Original article
Scand J Work Environ Health 1994;20(5):331-338
doi:10.5271/sjweh.1389

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This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/7863296
Mortality of filling station attendants

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LAGORIO S, FORASTIERE F, IAVARONE I, RAPITI E, VANACORE N, PERUCCI CA, CARERE A. Mortality of filling station attendants. Scand J Work Environ Health 1994;20:331–8.

OBJECTIVES — Gasoline contains established human carcinogens, such as benzene. The health impact of exposure to this fuel, however, has not been fully elucidated. We report on the mortality of a cohort of 2665 filling station managers from the Latium region (Italy).

METHODS — This is the first workplace-based cohort of gas station attendants. However, only self-employed individuals were available for study (about 50% of the whole workforce). The follow-up period extended from 1981 through 1992. The mortality experience of the cohort was compared with that of the regional population.

RESULTS — The overall analysis for standardized mortality ratios (SMR) showed a significantly decreased mortality from all causes, mainly due to a deficit of cardiovascular diseases and malignant neoplasms. Nonsignificantly increased risks for esophageal cancer (SMR 241, 90% confidence interval (90% CI) 82–551), brain cancer (SMR 195, 90% CI 77–401) and non-Hodgkin’s lymphoma (SMR 173, 90% CI 47–448) were found for the men; mortality due to lung cancer and leukemia was lower than expected, and no kidney cancer death was recorded. Among the attendants of small stations (characterized by a small number of employees and high sales of gasoline per full-time employee), the SMR values for esophageal cancer (for men SMR 351, 90% CI 120–803) and brain cancer (for men and women SMR 266, 90% CI 105–559) showed increased values.

CONCLUSIONS — Filling station attendants are exposed to gasoline vapors and seem at risk of cancer of various sites. Due to the power limitations of this study, however, a precise estimate of the risk for many causes of death was not achievable. Further cohort studies of greater size are warranted.

KEY TERMS — benzene, cohort, gasoline exhausts, gasoline vapors, occupational cancer.

Gasoline is a complex and highly variable mixture of aliphatic and aromatic hydrocarbons, mainly of low molecular weight (1). Exposures to gasoline fuel and to exhausts from engines operating on gasoline are considered by the International Agency for Research on Cancer as possibly carcinogenic to humans (2–3).

So far, however, the health impact of exposure to petroleum fuels has not been fully elucidated (4). In particular, the hazard posed by exposure to benzene via gasoline vapors and exhausts is of major concern, due to the great number of workers employed in petroleum distribution trades and to the relevant contribution of such sources to the pollution burden in urban environments (5, 6).

While in the United States and northern Europe self-service stations dominate, Italy and other southern European countries still employ large numbers of workers in gasoline retail trades. In this paper we describe the mortality experience of a cohort of filling station attendants from a region of central Italy.

Subjects and methods

Cohort design

A nationwide survey of service stations was carried out in Italy in 1980. Information on several characteristics of the stations and their managers was collected during the survey, such as the name, date of birth and length of employment of the manager, the number of attendants, the quantity of fuel sold in the previous four years, and the number of fuel deliveries to the station per year. Detailed data for the Latium region (central Italy) were obtained, and managers who were clearly identifiable as individuals (as opposed to commercial houses) and who were still alive on 1 January 1981 were considered eligible for the study [2665 stations and managers out of 3272 original records (81.4%)].

The cohort consisted of 2665 service station managers (2308 men and 357 women). At entry into the study their age averaged 46 years, their mean length of employment was 14 years, and most of them (91%) were full-time employees (table 1). At the end of the study, 2236 subjects were still alive (84%), 270 had died (10%), and 159 had not been traced
Table 1. Distribution of filling station attendants by gender according to age and length of employment at entry, worktime, vital status at the end of the follow-up, and person-years of observation.

| Age at entry (years) | Men | Women | Total |
|----------------------|-----|-------|-------|
|                      | N   | %     | N     | %     | N     | %     |
| 19—24                | 67  | 2.9   | 11    | 3.1   | 78    | 2.9   |
| 25—34                | 334 | 14.5  | 62    | 17.4  | 396   | 14.9  |
| 35—44                | 632 | 27.4  | 90    | 25.2  | 722   | 27.1  |
| 45—54                | 704 | 30.5  | 102   | 28.6  | 806   | 30.2  |
| ≥ 55                 | 571 | 24.7  | 92    | 25.8  | 663   | 24.9  |
| Total                | 2308| 100.0 | 357   | 100.0 | 2665  | 100.0 |

| Length of employment at entry (years) | Men | Women | Total |
|---------------------------------------|-----|-------|-------|
|                                       | N   | %     | N     | %     | N     | %     |
| 1—10                                  | 863 | 39.2  | 210   | 63.8  | 1073  | 42.4  |
| 11—20                                 | 897 | 40.8  | 85    | 25.8  | 982   | 38.8  |
| ≥ 21                                  | 439 | 20.0  | 34    | 10.3  | 473   | 18.7  |

| Worktime | Mean | Number of employees |
|-----------|------|---------------------|
| Full-time | 1941 | 92.5                |
| Part-time | 157  | 7.5                 |

| Vital status | Men | Women | Total |
|--------------|-----|-------|-------|
| Alive        | 1922| 83.3  | 228   | 88.0  |
| Deceased     | 250 | 10.4  | 20    | 5.6   |
| Lost to follow-up | 136 | 5.9   | 23    | 6.4   |

| Person-years by age | Men | Women | Total |
|---------------------|-----|-------|-------|
| ≤ 29                | 785 | 3.3   | 113   | 2.9   |
| 30—39               | 3487| 14.5  | 622   | 16.1  |
| 40—49               | 6617| 27.5  | 1020  | 26.4  |
| 50—59               | 7228| 30.1  | 1113  | 28.8  |
| 60—69               | 4252| 17.7  | 706   | 18.3  |
| ≥ 70                | 1664| 6.9   | 291   | 7.5   |
| Total               | 24033| 100.0 | 3864  | 100.0 |

Table 2. Characteristics of the 2665 stations whose managers were enrolled in the cohort study, by station size.

| Station size | Yearly gasoline sales | Capacity of underground asphalt tank | Number of employees | Yearly gasoline sales per full-time employee |
|--------------|-----------------------|--------------------------------------|---------------------|--------------------------------------------|
|              | Number of stations    | Mean number of liters                | Number of stations  | Mean capacity (m³) | Number of stations    | Mean number of employees |
| Small        | 1720                  | 409 605                             | 1738                | 9.64                           | 1683                    | 1.87                       |
| Large        | 911                   | 544 099                             | 918                 | 16.08                          | 896                     | 2.95                       |

(6%). No information on the cause of death was available for 12 deceased persons (4%).

Some characteristics of the 2665 service stations in 1980 are described in table 2 by station size. Large stations, as expected, had higher sales of gasoline, underground tanks of greater capacity, and a greater number of employees than the small stations. The latter, however, were characterized by significantly higher sales of gasoline per full-time employee.

Each subject was considered from 1 January 1981 through 31 July 1991 if resident in Rome at the time of entry into the study, or through 30 June 1992 if resident in any other municipality within the Latium region. Vital status was ascertained through the registry of the last municipality of residence. The code for the underlying cause of death in the International Classification of Diseases (ICD), IX revision, was retrieved by means of various methods, as described in detail elsewhere (7): first, through record linkage with the National Mortality File for deaths occurring before 1986; second, through record linkage with the Regional Death Index for deaths occurring during the period 1986—1992; third, from the registry of the municipality where the death occurred for those cases for which linkage procedures were unproductive. In the last case [75 out of 270 deceased individuals (28%)], the underlying cause of death was coded by an expert nosologist.

For the calculation of person-years at risk of dying, each subject was considered from 1 January 1981 until the end of the study period or the date of death. Those lost to follow-up were considered alive at the end of the study period. Standardized mortality ratios (SMR) and their 90% confidence intervals (90%
Exposure assessment

Information on duration of employment at entry, along with a series of indicators of work load, were available for all cohort members from the 1980 survey. No vapor recovery system has been enforced in Italy, and the relative quantity of fuel sold has remained relatively stable. Unleaded gasoline, in fact, still accounts for less than 5% of the total amount of marketed fuel. Due to the characteristics of Italian service stations, the yearly average quantity of gasoline sold per full-time employee can be considered an indicator of the average intensity of exposure experienced by the manager at refuelling.

Exposure to aromatic hydrocarbons among currently employed filling station workers was estimated by means of an environmental survey taken in 1992 (9). Measured concentrations of benzene, toluene, and xylene [8-h time-weighted averages (TWA)] averaged 0.55, 0.71, and 0.32 mg·m⁻³, respectively. The number of vehicles filled, the daily sales of super premium gasoline and motor-bike fuel, and the winter season were all significant predictors of the logarithmic concentration of benzene (8-h TWA) in the simple regression analyses. The size of the station acted as an exposure modifier. While no single variable was able to predict the benzene level in large stations, for small stations an increase of 0.0579 and 0.0418 in the log benzene concentration per unit of

model was, however, only 12.3%. Therefore, a clearly defined categorization of the subjects into groups with internally homogeneous and significantly different exposure levels was not feasible. As regards the exposure assessment of the cohort, it seems that workers in small-size stations with higher sales of super premium gasoline may experience higher levels of exposure. We decided, consequently, to examine in detail this group of workers.

Results

All-cause mortality was significantly decreased, mainly due to a deficit in cardiovascular diseases and malignant neoplasms. The risk of blood disease (among both the men and the women) and injuries (only among the men) was increased, but the excess was not statistically significant (table 3).

Although cancer mortality was lower than expected, nonsignificantly increased risks were found for non-Hodgkin’s lymphoma and for esophageal and nervous system cancers among the men (table 4). One case of soft-tissue sarcoma and one case of melanoma were observed versus 0.2 and 0.7 expected, respectively. The risk of colon and bladder cancers was slightly elevated, while mortality due to lung cancer and leukemia was lower than expected. No kidney cancer death was recorded, whereas two cases were expected. The number of deaths recorded among the women was very small (20 deaths, 5 cancers). Excess risks were found for pancreatic, uterine, and brain cancer, but each excess was based on one observed case (table 4).

Among the attendants of small stations, the SMR values for esophageal and brain cancer showed increased values when compared with the overall findings, reaching statistical significance among the men and in the whole subcohort. Moreover, the ex-
Table 4. Cancer mortality of the service station attendants from the Latium region (1981—1992). (O = observed deaths, E = expected deaths, SMR = standardized mortality ratio, 90% CI = 90% confidence interval)

| Cause of death* | Men | Women | Total |
|-----------------|-----|-------|-------|
|                 | O   | E     | SMR   | 90% CI | O   | E     | SMR   | 90% CI | O   | E     | SMR   | 90% CI |
| Oral cavity and pharynx (140—9) | 1.7 | 38 | 2—179 | 0.1 | 1.7 | 37 | 2—174 |
| Digestive organs (150—9) | 31.9 | 69 | 47—98 | 1.3 | 30 | 33 | 2—157 | 23 | 34.9 | 66 | 45—93 |
| Esophagus (150) | 4.1 | 214 | 82—551 | 0.1 | 4.1 | 234 | 80—535 |
| Stomach (151) | 9.3 | 64 | 28—127 | 0.7 | 9.3 | 60 | 26—118 |
| Colon (153) | 6.5 | 113 | 49—224 | 0.6 | 6.5 | 102 | 44—201 |
| Liver (155) | 3.8 | 52 | 14—135 | 0.5 | 3.8 | 48 | 13—125 |
| Pancreas (157) | 3.6 | 55 | 10—173 | 1.0 | 3.6 | 30 | 15—143 | 4.1 | 76 | 21—195 |
| Respiratory organs (160—5) | 37.0 | 69 | 65—119 | 0.9 | 37.0 | 87 | 64—117 |
| Larynx (161) | 2.9 | 105 | 29—272 | 0.0 | 2.9 | 105 | 29—270 |
| Lung (162) | 29 | 2.3 | 86—123 | 0.8 | 29 | 34 | 61—116 |
| Connective tissue (171) | 0.2 | 588 | 30—2791 | 0.9 | 0.2 | 529 | 27—1497 |
| Melanoma (172) | 0.7 | 137 | 7—850 | 0.1 | 0.7 | 123 | 6—730 |
| Breast (174—5) | 0.0 | 1.9 | 104—328 | 2 | 0.0 | 1.8 | 102—321 |
| Uterus (179—80, 182) | 0.7 | 154 | 8—730 | 1.0 | 0.7 | 154 | 8—730 |
| Prostate (185) | 2 | 5.3 | 105—119 | 0.0 | 2 | 5.3 | 81—119 |
| Bladder (188) | 6 | 4.9 | 114—224 | 0.6 | 6 | 10.0 | 44—201 |
| Kidney (189) | 2.3 | 0.2 | 5.8—173 | 0.3 | 2.3 | 1.8 | 3.8—193 |
| Non-Hodgkin's lymphoma (200—2) | 3 | 1.7 | 173—448 | 0.2 | 3 | 1.9 | 158—438 |
| Leukemia (204—8) | 2 | 3.3 | 61—119 | 0.3 | 2 | 3.6 | 56—107 |

* Code of the International Classification of Diseases, IX revision, in parentheses.

Table 5. Mortality of the attendants of small service stations from the Latium region (1981—1992) by selected causes of death. (O = observed deaths, E = expected deaths, SMR = standardized mortality ratio, 90% CI = 90% confidence interval)

| Cause of death* | Men | Women | Total |
|-----------------|-----|-------|-------|
|                 | O   | E     | SMR   | 90% CI | O   | E     | SMR   | 90% CI | O   | E     | SMR   | 90% CI |
| Malignant neoplasms (140—208) | 60 | 68.6 | 87 | 70—108 | 3 | 5.99 | 51 | 14—133 | 63 | 74.4 | 65 | 80—104 |
| Esophagus (150) | 4 | 1.1 | 35 | 120—803 | 0.0 | 4.0 | 13 | 120—803 | 4 | 1.2 | 342 | 117—782 |
| Colon (153) | 5 | 3.7 | 136 | 54—286 | 0.4 | 5.1 | 123 | 48—258 |
| Pancreas (157) | 2 | 2.5 | 80 | 14—252 | 0.0 | 2.7 | 111 | 30—296 |
| Larynx (161) | 3 | 2.0 | 135 | 42—396 | 0.0 | 3.0 | 152 | 42—394 |
| Lung (162) | 22 | 2.27 | 57 | 63—138 | 0.5 | 22.3 | 55 | 63—138 |
| Connective tissue (171) | 1 | 0.3 | 13 | 43—395 | 0.0 | 1.0 | 76 | 39—436 |
| Melanoma (172) | 1 | 0.5 | 204 | 10—968 | 0.0 | 1.0 | 152 | 9—863 |
| Bladder (188) | 1 | 0.3 | 15 | 42—119 | 0.0 | 1.0 | 73 | 42—119 |
| Kidney (189) | 1 | 0.1 | 833 | 43—968 | 0.0 | 1.0 | 76 | 43—968 |
| Non-Hodgkin's lymphoma (200—202) | 4 | 1.7 | 233 | 79—532 | 0.2 | 1.26 | 20 | 79—532 |
| Lymphohematopoietic (200—8) | 5 | 0.6 | 48 | 18—126 | 0.4 | 5.7 | 68 | 18—126 |
| Non-Hodgkin's lymphoma (200, 202) | 1 | 2.1 | 171 | 47—448 | 0.2 | 1.3 | 158 | 43—448 |
| Leukemia (204—8) | 2 | 3.3 | 111 | 30—119 | 0.3 | 2.5 | 36 | 10—119 |

* Code of the International Classification of Diseases, IX revision, in parentheses.

cesses of blood diseases, soft tissue sarcoma, and melanoma were concentrated into this subcohort (table 5). For these workers, furthermore, an increased risk of laryngeal cancer was recorded. The excess risk of non-Hodgkin’s lymphoma was, however, almost equally distributed among the two subcohorts (tables 5 and 6). Attendants of large service stations, on the other hand, showed increased risks of bladder cancer, leukemia, and nervous system diseases (table 6).

Discussion
This study represents the first workplace-based cohort of filling station attendants. In fact, epidemiologic investigations of this occupational group are particularly difficult to carry out because managers, although directly involved in refueling, are self-employed workers, attendants are scattered among a large number of very small stations, and neither of these groups are generally subject to any form of centralized personnel record-keeping requirements.
The following three issues are worth discussing: (i) the completeness of the cohort in relation to available sources which catalogue workers employed in this trade, (ii) a comparison of our findings with results from available relevant studies, (iii) and, finally, the major shortcomings of this study.

In the 1981 Italian census, the economic sector "retail sales of fuels and lubricants" listed 32,034 local units and 60,869 workers. More than 50% of the work force consisted of self-employed workers (N = 32,606), 20% were employed family members (N = 12,439), 4% were salaried clerks (N = 2,470), and 22% were workmen (N = 13,354) (10). Within the Latium region, according to the census (11), there were 3,077 service stations, employing 5,784 workers. Of these, 3,018 were self-employed workers (54%), 1,040 were employed family members (18%), 172 were salaried clerks (3%), and 1,464 were workmen (25%). The cohort data source recorded a higher number of service stations (N = 3,272) one year earlier, a finding compatible with normal market fluctuations.

We studied, therefore, about half of the whole work force employed in gasoline service stations in the region, namely, the self-employed managers, excluding family and salaried workers. The mortality experience of these populations might be different from that of the one under study. However, as most of the cohort members declared full-time employment [2,169 out of 2,379 with available information (91.2%)] and the majority of their stations employed one or two workers [1,827 out of 2,581 with available information (70.8%)], we deemed that our "filling station attendants" were directly involved in refueling.

We found excess risks, although not statistically significant, for blood diseases, esophageal cancer, nervous system cancer, and non-Hodgkin's lymphoma in the whole cohort. Moreover, an increase in the SMR values for these causes of death was found for the managers of small stations, along with an excess risk for laryngeal cancer. Managers of large stations, on the other hand, showed increased risks for bladder cancer, leukemia, and nervous system diseases. The exposure profile of small station workers can be the most easily characterized in terms of gasoline vapors and exhausts, while attendants in large stations were involved in other tasks besides refueling, such as mechanical, electrical, and tire repairing jobs. This difference could explain, at least partially, the different patterns of mortality observed.

Previous findings relating to risk excesses among filling station attendants stem from surveillance systems of occupational mortality or cancer incidence. Auto service and gasoline station workers in California (1959—1961) showed significantly elevated proportional mortality ratios (PMR) for oral cavity, lung, and testicular cancers (12). Among the service station owners and attendants in Washington State (1950—1979) elevated PMR values were found for cancers of the oral cavity, kidney, bladder, and testis and for aplastic anemia (13). In Massachusetts (1971—1973) a small increase in the PMR for leukemia was found for auto mechanics and gasoline station attendants (14). Service station workers in New Hampshire (1975—1985) showed increased mortality for leukemia, suicide, emphysema, and mental and psychoneurotic conditions (15). Owners of filling stations in Denmark, as defined on the basis of the 1970 Danish census, showed an increased incidence of kidney cancer over the period 1970—1980 (16). They were also found to be at increased risk of dying from respiratory cancers over the period 1970—1987 (17). A significantly

| Cause of death | Men | | | | | | Total | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | O | E | SMR | 90% CI | O | E | SMR | 90% CI | O | E | SMR | 90% CI |
| Malignant neoplasms (140—208) | 18 | 31.0 | 58 | 37—86 | 2 | 3.0 | 67 | 12—211 | 20 | 34.0 | 59 | 39—85 |
| Esophagus (150) | — | 0.5 | — | — | — | 0.0 | — | — | — | 0.5 | — | — |
| Colon (153) | 1 | 1.6 | 62 | 3—293 | — | 0.2 | — | — | 1 | 1.8 | 55 | 3—261 |
| Pancreas (157) | — | 1.1 | — | — | — | 0.1 | — | — | — | 1.3 | — | — |
| Larynx (161) | — | 0.9 | — | — | — | 0.9 | — | — | — | 1.2 | — | — |
| Lung (162) | 7 | 10.5 | 67 | 31—125 | — | 0.3 | — | — | 7 | 10.8 | 65 | 30—122 |
| Connective tissue (171) | — | 0.1 | — | — | — | 0.1 | — | — | — | 0.1 | — | — |
| Melanoma (172) | — | 0.3 | — | — | — | 0.3 | — | — | — | 0.3 | — | — |
| Bladder (186) | 2 | 1.4 | 139 | 25—437 | — | 0.1 | — | — | 2 | 1.5 | 134 | 24—423 |
| Kidney (187) | — | 0.7 | — | — | — | 0.7 | — | — | — | 0.7 | — | — |
| Nervous system (190—2) | 1 | 0.9 | 116 | 6—552 | — | 0.1 | — | — | 1 | 0.9 | 106 | 5—505 |
| Lymphomatosupertic (200—8) | 3 | 2.1 | 142 | 39—366 | — | 0.2 | — | — | 3 | 2.3 | 128 | 35—331 |
| Non-Hodgkin's lymphoma (200, 202) | 1 | 0.6 | 179 | 9—847 | — | 0.1 | — | — | 1 | 0.6 | 161 | 8—765 |
| Leukemia (204—8) | 2 | 1.0 | 196 | 35—617 | — | 0.1 | — | — | 2 | 1.1 | 177 | 31—557 |
| Blood (280—289) | — | 0.3 | — | — | — | 0.3 | — | — | — | 0.3 | — | — |
| Nervous system (320—359) | 3 | 1.3 | 231 | 83—596 | — | 0.2 | — | — | 3 | 1.5 | 204 | 56—527 |
| Circulatory system (390—459) | 27 | 34.0 | 80 | 56—110 | 4 | 3.1 | 129 | 44—296 | 31 | 37.1 | 84 | 61—113 |
| Respiratory system (460—519) | 7 | 5.5 | 127 | 59—238 | — | 0.3 | — | — | 7 | 5.9 | 120 | 56—225 |
| Accidents and violence (800—999) | 8 | 4.9 | 165 | 82—297 | 1 | 0.3 | 294 | 15—1395 | 9 | 5.2 | 173 | 90—302 |
| All causes (001—998) | 72 | 90.4 | 80 | 65—97 | 7 | 8.3 | 84 | 39—158 | 79 | 98.8 | 80 | 66—94 |

* Code of the International Classification of Diseases, IX revision, in parentheses.
increased standardized incidence ratio (SIR) for acute myeloid leukemia was found among Swedish gasoline station attendants, as of the 1970 census, followed-up over the period 1971—1984 (18). In the Montreal multisite, multiple-exposure case-referent study, exposure to automotive gasoline was associated with a significantly increased risk of stomach cancer, with a dose-response effect (19), while exposure to gasoline exhausts proved to be associated with excess risk of rectal cancer, also with a dose-response effect (20).

Further evidence about increased risk at different cancer sites in association with exposures relevant to filling station attendants (benzene, hydrocarbons, fuels, vehicle exhausts, and combustion products) was found in case-referent studies on leukemia (21—26), multiple myeloma (27—28), and esophageal cancer (29), laryngeal (30), bladder (31—35), kidney (19, 36—42) and lung (43—46) cancers. An excess risk of developing soft-tissue sarcomas for long-term occupational exposure to benzene and other solvents was reported in a case-referent study from northeastern Italy (47). Increasing risk with increasing level of exposure to benzene was found in a case-referent study in the United States on non-Hodgkin’s lymphoma (48). Excess risks for brain tumors have been associated with employment in petroleum refining (49). Finally, increased risks of kidney cancer, leukemia, and cancers of the larynx and prostate were found in a cohort of 23 306 British oil distribution workers (50).

Our findings essentially confirm previously reported excess risks, with the remarkable exclusion of kidney cancer, for which no death was recorded. The deficit in mortality from all causes, cardiovascular diseases, and respiratory diseases could be ascribed to the relatively low duration of the follow-up, and to the combination of factors generally referred to as the “healthy worker effect.” In spite of an increase in mortality from lung cancer, as reported in association with exposure to exhausts from engines operating on diesel fuel (3), we observed an SMR below the null value. The observed excesses of blood and nervous system diseases deserve attention, in view of the exposure to the hematological and neurological toxicants present in gasoline vapors.

A major drawback is that the power of this study, for most of the causes of interest, was low and the duration of the follow-up might have been insufficient for cancers that have a long induction period. Furthermore, because of the lack of information on employment termination dates, we did not examine the observed excess risks by length of employment, a usual proxy for duration of exposure. Lack of information about smoking habits and alcohol consumption is undoubtedly a weakness of this study. Nevertheless, mortality due to tobacco- and alcohol-related causes of death (lung cancer, respiratory diseases, and digestive diseases, particularly cirrhosis of the liver) was not increased in the cohort. Alcohol consumption is of major concern in relation to the observed increased risk of esophageal tumors. However, in the sample of current filling station attendants (9), only 27.3% of the subjects drank one glass of wine or more per day. In the Italian population in 1983, among men aged 30—60 years, there were 52.5% drinkers of a quarter liter or more of wine (51). Therefore, confounding from alcohol consumption, in respect of the association between exposure to gasoline vapors and esophageal cancer, seems unlikely.

In conclusion, filling station attendants are exposed to gasoline vapors containing aromatic hydrocarbons, including benzene. This group of workers seems at risk of cancer at various sites. The observed increased risks are consistent with the hazards to which they are exposed. Due to the power limitations of this study, a precise estimate of the risk for many causes of death is not achievable. Further cohort studies of greater size are warranted.

Acknowledgments

The technical assistance of Ms P Dell’Armi, Mr V Goffredo, and Ms M Tassi is gratefully acknowledged.

The study was partially funded by the Italian Ministry of Labour (contract 404/1990) and by the European Economic Community (contract EV5V-CT92—0221).

Preliminary results of this study were presented at the 9th International Symposium on Epidemiology in Occupational Health in Cincinnati, Ohio, on 23—25 September 1992.

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Received for publication: 20 January 1994