Unusual mortality pattern among short term workers in the perfumery industry in Geneva

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ABSTRACT A cohort of 537 workers employed for less than one year between 1900 and 1964 in the Geneva perfumery industry was followed up from entry to the end of 1983. During the period of study, 251 workers died and 41 (8%) were lost to follow up. The standardised mortality ratio (SMR) was significantly above 100 for all causes (SMR = 120), all cancers (SMR = 127), lung cancer (SMR = 186), and violent death (SMR = 179). The highest SMR from all causes was associated with the shortest period of employment (less than two months) and it decreased significantly with longer duration. Such mortality excesses had not been recorded among the 1168 workers of the same industry employed one year or more, previously studied in similar fashion. Interviews among a random sample of 52 workers employed for less than two months seem to indicate that the prevalence of smoking, exposure to asbestos, and occupational accidents in other hazardous industries were higher for these workers than for the reference population. Furthermore, unmarried men were overrepresented among the study cohort. These findings support previous observations indicating that short term workers share atypical features related to high mortality from various causes. It is suggested that mortality in this subgroup should be analysed separately in occupational studies.

We have previously described the mortality and the incidence of cancer among a cohort of 1168 workers of the Geneva perfumery industry first employed for at least one year in the period 1900-64 and followed up to 1980.¹ Overall mortality and overall incidence of cancer were similar to those of the Geneva male population and the cause specific analysis among the whole cohort showed that only mortality from tuberculosis was significantly raised.

In the present paper we analyse the mortality pattern of the workers employed for less than one year in the same industry.

Population and methods

The design of the present study was similar to that of the preceding study on workers with longer employment¹ except that the cut off date was the end of 1983 instead of 1980. All workers employed for less than one year in the three factories of the Geneva perfumery industry since their establishment at the turn of the century until 31 December 1964 were included in the base population. Clerks, workers born before

1880, and frontaliers (foreign workers commuting everyday into Swiss territory from neighbouring regions of France) were excluded as in the previous study (table 1). The 37 probationers were also excluded because their short term employment was assumed to have been planned before entry.

Data on the workers were extracted from the personnel registers which Swiss factory employers have had a legal duty to maintain since the end of the last

Table 1 Study cohort of short term workers by comparison with the cohort of workers employed one year or longer (as previously studied)

	Employed < 1 year	Employed ≥ 1 year
Total No entering industry 1900-64	768	1471
Excluded:		
Clerks	47	186
Born < 1880	48	66
Frontaliers*	68	51
Probationers	37	—
Unidentified	31 (4%)	0
Study cohort	537	1168
Swiss:	467	1006
Lost to follow up	6 (1.3%)	2 (0.2%)
Foreigners:	70	162
Lost to follow up	35 (50%)	26 (16%)

*Foreign workers commuting every day into Swiss territory from neighbouring regions of France.

century. Unfortunately this regulation was abolished in the last revision of the law introduced in 1966. Because no register was missing and because many workers with a few days or only one day of employment were recorded, we believe that the study population was fairly complete, although we have no other source to check the personnel lists.

The workers were first identified and followed up in the records of the Population Office of Geneva. Eighteen Swiss and 13 foreign workers could not be identified, probably because most were never registered with that office or possibly because some old records were missing, and they were excluded. The remaining 537 workers were traced from entry to 31 December 1983 (245 alive) or to their death (251) or to the date at which their trace was lost (41 or 8%).

Inquiries about the 180 Swiss workers who left Geneva were made at their "commune of origin." According to a law first implemented in 1875 the communes have a duty to maintain a register on each family with data on birth, marriage, and death of all their "native citizens," and this is coordinated through a system enabling communication between all communes of the country. This system also includes Swiss citizens who emigrate provided that they register with a Swiss consulate, which, however, is not always the case. For this reason the 18 Swiss workers known to have emigrated were followed up through Swiss consulates and family members remaining in Switzerland. It was ascertained that six of these men were alive and six dead (three deaths had not been notified to the commune of origin). No information could be obtained on the remaining six who were considered lost to follow up.

Of 45 foreign workers who left Geneva only ten could be traced (five deaths) through the population office of other Swiss cities or through family members and 35 were lost to follow up. For the 79 Swiss and the three foreign workers traced alive and who were aged 64 and over at 31 December 1983, vital status was ascertained at the Swiss central pension scheme which keeps complete and accurate records on all old age pensions actually paid over the past five years in Switzerland or abroad.

Death certificates have been available since 1942 and the 24 deaths between 1900 and 1941 (of a total of 251) were included only in the general mortality analysis. The official death certificate codings were obtained for 212 of the 227 men who had died from 1942 onwards. Of the outstanding 15 cases, three certificates could not be found and the remaining 12 deaths occurred abroad; the cause of death remained unknown in seven of these. It was ascertained in five from information supplied by the hospital physician or the attending physician and in three from information obtained from the next of kin (two deaths from

myocardial infarction and one from traffic accident).

Incident cases of cancer were collected from 1 January 1970 (the date of inauguration of the Geneva Cancer Registry) to the end of 1983 among the 245 men who lived in the Geneva area during that period.

Expected deaths and expected cases of cancer were calculated by the man-years method² using regional mortality and cancer incidence data, as described in detail elsewhere.^{1,3} The usual statistical analysis based on the Poisson distribution was used to test the one sided significance of any excess of observed deaths or cases of cancer.

STUDY SAMPLE

A random sample was drawn from the subgroup of short term workers who stayed less than two months. It was actually postulated that these men, who had the highest excess mortality, were the most representative for investigating atypical features related to short term employment. The 208 workers were stratified by year of birth and by nationality (Swiss and foreign) and a systematic sample of 52 men (1 in 4) was drawn. One man known to be alive had emigrated and 11 who had died had no relative who could be contacted. For these 12 the preceding man on the list was sampled; the procedure had to be repeated on similar grounds for five of the cases as well.

A total of 69 workers was finally sampled (25 alive, 40 dead, four lost to follow up) and information was collected on 52. The non-response rate of 25% (17/69) was not unexpected considering the difficulties of tracing relatives of dead workers for a third of whom death had occurred more than three decades ago.

Telephone interviews were made by one of us (EC) with the worker himself (22 men) or with the next of kin (30 men). Details of lifelong smoking habits were collected and the successive occupations were listed with the available data on type of work and hazardous exposure.

Smoking habits of the male population of the region were available from three studies of random samples, two drawn in the French speaking part of Switzerland in 1975⁴ and 1980⁵ and one drawn in the Geneva area in 1977-82.⁶ Smoking data from the three studies were combined and standardised to the age distribution of the sample of short term workers using three periods of birth (1880-99, 1900-1919, 1920-39). Data on men born from 1940 onwards were excluded because almost all short term workers were born between 1880 and 1939. Smoking habits among manual workers, available from two of these studies,^{5,6} were similarly combined and standardised.

Two industrial hygienists with long experience in the Geneva workplaces assessed exposure to occupational lung carcinogens from the lifelong occupational histories of the 52 short term workers.

and of 78 men from a comparison group. The comparison group was constituted from the population controls selected among the above mention Geneva random sample for a case control study on laryngeal cancer (unpublished). Exposure was classified as very likely, possible, and unlikely.

Results

As may be seen in table 1 the short term workers were more difficult to trace than the workers employed for one year or longer in the same industry. Among the short term workers, 4% could not be identified and in addition 1.3% of the Swiss and 50% of the foreigner were lost to follow up, whereas the proportions were much lower among the workers employed for one year or longer.

GENERAL AND CAUSE SPECIFIC MORTALITY

The 537 short term workers contributed 16933 man-years of observation. For the whole study period (1900-83) 251 deaths are observed v an expected 207.8 from regional death rates, giving a significantly higher SMR of 121 (90% confidence interval: 109-134).

Table 2 shows the mortality from selected causes in 1942-83 (no death certificate being available before 1942), allowing for one year of latency as for the subsequent table. Mortality is significantly raised for all neoplasms, cancer of the lung, and violent death. A non-significant mortality excess is recorded for four other cancers (oesophagus, pancreas, bladder, and

kidney), and for tuberculosis, chronic bronchitis, and emphysema, and circulatory disease. The latter excess is mainly accounted for by a non-significant increase in mortality from heart disease (observed deaths (O) = 53, expected deaths (E) = 46.2) although the mortality from ischaemic heart disease, only available since 1969, is not raised (O = 12, E = 14.6).

CANCER INCIDENCE

The analysis of cancer incidence covers only 1970-83 because there was no registry in Geneva before this. A total of 33 incident cancers is observed v 30.5 expected. No difference between observed and expected values reaches the level of statistical significance for the various cancer sites but the numbers are small in most comparisons. There is a non-significant excess in the incidence of lung cancer (O = 10, E = 6.4, SMR = 156, 90% CI = 85-265). Five additional cases of lung cancer, however, occurred in the cohort after the termination of the study (three in 1984 and two in 1985). These cases were fortuitously displayed because the search in the registry files was undertaken only in November 1985. Disregarding the fact that the collection of the cases by the registry was far from complete for 1985, these five cases of lung cancer may be compared with the expected value which would be 0.9 if the number expected for 1983 (0.43) is applied to the following two years. Taking this into account, the limited incidence data support the increased risk for lung cancer found in the mortality analysis.

Table 2 Mortality of short term workers from selected causes for 1942-83

Cause (ICD code 8th rev)	Obs	Exp	SMR	90% CI
All causes	227	189.9	120**	107-133
All neoplasms (140-239):	69	54.4	127*	103-155
Buccal cavity, pharynx (140-149)	3	2.8	107	29-277
Oesophagus (150)	6	2.9	207	90-408
Stomach (151)	5	5.0	100	39-210
Intestine, rectum (152-154)	5	6.2	81	32-170
Pancreas (157)	5	2.1	238	94-501
Larynx (161)	1	1.5	67	3-316
Lung (162, 163.0)	24	12.9	186**	128-262
Prostate (185)	3	5.0	60	16-155
Bladder (188, 223.3)	5	2.5	200	79-421
Kidney (189.0)	2	1.2	167	30-525
Lymph/haemopoietic (200-209)	3	3.2	94	26-242
Others	7	9.1	77	36-144
Circulatory disease (390-458)	76	66.6	114	93-138
Violent death (E 800-999):	28	15.6	179**	128-246
Motor vehicle accidents (E 810-823)	7	3.4	206	97-387
Other accidents (E 800-807, 825-949)	12	5.9	203*	117-330
Suicide (E 950-959)	9	5.8	155	81-271
All other causes (0-136, 240-389, 460-796):	47	53.3	88	68-112
Tuberculosis (10-19)	8	4.4	182	90-328
Chronic bronchitis and emphysema (491-492)	5	3.4	147	58-309
Cirrhosis of liver (571)	4	6.5	62	21-141
Unknown	7			

CI = Confidence interval.

*p < 0.05, **p < 0.01.

MORTALITY AMONG SUBGROUPS

As shown in table 3 there is a downward trend of mortality with longer employment, which is significant at the 5% level (χ^2 -test). The SMR is highest (140, $p < 0.01$) for those who stayed less than two months and there is no mortality excess (SMR = 92) for those who remained employed at least half a year. Among the former there is a great increase in mortality from violent death ($O = 16$, $E = 6.1$, SMR = 262, 90% CI = 165–398), which was particularly high for the years one to 14 after entry due to three deaths from accident and four from suicide ($O = 7$, $E = 1.2$, SMR = 583, 90% CI = 274–1096).

A trend, although not significant, is also observed in the analysis by age at death (table 3), with SMRs of 146 for the youngest age group (15 to 49) and of 111 for the oldest. Among the youngest age group much of the excess may be ascribed to the high mortality from neoplasms ($O = 8$, $E = 4.4$) and from violent death ($O = 15$, $E = 6.1$).

On the other hand, there is no trend of mortality by year of entry (table 3). This contrasts with the finding among the workers who stayed one year or more whose SMR from all causes was significantly raised for those born before 1900 and first employed before 1930, whereas no excess mortality was observed in the other subgroups.¹

According to registered occupation at entry, the 537 short term workers have been distributed in three categories: chemists ($n = 18$ or 3%), maintenance ($n = 74$, 14%), and production ($n = 445$, 83%). The latter category includes a few workers in miscellaneous occupations such as dispatching, handling, or driving. Production workers ($O = 213$, $E = 175.2$,

SMR = 122, 90% CI = 108–136) and maintenance workers ($O = 24$, $E = 19.8$, SMR = 121, 90% CI = 84–170) share a similar excess mortality. As with the chemists who stayed one year or more,¹ the “short term chemists” had a lower mortality than other categories ($O = 14$, $E = 12.8$, SMR = 109, 90% CI = 66–171), although the small number of deaths precludes any interpretation.

LUNG CANCER

The significant excess mortality from lung cancer (table 2) suggests a high rate of smoking among the cohort. The combined mortality from the six other smoking related cancers⁷ (buccal cavity and pharynx, oesophagus, pancreas, larynx, bladder, and kidney) is also significantly increased ($O = 22$, $E = 13.0$, SMR = 169, 90% CI = 115–242) whereas the combined mortality from all other cancers is not ($O = 23$, $E = 28.5$, SMR = 81, 90% CI = 55–114).

As may be seen in table 4 the short term workers seem to smoke significantly more than both men in general from the region and manual workers from the same region. In addition, three of the six short term workers classified as never smokers might have been ex-smokers because the smoking history obtained from the relative (a niece, a second wife, and a brother-in-law) did not cover young adult life.

Contrary to the study sample, however, the three random samples from the general population were assembled cross sectionally and did not include men who died prematurely. Smokers were probably over-represented among the latter. This “survivor bias” cannot be overlooked but its effect might be limited considering the smoking habits of the 22 short term

Table 3 Mortality 1900–83 from all causes in various subgroups of short term workers

Subgroup	No of men	No of deaths		SMR	90% CI
		Observed	Expected		
Months of employment:					
0–1	208	115	81.9	140**	120–164
2–3	124	57	47.4	120	95–150
4–5	64	31	26.4	117	85–158
6–11	141	48	52.1	92	71–117
Age at death:					
15–49		54	37.1	146**	115–183
50–69		108	90.5	119*	101–140
70–		89	80.2	111	92–132
Year of entry:					
1900–29	159	123	101.5	121*	104–141
1930–49	230	116	95.0	122*	104–142
1950–64	148	12	11.2	107	62–174
Year of birth:					
1880–99	131	113	99.9	113	96–132
1900–	406	138	107.9	128**	111–147

CI = Confidence interval.

* $p < 0.05$, ** $p < 0.01$.

Table 4 Percentages by smoking category among the sample of short term workers and among all men and manual workers from the region (combined results of three random samples: see methods)

Smoking category	Short term workers (n = 49*)	General population	
		All men (n = 815)	Manual workers (n = 215)
Never smokers (%)	12.2	28.7	22.0
Ex-smokers (%)	20.4	42.9	45.8
Cigar, pipe smokers (%)	10.2	4.3	4.3
Cigarette smokers (%)	57.1	24.1	28.0

*Smoking habits not ascertained in three of the 52 workers.

Significant difference (χ^2 test) between short term workers and either all men ($p < 0.001$) or manual workers only ($p < 0.001$).

workers who were personally interviewed (9.1% never smokers, 36.4% ex-smokers, 4.5% cigar or pipe smokers, and 50.0% cigarette smokers), which are also significantly higher than those of the population ($p < 0.05$).

To evaluate the confounding effect of the smoking habits among the short term workers on their lung cancer mortality, the procedure described by Axelson⁹ was applied to the data of table 4 using relative risks obtained in the United States veterans study¹⁰ (1.0 for never smokers, 4.0 for ex-smokers, 1.9 for pipe or cigar smokers, and 11.3 for cigarette smokers). Under such assumptions the SMR from lung cancer among the study cohort would be 158 due to smoking alone.

An attempt was also made to assess the occupational exposure to lung carcinogens from the lifelong occupational histories of the sample of 52 short term workers and of a comparison group of 78 men (see Methods). Results indicate that 28.8% of the short term workers and 14.1% of the men from the comparison group were likely to have been exposed to asbestos for more than five years—for example, in boiler making, carpentry, electrical installation, gas work, or automobile repair. The proportions of men possibly exposed to asbestos were respectively 13.5% and 7.7%, and of men unlikely to have had exposure, 57.7% and 78.2%.

Exposure to other occupational lung carcinogens, mainly polycyclic hydrocarbons, nickel, chromium, and arsenic compounds was less frequent and more difficult to assess, and was therefore disregarded.

Taking into account the combined effect of asbestos and tobacco smoke in causing lung cancer¹¹ the likely higher prevalence of asbestos exposure among the study cohort than the reference population might account for a limited part of the excess risk for lung cancer among the short term workers.

VIOLENT DEATH

Excess mortality from accident and suicide related to alcohol abuse has been reported in many studies—for example, Thorarinsson¹² and Nashold and Naor¹³—

and this factor might be related to the significant increase in mortality from violent death among the study cohort. There is no excess mortality from hepatic cirrhosis ($O = 4$, $E = 6.5$), only one death from alcoholism (ICD-8: 303), and none from alcoholic psychosis (291) or alcohol poisoning (860). On the other hand, one of the four above mentioned diagnoses appears as an associated cause of death on 10 of a total of 212 available death certificates (4.7%).

These results are to be compared with those obtained for four other cohorts that we have studied in Geneva and which were constituted by the perfumery workers who stayed one year or longer,¹ by 703 male hairdressers,³ by 1917 painters, and by 1948 electricians (last two studies not yet published). The observed v expected deaths from hepatic cirrhosis were respectively 14/11.3, 11/10.1, 14/8.8, and 4/5.9. The proportions of the death certificates which mention, as associated cause of death, cirrhosis or any form of alcoholism (ICD-8: 291, 303, 860) were respectively 5.4% ($n = 17$), 3.0% ($n = 9$), 5.6% ($n = 14$), and 3.8% ($n = 5$). Thus the limited evidence obtained from the mortality data does not support the hypothesis of higher alcohol abuse among the short term workers.

Further scrutiny of the death certificates indicates that four of the 19 accidental deaths in the study cohort were of occupational origin compared with only two of 24 among the perfumery workers employed for more than one year, although two additional deaths were due to chronic benzene poisoning.¹ Analysis of the 52 occupational histories of the short term workers shows that 11 (21%) spent most of their active life in the construction industry, road maintenance, and forestry, which are among the occupations with the highest mortality rates from accidents in Switzerland. Thus some part of the excess deaths from accidents among the short term workers might be related to higher than average exposure to occupational accidents in other hazardous industries.

Previous studies of mortality by social class and by marital status¹⁴⁻¹⁶ have shown a steep mortality gradient for violent death from the more skilled to the

less skilled occupations. A sharp mortality differential between married and unmarried men has also been shown. Tables 5 and 6 show that both unskilled and unmarried workers were overrepresented in the study cohort. The limited differences between the short term workers and the reference population, however, could account for only a small part of the excess mortality from violent deaths.

LIFELONG CAREER OF SHORT TERM WORKERS

According to the personnel records of the three perfumery factories, 38 (73%) of the 52 workers sampled were engaged in unskilled occupations, 13 in skilled occupations, and one was a chemist. Scrutiny of occupational histories indicates that 16 workers (31%) remained unstable, all but one in unskilled occupations, and may be considered as "lifelong short term workers," whereas 14 workers (27%) had fairly stable careers with a few changes within the same occupation. The remaining 22 workers (42%) may be classified as "intermediate" so far as occupational stability is concerned. As may be inferred from table 5, most of the 52 men moved up the socioeconomic categories after their short term employment in the perfumery industry when 80% of them were aged below 30.

Various explanations concerning the shortness of their period of employment were given by the workers who were personally interviewed. Several men evoked dislike of the work, rashes, or unbearable smells from the aromatic chemicals; one man claimed that he liked the job but the smell of violets made him feel faint. Other workers had already planned a short stay while looking for another occupation.

Discussion

In a cohort study of beryllium workers published in 1970 Mancuso found higher death rates among men exposed for up to 14 months than among those exposed for 15 months or more.¹⁷ The ratio of age

Table 5 Percentages by socioeconomic category among the sample of short term workers (according to the main lifelong occupation) and among all active men from Geneva (mean results of the 1941, 1950, and 1960 census)

Occupation	Short term workers (n = 52)	Geneva male population (n = 70 265)
Professional and intermediate (%)	13.5	24.3
Other non-manual (%)	19.2	24.0
Manual skilled (%)	28.8	26.5
Manual partly skilled and unskilled (%)	38.5	25.1

There is a significant trend ($p < 0.01$) for short term workers to be more probably employed in manual and unskilled occupations as compared with the Geneva male population (χ^2 for trend).

Table 6 Percentages by marital status among the short term workers resident in Geneva at 1 January 1970 (mean age 50.6) and among the workers employed one year or more resident in Geneva at 1 January 1974 (mean age 50.6 years)

Marital status	Short term workers (n = 242)	Perfumery workers employed ≥ 1 year (n = 738)
Single (%)	12.8	7.5
Married (%)	73.6	82.8
Widowed (%)	5.0	3.5
Divorced (%)	8.7	6.2

Significant difference between the two groups: $p < 0.05$ (χ^2 test)

adjusted death rates was 1.11 for overall mortality (based on 500 deaths), 1.27 for all neoplasms, 3.01 for lung cancer, 2.03 for diseases of the respiratory system, and 1.24 for accidents and poisoning. In recent years additional evidence of odd mortality patterns for short term workers has been reported in chemical workers in Texas (significant increase in mortality from all causes and from circulatory disease),¹⁸ in Australian fire fighters (all causes, traffic accidents),¹⁹ in asbestos workers in Connecticut (all causes, all neoplasms, respiratory cancers and heart disease),²⁰ and in nuclear workers in Hanford (all causes, infectious diseases, ill defined conditions, and violent death).²¹ By contrast, no significant excess in mortality related to short term employment was found in studies of United States dye workers,²² asbestos workers in South Carolina and Pennsylvania,^{23,24} uranium workers in Tennessee,²⁵ pesticide workers in Baltimore,²⁶ chrysotile miners and aluminium workers in Quebec,^{27,28} and Swedish railroad maintenance shopworkers.²⁹ No convincing explanation of the unexpected mortality excesses has been offered by the authors of the "positive" studies.

The 537 short term workers who entered the Geneva perfumery industry between 1900 and 1960 have experienced a significantly higher mortality from all causes, all cancers, lung cancer, and violent death, whereas no significant excess mortality for these causes has been found among the workers of the same industry employed for one year or more.¹ It seems that most of the increase in cancer mortality may be ascribed to smoking, considering the high smoking habits recorded among the study sample and the finding that the smoking related cancers accounted for the whole excess in cancer mortality. There is also limited evidence that occupational exposure to asbestos in other hazardous industries, combined with the effect of smoking, might have contributed to the high mortality from lung cancer.

By contrast it is difficult to suggest what factors might be accountable for the excess mortality from accidents and suicide, which was particularly pre-

dominant among the workers who stayed less than two months. As we have seen, the prevalence of alcoholism is unlikely to be increased among the study cohort and only a small part of the mortality excess for violent death might be attributed to the association of short term employment with unskilled occupation and with unmarried status.

From our results and from those of about half the quoted studies there is evidence of an odd mortality pattern among very short term workers. These findings have important implications for studies of occupational cohorts and suggest that this subgroup should be studied separately and excluded from any analysis of the relation between the duration of exposure to an occupational hazard and the subsequent mortality or disease incidence.

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