugs.

An examination of the presence of sedatives or hypnotics in fasting serum among 70-year-old persons in Denmark showed that these drugs were really taken to a high extent: 15% of the men and 35% of the women showed positive tests (177).

A comparison of the performed population studies on drug use is somewhat hampered by the different denominations used for the same compounds. In Gothenburg and Tampere, the use of neuroleptics was increasing from 5% at age 70 to 15% at age 88 (53, 174). Antidepressants were used by 2-4% of the men and 4-7% of the women aged 70 to 82 years in Gothenburg (174). Both the use of neuroleptics and antidepressants were very close to that in Umeå. The consumption of sedatives/hypnotics among those aged from 70 to 82 years in Gothenburg was increasing
from 20 to 27 % in men and from 29 to 49 % in women. In Glostrup, corresponding figures were 15 % among men and 21 % among women aged 80 (43, 174). Twenty-three per cent of those 75, 80, and 85 years of age in Copenhagen and 9 % of those aged 65+ in Turku used sleeping pills (23, 175). In Jönköping, 36 % of the women and 38 % of the men aged 84+ used psychoactive drugs (20).

**Analgesics**

The consumption of analgesics, one of the four most used drug groups, was widespread, especially among the oldest in both age cohorts. It was increasing with age in both cohorts and much higher among the women than among the men in most ages (figure 51). Paracetamol was the most common preparation among the oldest women in both cohorts and the 88-year-old men. The increased use of salicylic agents for pain relief among those born 1911 was not seen in the cohort born 1902, where instead opiate use increased with age. The most common preparation in this drug class was dextropropoxyphene. Morphine was only used by 1 person at 1 examination year. The use of non-steroidal anti-inflammatory drugs (NSAIDs) was 10 % or less in all groups (figure 60).

Fig. 60. Proportion of subjects using analgesics.

In Glostrup, analgesics were used by 5-21 % of the men and 11-26 % of the women aged 70 and by 13 % of the men and 22 % of the women aged
80 (43, 55, 105). In Gothenburg, the consumption of analgesics between 70 and 82 years of age increased from 12 to 39% among men and from 20 to 56% among women (174), figures not far from those in Umeå. In Turku, 11% of the men and 22% of the women aged 65+ took analgesics regularly (23). In Copenhagen, 11% of a sample aged 75, 80, and 85 years (mean age 80) took analgesics; 8% used NSAIDs (175). Among those 85+ years (mean age 88) in Tampere, the use of analgesics was only 10% (21). In Jönköping, 27% of both men and women aged 84+ took analgesics regularly (20).

RESULTS OF PAPER I-V

Paper I

Two of the papers are based on analyses of selected, healthy populations, namely, papers I and III.

In paper I, the reference intervals of 18 blood components were established in healthy men and women with a mean age of 74.3 and 74.6 years, respectively, and compared with those of young persons in Umeå and of elderly persons in Gothenburg. It was shown that, for many components, the intervals were broader than among young, healthy individuals. It was also shown that the level of the reference intervals of some of the components differed from those of young, healthy people. The intervals of P(lasma)-folate and P-potassium were on a lower level and those of the erythrocyte sedimentation rate (ESR), P-creatinine and, in women, S(erum)-cholesterol, on a higher level than those of young people.

The comparison with the reference intervals of the Gothenburg study performed by Landahl et al. (37) was somewhat hampered by the different mean age of the populations studied; in Umeå, it was 74.5 years, while it was 70 years of age in Gothenburg. Despite this difference, most of the reference intervals and median values coincided fairly well in the two elderly city populations. The higher ESR and lower S-cholesterol values found in Umeå may be explained by the higher mean age in this study, since the ESR has been shown to increase (178) and the S-cholesterol to decrease with high age (46). The median value of S-iron was higher and that of B-glucose was lower in Umeå. The difference in S-iron values has no obvious explanation. The median B-glucose value in Gothenburg subsequently has been shown unchanged at approximately 4.5 mmol/l between 70 and 82 years of age (131), a value in between those shown in the two studies.
The five year survival of the "healthy" persons used in the calculations of reference intervals was 94 %, while that of the rest of the persons participating in the 1981 examination (mean age 74.8 years) was 72 %, a statistically significant difference (Chi-square 9.020, p = .003). There were 25 men and 27 women among the "healthy", while there were 72 men and 63 women among the rest. The difference in 5 year survival between the "healthy" and the other men was statistically significant (Fisher's exact test, p = .02), and that of the women was on the border of statistical significance (Fisher's exact test, p = .05). Consequently, it seems that the "healthy" persons were really more healthy than the rest.

Since the number of diseases and that of drugs per person were shown to increase quite sharply with age, the size of the population required to yield a healthy sample also increase considerably with age. Consequently, it has not been possible to construct reference intervals for people older than those in paper I. The healthy persons, after exclusion of those with diseases and drugs possibly affecting the values of the components, became too few.

**Paper II**

More than one third of the subjects in the study did not feel healthy. This feeling of unhealthiness was generally confirmed by the physicians, since 63 of the 65 subjects who did not feel healthy were judged either ill or in need of further investigations by the doctor. The mean number of diseases was 1.9 in men and 1.8 in women. Only 13 % had no definable disease at all. The cardiovascular system was by far the most affected. Hypertension, defined as current treatment with antihypertensive agents or a casual diastolic pressure of ≥115 mm Hg, was the most frequent disease, followed by angina pectoris. Around half of the subjects complained of daily pain. 84 % of the women and 72 % of the men were on drugs, the most frequent groups being the cardiovascular, the psychoactive, those acting on gastrointestinal symptoms, and analgesics. 67 % of the men and 79 % of the women consulted their doctor regularly. 69 % of both men and women had been cared for in hospitals after the age of 60.

While the women felt more ill than the men, the number of diagnosed diseases revealed no such gender difference. Among the females, the feeling of discomfort seemed, to a greater degree than that of the men, to be based on symptoms that do not easily show up as established medical
diagnoses. The reasons of this gender difference are discussed below (paper IV).

The high proportions of persons regularly using drugs were also found in Gothenburg, where 90% of the women and 74% of the men aged 75 were on drugs (174). The high frequency of diseases and drug intake among the elderly makes it worthwhile to discuss if the WHO definition of health (179) is applicable to an elderly population. According to the criteria used in this study, only 13% were considered healthy from a purely medical aspect. Furthermore, there was only a very rough estimation of psychiatric and no estimate of social unhealthiness.

Paper III

A description of the characteristics of the 24-hour electrocardiogram in healthy persons with a mean age of 78 years was given. It was shown that some presumed pathological conditions, including supraventricular premature beats (SPB), episodes of supraventricular tachycardia (SVT), and ventricular premature beats (VPB) were rather frequent among these healthy persons. Also, almost half of the persons had more than one VPB configuration type.

All these conditions were much more frequent than among younger persons (180). Nine per cent showed more than 1,000 SPBs/24 h, the upper limit of "normality" of persons over 60 years of age proposed by Bjerregaard (180). Eighty-seven per cent of the persons in this study showed more than 10 SPBs/24 h, the limit proposed for persons aged 20-40 years. The proportion of persons having episodes of SVT was 63%, a higher figure than previously reported (180). Twenty-eight per cent showed more than 100 VPBs/24 h, a figure proposed to be the upper limit of "normality" among persons 50 years of age or less. Six persons (23%) had more than two types of VPB configurations, the upper "normality" limit proposed (180). Three of these persons had pathological resting ECGs. The proportions of persons with SVT and with more than two VPB configuration types were higher than previously reported.

Changes in the standard ECG were not considered exclusion criteria for the study. When studying normal features of a variable, one can hardly use changes in that variable as exclusion criteria. A comparison of the 24-hour ECG between the subjects with a normal and those with a pathological standard ECG showed no statistically significant differences in any of the examined features.
Also, persons who used other drugs than those directed against cardiovascular diseases but possibly affecting the heart were not excluded. Four persons using timolol eye-drops were included. The small number of persons made calculations of statistically significant differences less meaningful. The ranges of the 24-hour ECG features were: mean heart rate (66-92 beats/min), mean minimal (47-75 beats/min) and maximal (99-128 beats/min) heart rate, R-R interval (all four persons <1.5 s), mean numbers of supraventricular (16-466), and ventricular (7-345) premature beats. All these ranges, however, were inside the ranges of those of the rest of the participating persons.

The five year survival of the 32 persons performing the 24-hour ECG was 88% and that of the rest of the persons participating in the 1984 examination (mean age 79 years) 71%. The difference was statistically significant (Chi-square 5.287, p = .02). The 24-hour ECG was performed by the same number of men and women, while the proportion men/women among the rest was 56/94. The five year survival difference among the men was statistically significant (Fisher's exact test, p = .04), while that among the women was not significant (Fisher's exact test, p = .35). The results are suggesting that at least the men included, were really more healthy than those excluded.

Paper IV

A cohort born 1902 was examined in 1981, expanded in 1984 and then followed until 1990, i.e. between 79 and 88 years of age. It was shown that the mean drug consumption during the period increased from 2.5 to 5.2 drugs per man and from 3.3 to 5.3 per woman. By way of a multiple linear regression, using also the cohorts born in 1911 and 1920, it was shown that the main correlate of this increase was the ageing individuals' greater morbidity. There was also, however, a general increase in drug consumption, independent of age, gender or morbidity, during the period.

Despite a lower morbidity among the women, they had a higher drug consumption, especially of analgesics, drugs used for gastrointestinal complaints, psychoactive drugs and drugs for the genitourinary systems. The most common drug groups used were cardiovascular preparations, analgesics, psychoactive substances and drugs used to alleviate gastrointestinal symptoms. At the age of 88, half of the individuals used drugs belonging to each one of these drug groups. Among the most common subgroups were benzodiazepines, used by 39%, laxatives, used by 43%
and diuretics, used by 37 % of those 88 years of age. The use of drugs prescribed specifically as antihypertensives were much less common in the end of the period than in the beginning among both men and women. The proportion of persons using drugs regularly increased from 82 % at 79 years to 95 % at 88 years of age.

The accuracy of the data regarding the amount of drugs consumed is, of course, crucial to the results but difficult to assess. There were factors suggesting a lower, as well as a higher, utilisation than the value obtained from the study persons. The longitudinal approach of the study, and the regular checks of the hospital and general practitioner case records, however, probably made it easier to detect errors in reporting than in a study of only one time-point.

The adequacy of the level of drug consumption is discussed in the paper. In a prospective population study, it is not possible to determine whether the substantial use of medicines is adequate or not. Withdrawal studies with control groups are probably required.

The fact that elderly women use more drugs than men is well-established and is discussed below.

**Paper V**

In this paper, the death risk associated with different life characteristics in high age was investigated. The type of residence among both men and women was shown to be an indicator of increased death risk. The ADL index used and dementia disease both correlated considerably with the residence type. On the basis of experience, it was suggested that these are better explanatory factors.

Analyses of survival were made for diseases with a prevalence of more than 10 % of the persons examined. Bivariately, dementia, cerebrovascular diseases, congestive heart failure, diabetes mellitus, and a history of myocardial infarction all conveyed an increased risk of death. A multivariate analysis, keeping gender, age, and other diseases constant, showed that only congestive heart failure and dementia remained predictors of an increased death risk. It was also shown that the probability of survival decreased with the seriousness of the dementia disease.

Among the twenty-six clinical-chemical blood components examined, low creatinine, low haemoglobin and low prealbumin values as well as a
high white cell count were, by way of bivariate technique, shown to be predictors of an increased death risk. The multivariate analysis, again, conveyed a reduction of the number of predictors. Only a high white cell count and low creatinine values remained as independent predictors of a raised death risk. The white cell count, however, was shown to be strongly related to congestive heart failure, thus disappearing as an independent factor.

Due to the relatively small number of subjects studied and to the low prevalence of many diseases it was not possible to demonstrate potentially increased death risks of some other diseases. Inspection of the survival curves of different diseases, however, showed that the largest difference in survival between diseased and non-diseased persons occurred within the first five years. After that, the survival curves were almost parallel. The differences, thus, disappeared. It is therefore possible that a survival analysis, based on a stop date after 5 years, discloses the indicators of an increased death risk better than the ten year measure used in this paper.
GENERAL DISCUSSION

The mechanisms behind the time trends found when studying e.g. prevalence rates of symptoms or diseases are of three kinds. Those associated with ageing are age effects, those associated with birth cohort membership are cohort effects, and those associated with the period studied are period effects. Unfortunately, there is often no straightforward way to determine which effect(s) were responsible for the trend disclosed. This difficulty is a reason to use several birth cohorts instead of just one in longitudinal studies, though this kind of design in no way solves the problem completely. Sometimes, however, when the influence of one of the effects can be considered negligible, a conclusion could be drawn. This problem is a major one in all prospective studies, and should be born in mind when interpreting the results.

A different kind of problem arises when interpreting the time trends disclosed in the figures. It must be born in mind that the figures shown are prevalences. A disease prevalence that decreases with increased age can be explained in several ways. Apart from prevalence fluctuations by chance, the disease in question may be very serious, thus causing selective survival. Consequently, an increasing incidence of the disease can be compatible with a decreasing prevalence.

A major problem of certain kinds of longitudinal studies is that with intervention, you change the "natural" behaviour of many study variables. Had there not been intervention, they would have looked otherwise. To ensure a good care for the study persons, we took all the measures we should have taken at a normal medical health examination. This was of course changing the course of the variables. In the absence of this study, however, many of the persons with symptoms would have visited another doctor. The effect of the study, then, was probably not as drastic as it could seem. It has previously been shown that in a prospective study with three examinations the 15-year morbidity and mortality did not differ between the participants and an age-matched control group (181).

There is often no universally accepted agreement on definitions of symptoms, diseases or dysfunctions. This causes difficulties when comparing prevalence rates from different studies and makes it important to mention the criteria used in the definitions. In this study, the definitions used have been stated whenever necessary. The comparisons with the other studies must sometimes be interpreted with caution because of the various definitions used. There is a difference in comparisons of diseases having universally accepted definitions, e.g. atrial flutter, and those not,
e.g. congestive heart failure. Other sources of uncertainties when comparing different studies are the analytic methods used and the representativeness of the samples.

The mean number of diseases recorded in different studies are not compared here. Because of the various definitions of diseases, those comparisons are not meaningful. On the other hand, given that the definitions in a prospective study are consistent, the change of the mean number of diseases with time in a study may well be calculated.

The reported prevalence rates of subjective symptoms of course become more uncertain with increasing age of the study subjects, since the prevalence of cognitive dysfunction is very age dependent. This is a methodological problem that cannot be solved. It does, however, probably not preclude comparisons between representative studies of populations, since no statistically significant regional prevalence differences of dementia have been found. Studies of dementia prevalence, however, are scanty in many parts of the world (165).

If the size of the samples in this study had been larger, the possibility of detecting gender, age, cohort and period differences would have increased. The monetary and personal resources, however, did not allow this extension. The implication is that the prevalences of the various states have to be larger to detect such differences and that group differences of many symptoms, diseases and drugs used become more uncertain than if the analysis had been based on larger samples.

Considering the whole study period, the sample sizes were chosen to be sufficiently large to provide good estimates of the population means of the different gender and age groups. According to the central limit theorem, sample sizes of at least 20 generate a normal distribution of the means of the samples. At the end of the study period, the smallest sample size, that of the men born 1911, was 20 persons. The means reported, thus, were sufficiently good estimates of those of the populations sampled.

The non-response rates are usually high in studies of elderly populations (5, 15, 182, 183). Consequently, the non-response analysis becomes more important than in studies with low rates of non-response. In this study, there was a tendency of female over-representation among the non-responders, though statistically significant only in 1990. The five year survival rate was lower among the non-responding than among the responding women in 1984. In 1987, however, and in males in 1984, the survival
rate was higher among the non-responders. There was no consistent trend. Consequently, we consider the responders representative of the men as well as the women in these ages in Umeå.

The comparison between those born 1902 and living in the town parish and those born the same year and living in other parts of the town showed that there was a statistically significant difference in the proportion of women suffering from dementia. If that many variables are compared, however, one statistically significant difference between the sampled groups is expected even if there is no such difference in the population. The analysis of certain changes of variable values between 1981 and 1984 among the females born 1902 should, however, be made with caution.

Apart from the change in the cohort born 1902 in examination year 1984, the birth cohorts were used as panels. Once drawn, they did not change, and the same persons were followed through the years. This means that the representativeness of the men and women in the birth cohorts was not complete during all examination years. Two study subjects moved from the town. Umeå grew during the period, and some people born 1902 or 1911 moved to the town.

**GENERAL SUMMARY AND CONCLUSIONS**

The results of this study are based on age and gender stratified samples of the elderly population in the town of Umeå in northern Sweden. When drawn, the samples were representative of the men as well as the women in these ages in Umeå. Most persons had been blue- or white-collar workers and most had only elementary school education. Even among those aged 88, most persons still lived in private housing.

The longer life expectancy in women caused the proportions of married persons to differ considerably with gender; the older the persons, the larger the difference. The proportions of married men decreased from 80 to 50 %, and that of women from 70 to 20 %.

The number of persons practising social activities regularly decreased considerably during the period, while the frequency of weekly contacts with their children was almost constant. Even among the oldest persons almost three fourths read a daily newspaper.
The proportion of persons receiving regular help increased considerably during these two decades; from less than one fifth to around four fifths. Half of the persons receiving help were provided municipality home-help. The need of help, assessed by the Katz' index of ADL, increased from almost none to 60 % during the period. Those being able to walk without aids or assistance decreased from almost all to half of the persons.

The mean body weight decreased from around 77 kg to 65 kg in men and from around 67 kg to 56 kg in women. The measure of obesity, the BMI, also decreased in both sexes. Both the proportions of persons with full or almost full sight and those with normal hearing ability decreased from two thirds to around one tenth of the persons. The men had inferior hearing ability than the women.

Fifty to 75 % said that they felt healthy. There were tendencies, though not statistically significant, for the younger persons and the men to feel more healthy than the older and the women. The most frequent symptoms were general tiredness, pains, dyspnoea, constipation and dryness of the mouth. Tiredness and constipation were distinctly age related.

The most frequent group of diseases was by far the cardiovascular, affecting 50 to 70 % of the persons. Hypertension was the most frequent cardiovascular disease among the younger persons, while the disease affecting most older persons was congestive heart failure. The prevalences of several of the diseases (hypertension, myocardial infarction and angina pectoris) were shown to be higher in Umeå than in the other population studies. The blood pressure in the beginning of the study period was higher than that in the end, probably not only an age but also a period effect.

The frequency of persons suffering from eye cataract and glaucoma increased considerably with age, being more than one third and one fifth, respectively, at the age of 88. The prevalence of chronic obstructive diseases of the lungs was larger among the men and among the older persons. Despite the decreasing number of smokers shown, the proportions of people suffering from these diseases did not decrease. Instead, there was an increasing tendency, probably mirroring the delay of the effect.

The frequency of dementia was increasing very steeply among the oldest persons; at the age of 88, 40 % of the persons were demented.
Drug consumption was increasing; the oldest persons in both cohorts used 5 different drugs or more per person. It was shown that the consumption increase was mainly due to the increasing morbidity accompanying age. The women had a higher consumption than the men. The most common drugs taken were cardiovascular preparations, psychoactive agents, drugs to alleviate gastrointestinal symptoms, and analgesics. The proportion of persons treated with drugs prescribed for hypertension decreased during the period. Forty to 50% of both men and women used sleeping pills regularly.

High age, male sex, dementia, congestive heart failure, and low S-creatinine values were independently associated with an increased time-dependent death risk.

The reference intervals of many clinical-chemical blood components among healthy elderly people were shown to be broader than those of younger persons. The level of the reference intervals of some of the components, notably P-folate, P-potassium, ESR, P-creatinine and in women, S-cholesterol, were different from those of the younger persons.

The characteristics of the 24-hour ambulatory ECG in elderly, healthy persons, were investigated. It was shown that some presumed pathological conditions, including supraventricular premature beats, episodes of supraventricular tachycardia (SVT), and ventricular premature beats (VPB) were frequent, both among the healthy elderly persons examined and compared to younger persons. The proportion of persons with SVT and with more than two VPB configuration types was higher than previously reported.

The six years' gender difference in life expectancy does of course affect many life characteristics in these ages. Till the age of 82 years, the proportion of widows was at least double that of widowers. This ought to mean that the women needed more help from outside the home, provided the functional ability was the same in men and women. In fact, there was a tendency for the women in all age groups to score inferior to the men in the Katz’ index of ADL but the provision of municipality home help did not differ.

The female preponderance in frequency of symptoms and drug consumption found in most other studies (23, 43, 49, 52, 87, 174, 184) was confirmed in this study. There were proportionally more women using medicines from almost all drug groups and complaining of almost all symptoms, despite the fact that the number of diseases did not differ with
gender. The gender difference in drug use has been shown to be present in all ages. Various explanations have been proposed. It has been argued that females pay more attention to body discomforts and therefore are more prone to evaluate symptoms as illness, and that they have stronger predispositions to seek medical care for minor health problems and are better reporters of minor problems than men (185).

Many of the variables investigated show large prevalence changes during these years, especially in the ninth decade of life. Evidently, up to the age of around 80 years of age, most persons surviving were in relatively good shape. To name some of the measures at age 79, the proportion of persons fully or almost independent according to the Katz' index of ADL was more than four fifths, the ability to walk without an aid was around 80 %, the prevalence of dementia was less than 10 %, and more than four fifths of the women and around two thirds of the men could hear a person talking at 5 m distance. After that age, however, conditions were steeply deteriorating. At the age of 88, only half of the persons were fully or almost independent, the ability to walk independently was also 50 %, dementia prevalence was around 40 %, and less than half of the persons could hear a person talking at 5 m distance. Since dementia was found doubling the time-dependent death risk, the high prevalence meant that the disease contributed heavily to the low life expectancy in this age.

Thus, during the ninth decade of life, functions crucial to the chances of living a rich and vital life were found deteriorating in many elderly. Because of the large variation in most life characteristics in high age, however, many very old persons could still enjoy such a vital life.
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