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# The Prospective Population Study of Women in Gothenburg, Sweden, 1968-69 to 1992-93

## *A 24-year follow-up study with special reference to participation, representativeness, and mortality*

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**Objective** – To describe the fourth phase of the Prospective Population Study of Women in Gothenburg, Sweden, with special reference to participation and survival.

**Design** – Prospective population study.

**Setting** – City of Gothenburg with about 430 000 inhabitants.

**Participants** – 1462 participants and 128 refusers aged 38-60 years at the time of the initial study in 1968-69, 282 women who were sampled but not invited to the study in 1968-69, and 266 women participating since 1980-81 and 32 women for the first time in 1992-93.

**Main outcome measures** – Participation rate, survival, anthropometric and metabolic characteristics.

**Results** – The participation rate throughout the study period was high. The participants were mainly characteristic of

women of the same ages in the general population even after 24 years. The mortality after 24 years was higher in non-participants than in participants, while there was no difference in survival between women who were invited and women who were not invited to the study.

**Conclusions** – The initial participants were mainly characteristic of the general population, also after a long follow-up period. The long-term survival was lower in initial refusers than in initial participants.

**Key words:** population study, participation, non-participation, mortality, women.

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The Prospective Population Study of Women in Gothenburg started in 1968-69 with a cross-sectional examination of 1462 women aged 38, 46, 50, 54, or 60 years. The women have been followed up at three additional examinations, the latest in 1992-93. During the 24-year follow-up, new cohorts of younger women have been included, thus making it possible to describe secular trends in 38- and 50-year olds. Women in some selected age cohorts who moved to Gothenburg during the study period were also invited to participate in order to obtain representative samples of women living in Gothenburg at the time of the later examinations. The inclusion criteria were based on date of birth in order to ensure that the women were representative of women of the ages studied in Gothenburg. Details of the first three examinations in 1968-69, 1974-75, and 1980-81 have been described previously (1-3) and, in addition, some 300 papers have been published describing various aspects of health in this population sample.

The purpose of the present paper was to describe the population sample studied during a 24-year follow-up period, from 1968-69 to 1992-93. This is the first report from the 24-year follow-up study. Special reference is

given to participation and to a comparison between participants and non-participants in the context of mortality, and the following question is also addressed: Is a population, when re-examined a number of years after the sampling, still representative of the general population? And, as far as mortality is concerned: Is there any indication that participation in this type of population study leads to lower mortality among the participants than in women who were not invited to the study?

### STUDY POPULATION

#### *Sampling*

The study was initiated in 1968-69, when the baseline examinations were conducted (1). The sample was obtained from the Revenue Office Register and consisted of women living in Gothenburg at the beginning of 1968 and born on certain dates of the years 1908, 1914, 1918, 1922, and 1930 (Table I). Gothenburg is situated on the west coast of Sweden and had about 445 000 inhabitants at that time and 24 years later. In all, 1462 women participated in the initial study (Table II), 682 of whom (46.6%) had been born outside Gothenburg but

Table I. Principles for selection of the material.

Year of birth	Date of birth during each month of the year				
1930	6	12	18	24	30
1922	6	12	18	24	30 <sup>1</sup>
1918	6	12	18	24	30 <sup>1</sup>
1914	6	12			
1908	6				

<sup>1</sup>Of the women born on the 30th only those born in January–June were called for the examination.

moved there before sampling according to the information from the Revenue Office Register.

The participants were re-examined after six years, in 1974-75 (2), after 12 years, in 1980-81 (3), and after 24 years, in 1992-93. In 1980-81 two additional groups aged 26 (85 participants) and 38 (122 participants) were included (Table II). These age-groups were again invited to the study in 1992-93 and, in addition to the numbers shown in Table II, six women born in 1942 and eight born in 1954, who did not participate in 1980-81, took part in the study in 1992-93. Furthermore, in 1980-81 the women born in 1930 (50 years of age in 1980-81) who had moved to the study area since the initial examination, and who fulfilled the inclusion criteria with respect to date of birth, were invited (59 participants in this group in 1980-81). They were also invited to the study in 1992-93, and 26 of them participated. In order to guarantee a more representative sample of the female population of Gothenburg in 1992-93, women born in 1922 who had moved to the study area since the initial examination in 1968-69, and who fulfilled the inclusion criteria with respect to date of birth, were invited, and 33 women in this group participated (not included in Table II). In this way the total number of participants available for cross-sectional analyses in 1992-93 was 1056, i.e. eight additional women born in 1954, six in 1942, 26 in 1930, and 32 in 1922, compared with those shown in Table II. The present paper is confined to data

collected in 1968-69, 1980-81, and 1992-93, corresponding to two 12-year observation periods.

## METHODS

At the time of the examinations in 1974-75, 1980-81, and 1992-93, the women who had been sampled were checked with the Revenue Office Register of Gothenburg and the Swedish National Death Registry for vital status, and with the Swedish Person and Address Registry for place of residence. Death certificates were obtained from the Central Bureau of Statistics. Cause of death as registered on the death certificates was recorded, and performance or not of autopsy was also registered.

Non-participation analyses have been conducted in connection with the four examinations in 1968-69, 1974-75, 1980-81, and 1992-93. Non-participants were interviewed by means of a telephone call or a letter, and additional information was obtained from national registers and inpatient and outpatient records.

### Statistical methods

Student's t-test (two-tailed test) was used to test the hypothesis of no difference in mean values between groups. An extension of the  $\chi^2$ -test, the Mantel-Haenszel procedure with one degree of freedom (4), by means of which age strata were included in the analysis, was used for testing the hypothesis of no differences between frequencies. The odds ratio and the confidence interval of odds ratio were calculated according to the Mantel-Haenszel procedure. Differences were considered statistically significant for *p*-values <0.05.

## RESULTS

### Participation

The participation rate in the initial study in 1968-69 was 90.1%, similar in the different age strata (1). Eight

Table II. Year of birth and age (years) and number of participants (n) in 1968-69, and age, number of participants, and participation rates (% of those participating in 1968-69 if nothing else is indicated) in the population study of women in Gothenburg in the follow-up studies in 1980-81 and 1992-93 (women born 1908–1930 sampled in 1968 and women born 1942 and 1954 sampled in 1980).

Year of birth	1968–69		1980–81			1992–93		
	Age	n	Age	n	% <sup>1</sup>	Age	n	%
1954	–	–	26	85	66 <sup>1</sup>	38	61	72 <sup>2</sup>
1942	–	–	38	122	85 <sup>1</sup>	50	93	76 <sup>2</sup>
1930	38	372	50	308	83	62	249	67
1922	46	431	58	332	77	70	270	63
1918	50	398	62	325	82	74	213	54
1914	54	180	66	140	78	78	79	44
1908	60	81	72	49	60	84	19	23
Total	38–60	1462	26–72	1361	79 <sup>3</sup>	38–84	984	57 <sup>3</sup>

<sup>1</sup>Of those sampled in 1980–81, <sup>2</sup>of those participating in 1980–81, <sup>3</sup>in women born 1908–1930.

women had died between the time for sampling and the invitation to the examination, 20 had moved from the city, 128 refused to participate, and four were not accessible. Information was obtained by telephone or letter from 107 non-participants (70.4% of 152 non-participants who were alive). Further information was obtained from inpatient and outpatient records, and altogether information was obtained from 99.2% of those who had been sampled. The participation rates at the three follow-up studies were 89.1%, 78.9% and 57.2%, respectively (% of those participating in 1968-69). Of the participants in 1968-69, 280 (19.2%) had died before the 24-year follow-up study in 1992-93. This means a participation rate of 70.2% among those who had participated in 1968-69 and who were alive in 1992-93. Another 89 women in this group had moved from the city and did not participate in 1992-93, 255 refused to participate, and two were not accessible at the time of the study.

#### *Mortality rate and causes of mortality*

The mortality rates during the 24-year period in the different age strata are shown in Table III. Table IV shows causes of death. In the total series, cardiovascular disease was about as common as cancer as the cause of death, and "other cardiovascular disease" (other than myocardial infarction) was slightly more frequent than myocardial infarction.

#### *Survival in participants and non-participants*

In Fig. 1 the cumulative age-standardized survival is shown for participants in the initial study in 1968-69,

and for the 128 women who refused to participate in that study. The survival was lower in refusers than in participants, the risk ratio for death for refusers within 24 years being 1.65 compared with participants, 95% confidence interval 1.14-2.38 ( $p < 0.01$ ).

#### *Survival in non-invited women compared with participants*

In the 1914 birth cohort, women born on all dates divisible by six were sampled in 1968, but only those born on the 6th and 12th of each month were invited to the examination. In this way it was possible to compare the participants ( $n=180$ ) and those of the same age who were sampled at the same time but not invited ( $n=282$ ). The cumulative mortality during 24 years is shown in Fig. 2. The mortality curves for these two groups of women were similar, and there was no difference of statistical significance after 24 years between the groups (risk ratio for death in those not invited compared with participants 0.86, 95% confidence interval 0.57-1.28).

#### *Representativeness of the initial sample in 1992-93*

In 1980-81 the 50-year old group of women was enlarged to include women of the same age and the same dates of birth who had moved to Gothenburg since the initial study. In 1992-93 the 70-year old group of women was enlarged in the same way. This ensured representativeness of these age strata in 1980-81 and 1992-93, respectively. Table V shows some selected characteristics, as observed in 1992-93, of women belonging to the initial sample and of the additional women aged 70 in 1992-93 who had moved to the city after the initial study. There were only very small differences between this latter group and the initial participants, and no difference of statistical significance.

In Table VI a comparison is made concerning the same variables from the initial study between women born in 1922 who participated in 1968-69 and 1992-93 (aged 46 years in 1968-69 and 70 years in 1992-93) and the women born in 1922 who participated only in 1968-69 but were alive at the time of the study in 1992-93. Again there were only small differences, and only one of statistical significance.

Table III. Mortality during the 24-year follow-up period.

Initial participants		Died within 24 years	
Age	n	n	%
38	372	31	8.3
46	431	54	12.5
50	398	88	22.1
54	180	61	33.9
60	81	46	56.8
Total	1462	280	19.2

Table IV. Cause of death (number and % of total number of deaths) in respective age strata and in the total series during the 24-year period.

Age in 1968-69	Myocardial infarction		Other cardiovascular disease		Cancer		Suicide or accident		Other reason	
	n	%	n	%	n	%	n	%	n	%
38	3	9.7	2	6.5	20	64.5	2	6.5	5	16.1
46	8	14.8	16	29.6	24	44.4	1	1.9	10	18.5
50	11	12.5	12	13.6	37	42.0	3	3.4	22	25.0
54	14	23.0	16	26.2	18	29.5	2	3.3	13	21.3
60	5	10.9	16	34.8	12	26.1	1	2.2	14	30.4
Total	41	14.6	62	22.1	111	39.6	9	3.2	64	22.9

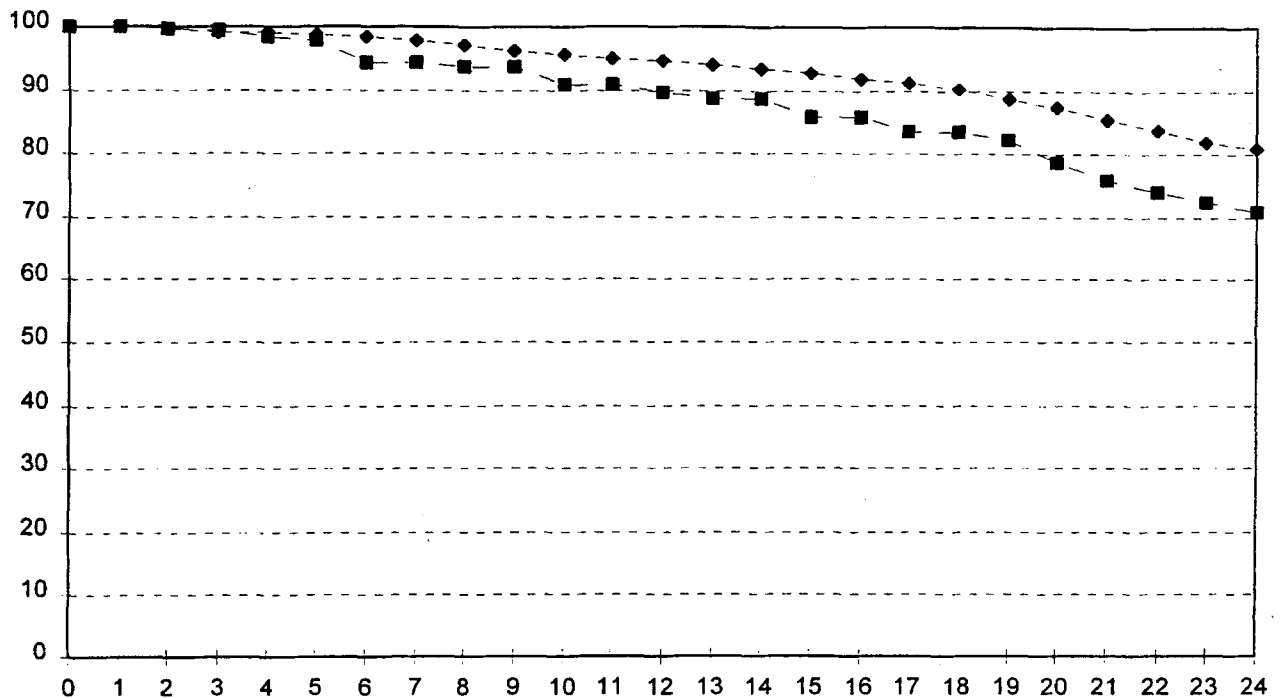


Fig. 1. Cumulative survival (%) during 24 years of participants and refusers in the initial study in 1968–69 (refusers re-calculated to match the participants with respect to age and numbers), rhombic symbols for participants, squared symbols for refusers.

## DISCUSSION

The way of sampling, based on date of birth, and a high participation rate were strong indications that the initial participants were representative of all women in Gothenburg of the birth cohorts studied. The prospective population study of women in Gothenburg has now lasted for more than 24 years. There is no other prospective population study in the world that combines a similar representativeness, thanks to the way of sampling and the high initial participation rate, with such a long and careful follow-up and such a broad examination

programme. There are many similarities with the prospective population study in Framingham, United States (5), which had a larger initial sample and also a long follow-up, but with a much lower initial participation rate. The population sample described in the present paper is confined to women, but another research group has been carrying out a population study of men in Gothenburg, which started in 1963 (6) and is still continuing. It has therefore been possible to compare men and women in Gothenburg (7). A third research group in Gothenburg (the H70 research group) began to study

Table V. Some characteristics of initial participants born in 1922 and women born in 1922 who moved to Gothenburg during the 24-year study period, data from 1992–93 (no differences of statistical significance).

	Initial participants			Moved to Gothenburg		
	n	Mean	SD	n	Mean	SD
Systolic blood pressure (mmHg)	263	157	24	33	157	24
Diastolic blood pressure (mmHg)	261	81	12	33	82	13
Body weight (kg)	258	68.3	11.9	33	69.0	10.0
Body height (cm)	257	161.7	6.0	33	162.0	5.2
BMI (kg/m <sup>2</sup> )	257	26.1	4.3	33	26.4	4.0
Waist circumference (cm)	259	83.5	11.0	33	84.3	11.2
Hip circumference (cm)	259	100.8	9.6	33	102.4	8.6
WHR (cm/cm)	259	0.83	0.06	33	0.82	0.07
Serum cholesterol (mmol/l)	259	6.41	1.06	32	6.31	1.01
Serum triglycerides (mmol/l)	259	1.54	0.71	32	1.56	0.82
Serum urate (mmol/l)	261	269	70	32	280	78

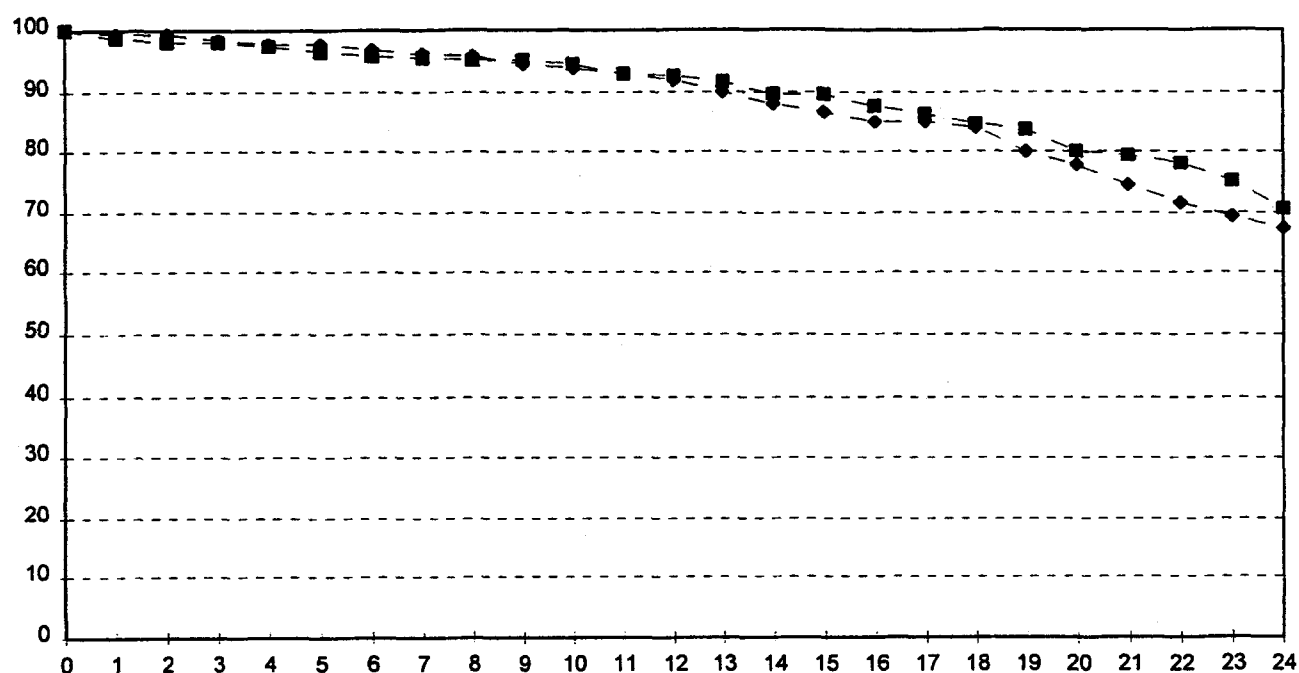


Fig. 2. Cumulative survival (%) of women born in 1914 during 24 years, a comparison between women who were sampled and who participated in the study in 1968–69 and women who were sampled but not invited (rhombic symbols for participants, squared symbols for those not invited).

older people in 1971, initially examining 70-year old women and men (8). One of the age cohorts in the present study, women born in 1922 and aged 70 years in 1992–93, was examined in cooperation between our research group and the H70 research group.

Future research will concentrate on comparisons between groups with different characteristics in a gender perspective, using a pathogenetic and a salutogenetic

approach. By adding younger participants to the study groups, it has been possible to make comparisons in the population perspective cross-sectionally as well as longitudinally, and to study secular trends.

The sample was drawn in 1968, and it is of great interest to know whether the sample was still representative for women of the same ages in the general population at the time of the follow-up studies. When com-

Table VI. Some characteristics (data from 1968–69) of women born in 1922, invited for examinations at the age of 46 years in 1968–69 and at the age of 70 years in 1992–93, a comparison between non-participants who were alive in 1992–93 but did not return for the 24-year follow-up, and those who participated in 1992–93.

	Alive in 1992–93, did not return for the 24-year follow-up study			Returned for the 24-year follow-up		
	n	Mean	SD	n	Mean	SD
Systolic blood pressure (mmHg)	112	132	18	266	129	17
Diastolic blood pressure (mmHg)	112	86*	10	266	81	9
Body weight (kg)	112	62.9	10.0	266	62.7	8.8
Body height (cm)	112	163.6	6.6	266	163.9	6.0
BMI (kg/m <sup>2</sup> )	112	23.5	3.2	266	23.4	3.2
Waist circumference (cm)	112	72.5	7.8	266	71.4	7.0
Hip circumference (cm)	107	98.4	6.6	254	98.5	6.5
WHR (cm/cm)	107	0.74	0.05	254	0.73	0.05
Serum cholesterol (mmol/l)	112	6.76	1.03	265	6.79	1.59
Serum triglycerides (mmol/l)	112	1.29	0.62	265	1.17	0.71
Serum urate (mmol/l)	112	221	63	264	223	62

\* $p < 0.05$ , comparison with women who returned for the 24-year follow-up.

paring initial participants with women who had moved to the study area during the 24-year study period, there were only small differences, and when comparing initial characteristics between participants and non-participants in the 24-year follow-up study (non-participants who were alive at the time of the study), again only small differences were observed. This indicated that the initial sample was still mainly representative of the general population, even after 24 years. This is further strengthened by the fact that rather few women moved to or from the area, despite the long study period.

It has been observed from previous studies that individuals who choose not to participate in health examinations have more morbidity and mortality than the participants (9-11). This was also observed in our study. It could be due to psychosocial differences or to a beneficial effect from the health examinations. When comparing participants and non-participants in the initial study, no obvious differences were observed (1). Our study did not include any intervention programme, apart from further follow-up and treatment of women with arterial hypertension. Furthermore, additional examinations and treatment were initiated when they were considered clinically motivated. In spite of undertaking these measures, we cannot state that participation in our study has had a salutogenetic affect with respect to survival. When comparing two groups of women born in 1914 but on different dates of birth, one invited and the other not invited to the study, the 24-year cumulative survival curves for the two groups were similar. We hope that participation in the population study has been beneficial for the participants in many other ways. We who work in the research staff are very grateful to the participating women, who have returned repeatedly for new examinations during the 24-year period in order to increase our knowledge about women's health.

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