**ONLINE SUPPLEMENT**

**Title:** Particulate Air Pollution and Liver Cancer Survival

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**eTable 1**. Summary of demographic, clinical, treatment characteristics, and distances of residential addresses at diagnosis from highways and PM2.5 exposures for liver cancer patients newly diagnosed in California from 2000-2009, by PM2.5 concentration levelsa.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Characteristics  (Mean ± SD or %) | Low n=5,364 (26.5%) | Medium n=7,431 (36.7%) | High n=5,668 (28.0%) | Missingb n=1,758  (8.7%) | Total n=20,221 |
| Age at diagnosis (years) | 63.6±12.2 | 63.8±12.3 | 64.0±12.8 | 62.9±12.1 | 63.7±12.4 |
| Male | 76.0 | 74.2 | 74.0 | 78.8 | 75.0 |
| Race (%) | | | | | |
| Non-Hispanic whites | 45.8 | 36.6 | 29.0 | 59.8 | 38.9 |
| Hispanic | 19.0 | 26.4 | 32.9 | 22.0 | 25.9 |
| Non-Hispanic blacks | 7.2 | 7.2 | 9.9 | 5.1 | 7.8 |
| Asian/Pacific islanders | 26.5 | 28.7 | 27.5 | 9.0 | 26.1 |
| Others/Unknown | 1.5 | 1.0 | 0.6 | 4.0 | 1.3 |
| Marital status (%) | | | | | |
| Single | 19.3 | 18.1 | 18.0 | 22.2 | 18.7 |
| Married | 56.2 | 55.6 | 56.6 | 49.3 | 55.5 |
| Formerly married | 22.4 | 23.5 | 23.3 | 24.6 | 23.3 |
| Unknown | 2.1 | 2.7 | 2.2 | 3.9 | 2.5 |
| Rural-urban commuting area (%) | | | | | |
| Metropolitan core | 90.2 | 95.8 | 97.0 | 49.1 | 90.6 |
| Non-metropolitan core | 9.8 | 4.2 | 3.0 | 50.9 | 9.4 |
| Socioeconomic status (SES, %) | | | | | |
| Lowest | 13.1 | 19.4 | 30.1 | 19.4 | 20.7 |
| Lower-middle | 17.7 | 21.5 | 24.9 | 27.6 | 22.0 |
| Middle | 22.1 | 20.7 | 19.1 | 23.1 | 20.8 |
| Higher-middle | 23.8 | 20.5 | 15.5 | 17.2 | 19.7 |
| Highest | 22.6 | 17.1 | 10.3 | 12.1 | 16.2 |
| Unknown | 0.7 | 0.8 | 0.1 | 0.6 | 0.6 |
| Stage of diagnosis | | | | | |
| Local | 47.5 | 48.3 | 38.6 | 42.4 | 44.8 |
| Regional | 28.1 | 27.0 | 28.0 | 27.0 | 27.5 |
| Distant | 16.2 | 16.0 | 20.9 | 18.3 | 17.6 |
| Unknown c | 8.2 | 8.8 | 12.5 | 12.3 | 10.0 |
| First-course treatment types (%) | | | | | |
| Surgery | 24.6 | 25.9 | 15.3 | 18.7 | 21.9 |
| Radiation | 3.0 | 3.4 | 3.6 | 2.7 | 3.3 |
| Chemotherapy | 37.0 | 33.9 | 27.7 | 27.6 | 32.4 |
| Geocode match quality (%) | | | | | |
| Street address | 92.0 | 93.7 | 93.5 | 73.1 | 91.4 |
| Area-level | 8.0 | 6.3 | 6.5 | 26.5 | 8.6 |
| Other or missing | <0.1 | <0.1 | <0.1 | 0.4 | <0.1 |
| Distance to primary interstate highwayb | | | | | |
| < 300 m | 10.8 | 11.3 | 10.2 | 3.8 | 10.2 |
| 300 – 1500 m | 38.5 | 41.8 | 43.0 | 12.5 | 38.7 |
| >1500 m | 42.7 | 40.6 | 40.4 | 46.0 | 41.5 |
| % missing | 8.0 | 6.3 | 6.5 | 37.7 | 9.5 |
| Distance to primary US and State highwaysd | | | | | |
| < 300 m | 4.9 | 3.4 | 4.0 | 5.5 | 4.1 |
| 300 – 1500 m | 17.9 | 12.9 | 14.1 | 10.6 | 14.4 |
| >1500 m | 69.2 | 77.4 | 75.5 | 46.1 | 71.9 |
| % missing | 8.0 | 6.3 | 6.5 | 37.7 | 9.5 |

a Percentage of patients with exposure assignment available (requires a monitor for that pollutant ≤25 km from residential address and non-missing geocode).

b The categories of PM2.5 exposure were 0-10, 10-15, 15+µg/m3.

c Insufficient evidence available to assign a stage (e.g., patient dies before workup is complete, patient refuses diagnostic procedure, or limited workup is performed due to patient’s age or simultaneous contraindicating condition).

d Distance values are primarily missing for participants with poor geocode matches (worse than street address match).

**eTable 2**. Adjusted hazard ratios for all-cause mortality and liver cancer specific survival from pooled and stage-specific Cox proportional hazard models.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Hazard Ratio (95% confidence interval)c | | | | | | |
|  |  | Local | Regional | Distant | | Overall |
| All-cause mortality | Base modela | 1.41 (1.37 – 1.45) | 1.24 (1.20 – 1.28) | 1.02 (0.99 – 1.06) | 1.28 (1.26 – 1.31) | |
| Fully adjusted modelb | 1.31 (1.26 – 1.35) | 1.19 (1.14 – 1.23) | 1.05 (1.01 – 1.10) | 1.18 (1.16 – 1.20) | |
| Liver cancer specific survival | Base modela | 1.37 (1.32 – 1.42) | 1.24 (1.19 – 1.29) | 1.03 (0.99 – 1.07) | 1.27 (1.24 – 1.30) | |
| Fully adjusted modelb | 1.24 (1.19 – 1.30) | 1.19 (1.13 – 1.24) | 1.05 (1.00 – 1.10) | 1.15 (1.12 – 1.18) | |

a Adjusted for age, sex

b Adjusted for age, sex, race/ethnicity, marital status, socioeconomic status, rural–urban commuting area, distance to primary interstate highway, distance to primary US and state highways, month of diagnosis, year of diagnosis and initial treatments.  
c Hazard ratios are scaled to a 1 standard deviation increase in PM2.5 (equivalent to 5.0 µg/m3)

**eTable 3**. Sensitivity analysis for PM2.5: adjusteda all-cause mortality hazard ratios (and 95% confidence intervals) associated with a standard deviation (SD)b increase in PM2.5 exposure, from models stratified by stage at diagnosis (see Table 2) but with additional stratification by factors of interest.

|  |  |  |  |
| --- | --- | --- | --- |
| Stratifying factor | Local | Regional | Distant |
| Distance to closest air quality monitor |  |  |  |
| <5 km | 1.25 (1.17, 1.34) | 1.12 (1.05, 1.20) | 1.05 (0.97, 1.13) |
| 5-25 km | 1.33 (1.27, 1.38) | 1.22 (1.17, 1.28) | 1.05 (0.99, 1.10) |
| Highest quality geocode match (street-address) | 1.32 (1.27, 1.37) | 1.18 (1.14, 1.23) | 1.05 (1.01, 1.10) |
| Socioeconomic status (SES) |  |  |  |
| Lowest | 1.39 (1.28, 1.51) | 1.18 (1.09, 1.27) | 1.04 (0.96, 1.13) |
| Lower-middle | 1.24 (1.16, 1.33) | 1.14 (1.05, 1.24) | 1.06 (0.96, 1.16) |
| Middle | 1.38 (1.28, 1.48) | 1.18 (1.08, 1.28) | 1.06 (0.96, 1.16) |
| Higher-middle | 1.22 (1.13, 1.33) | 1.21 (1.10, 1.33) | 1.05 (0.96, 1.16) |
| Highest | 1.46 (1.32, 1.61) | 1.30 (1.16, 1.45) | 1.02 (0.90, 1.15) |
| Regions in California |  |  |  |
| Los Angeles County | 2.90 (2.60, 3.23) | 1.88 (1.66, 2.12) | 1.17 (1.02, 1.33) |
| San Francisco Bay Area | 1.52 (1.21, 1.88) | 1.61 (1.31, 1.97) | 1.08 (0.89, 1.31) |
| San Diego County | 2.79 (2.15, 3.61) | 2.05 (1.55, 2.70) | 1.35 (0.92, 1.99) |
| Other | 1.29 (1.23, 1.35) | 1.13 (1.07, 1.20) | 1.02 (0.96, 1.09) |

a Adjusted for age, sex, race/ethnicity, marital status, socioeconomic status, rural–urban commuting area, distance to primary interstate highway, distance to primary US and state highways, month of diagnosis, year of diagnosis and initial treatments.  
b Hazard ratios are scaled to a 1 standard deviation increase in PM2.5 (equivalent to 5.0 µg/m3)

**Information about the socioeconomic variable (SES):**

The area-level SES indicator developed by the CCR1-3 is a composite measure at the census block group level, based on census 2000 data and American Community Survey 2007-2011 5-year estimates, created through a principal components analysis that included the following census variables:

* Proportion with a blue-collar job,
* Proportion older than 16 years in the workforce without a job,
* Median household income,
* Percent below 200% poverty level,
* Median gross rent,
* Median value of owner-occupied houses, and
* Average years of education for individuals 25 years of age and older.

The SES composite score was calculated for all census block groups (n = 22,960) and were then ranked into quintiles resulting in five SES groups.

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