**Supplementary Material**

**Occupational exposure to extremely low frequency magnetic fields and brain tumour risks in the INTEROCC study**

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Supplementary Table S1. Description of ELF levels in the most frequent jobs in low (<0.12 µT), medium (0.12 -< 0.15 µT), and high (≥ 0.15 µT) ELF categories based on the 33rd, and 66th percentile of jobs among study participants.

|  |  |  |  |
| --- | --- | --- | --- |
| **ISCO88** | **Job Title** | **Frequency**  **(n)** | **GM**  **(µT)** |
| **Low** |  |  |  |
| 5220  4115  2230  2320  4222 | Shop salespersons and demonstrators  Secretaries  Nursing and midwifery professionals  Secondary education teaching professionals  Receptionists and information clerks | 1,721  1,699  732  603  490 | 0.117  0.103  0.119  0.074  0.115 |
| **Medium** |  |  |  |
| 4190  4121  3415  2331  4131 | Other office clerks  Accounting and bookkeeping clerks  Technical and commercial sales representatives  Primary education teaching professionals  Stock clerks | 1,218  712  598  503  417 | 0.130  0.128  0.126  0.140  0.149 |
| **High** |  |  |  |
| 9132  AA001  5122  5123  7233 | Helpers and cleaners in offices, hotels and other establishments  Military service  Cooks  Waiters, waitresses and bartenders  Agricultural- or industrial-machinery mechanics and fitters | 705  544  457  448  406 | 0.153-0.735  0.160  0.232  0.206  0.214-0.443 |
| **Maximum** |  |  |  |
| 8311 | Locomotive-engine drivers | 17 | 17.88 |

Note: ranges are provided where exposure was assigned based on a more specific ICSO68 code. For ISCO88 = 9132, the GM value of 0.153 µT corresponds to ISCO68 values of 5-31.30, 5-31.90, 5-32.90, 5-40.50, 5-52.20, 5-52.30, 5-52.90, 5-99.40; whereas the GM value of 0.735 µT correspond to a ISCO68 value of 9-99.10. For ISCO88 = 7233, the GM value of 0.214 µT corresponds to ISCO68 values of 7-00.50, 8-41.05, 8-41.10, 8-41.15, 8-41.25, 8-41.35, 8-41.40, 8-41.45, 8-41.50, 8-41.60, 8-41.65, 8-41.70, 8-41.75, 8-41.80, 8-41.90, 8-49.10, 8-49.15, 8-49.20, 8-49.35, 8-49.40, 8-49.45, 8-49.55, 8-49.60, 8-49.65, 8-49.70, 8-49.90, 9-82.30; whereas the GM value of 0.443 µT corresponds to a ISCO68 value of 8-51.90.

Supplementary Table S2. Distribution of cumulative (uT-years) and average (uT) occupational ELF exposure levels, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Exposure** | **n** | **Minimum** | **5th percentile** | **25th percentile** | **50th percentile** | **75th percentile** | **95th percentile** | **Maximum** |
| **Cumulative Exposure 1-Year Lag** | |  | | | | | | |
| Glioma Cases | 1,939 | 0.02 | 0.74 | 2.13 | 3.54 | 5.41 | 11.04 | 467.83 |
| Meningioma Cases | 1,822 | 0.05 | 0.76 | 2.06 | 3.33 | 5.09 | 11.68 | 715.93 |
| Controls | 5,404 | 0.03 | 0.82 | 2.11 | 3.40 | 5.00 | 9.95 | 609.38 |
| **Cumulative Exposure 1-4 Years** | |  | | | | | | |
| Glioma Cases | 1,636 | 0.01 | 0.14 | 0.38 | 0.48 | 0.64 | 1.28 | 71.51 |
| Meningioma Cases | 1,318 | 0.01 | 0.11 | 0.36 | 0.47 | 0.60 | 1.14 | 10.47 |
| Controls | 4,406 | 0.004 | 0.13 | 0.34 | 0.46 | 0.58 | 1.06 | 71.51 |
| **Average Exposure 1-Year Lag** | |  | | | | | | |
| Glioma Cases | 1,939 | 0.01 | 0.08 | 0.11 | 0.14 | 0.18 | 0.36 | 16.01 |
| Meningioma Cases | 1,822 | 0.01 | 0.08 | 0.11 | 0.13 | 0.17 | 0.49 | 16.27 |
| Controls | 5,404 | 0.01 | 0.07 | 0.11 | 0.13 | 0.17 | 0.34 | 17.29 |
| **Average Exposure 1-4 Years** | |  | | | | | | |
| Glioma Cases | 1,636 | 0.01 | 0.07 | 0.11 | 0.13 | 0.18 | 0.34 | 17.88 |
| Meningioma Cases | 1,318 | 0.004 | 0.07 | 0.11 | 0.12 | 0.16 | 0.29 | 2.62 |
| Controls | 4,406 | 0.001 | 0.07 | 0.10 | 0.12 | 0.15 | 0.28 | 17.88 |

Supplementary Table S3. Correlation between cumulative ELF in the three exposure time windows, 1-4, 5-9, and 10+ years prior to the date of diagnosis/reference date, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Time Windows** | | |
|  | **1-4 and 5-9** | **1-4 and 10+** | **5-9 and 10+** |
| Glioma | 0.95 | 0.38 | 0.47 |
| Meningioma | 0.35 | 0.05 | 0.71 |
| Controls | 0.83 | 0.37 | 0.63 |

Supplementary Table S4. Adjusted ORs (95% CIs)a for high- and low-grade glioma in relation to categorical indicators of cumulative occupational ELF exposure, overall and in selected separate exposure time windows, 1-4, 5-9, and 10+ years prior to the date of diagnosis/reference date, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **High-Grade Glioma** | | | **Low-Grade Glioma** | | |
| **Cumulative Exposure**  **(µT-years)** | **Cases** | **Controls** | **OR 95% CIa** | **Cases** | **Controls** | **OR 95% CIa** |
| **1-Year Lag** |  |  |  |  |  |  |
| < 2.11 | 290 | 1,286 | 1.00 (ref) | 177 | 1,151 | 1.00 (ref) |
| 2.11-< 3.40 | 303 | 1,294 | 0.98 (0.80, 1.19) | 145 | 1,127 | 1.02 (0.79, 1.33) |
| 3.40-< 5.00 | 312 | 1,319 | 0.88 (0.72, 1.08) | 127 | 1,122 | 1.07 (0.80, 1.45) |
| 5.00-<7.50 | 292 | 805 | 1.09 (0.87, 1.36) | 77 | 689 | 1.05 (0.74, 1.49) |
| 7.50+ | 148 | 537 | 0.77 (0.59, 1.00) | 49 | 472 | 0.93 (0.62, 1.39) |
| *p*-value trend |  |  | 0.11 |  |  | 0.72 |
|  |  |  |  |  |  |  |
| **1-4 Years** |  |  |  |  |  |  |
| < 0.34 | 227 | 1,083 | 1.00 (ref) | 102 | 891 | 1.00 (ref) |
| 0.34-< 0.46 | 226 | 992 | 1.19 (0.96, 1.47) | 112 | 834 | 1.25 (0.93, 1.68) |
| 0.46-< 0.58 | 303 | 1,112 | **1.52 (1.24**, **1.86)** | 122 | 971 | 1.27 (0.95, 1.70) |
| 0.58-<0.80 | 201 | 619 | **1.57 (1.25**, **1.97)** | 96 | 544 | **1.57 (1.14**, **2.16)** |
| 0.80+ | 153 | 430 | **1.63 (1.27**, **2.09)** | 83 | 359 | **1.93 (1.38**, **2.70)** |
| *p*-value trend |  |  | **<0.0001** |  |  | **<0.0001** |
|  |  |  |  |  |  |  |
| **5-9 Years** |  |  |  |  |  |  |
| < 0.45 | 245 | 1,091 | 1.00 (ref) | 109 | 936 | 1.00 (ref) |
| 0.45-< 0.59 | 263 | 1,097 | 1.10 (0.90, 1.34) | 125 | 915 | 1.20 (0.90, 1.59) |
| 0.59-< 0.77 | 342 | 1,244 | 1.23 (1.01, 1.48) | 145 | 1,041 | 1.23 (0.93, 1.62) |
| 0.77-<1.07 | 189 | 661 | 1.13 (0.90, 1.41) | 74 | 559 | 1.01 (0.73, 1.40) |
| 1.07+ | 139 | 439 | 1.21 (0.94, 1.55) | 64 | 362 | 1.23 (0.87, 1.75) |
| *p*-value trend |  |  | 0.16 |  |  | 0.48 |
|  |  |  |  |  |  |  |
| **10+ Years** |  |  |  |  |  |  |
| < 1.38 | 260 | 1,200 | 1.00 (ref) | 176 | 1,083 | 1.00 (ref) |
| 1.38-< 2.48 | 303 | 1,264 | 1.03 (0.84, 1.27) | 123 | 1,089 | 0.83 (0.62, 1.10) |
| 2.48-< 3.98 | 315 | 1,271 | 0.92 (0.74, 1.15) | 120 | 1,081 | 0.89 (0.65, 1.21) |
| 3.98-<6.23 | 263 | 785 | 0.97 (0.76, 1.25) | 61 | 667 | 0.80 (0.54, 1.19) |
| 6.23+ | 149 | 519 | 0.79 (0.59, 1.05) | 46 | 458 | 0.83 (0.54, 1.28) |
| *p*-value trend |  |  | 0.07 |  |  | 0.51 |

a OR estimated for each exposure time window separately using conditional logistic regression models stratified by country, region, sex, and 5-year age group at the reference date and adjusted for level of educational attainment. Cut-points from Tables 2 and 3 used here. Different numbers of cases/controls in different time windows due to the exclusion of participants from particular time windows where they reported not being employed and glioma cases with unknown tumour grade. Tests for linear trend used Wald *x*2 tests, with categorical medians modeled as ordinal variables.

Supplementary Table S5. Adjusted ORs (95% CIs)a for glioma and meningioma in relation to categorical indicators of time-weighted average occupational ELF exposure in three separate exposure time windows, 1-4, 5-9, and 10+ years prior to the date of diagnosis/reference date, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom**.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Exposure Metric** | **Glioma** | | | **Meningioma** | | |
| **Average Exposure (µT)** | **Cases** | **Controls** | **OR 95% CIa** | **Cases** | **Controls** | **OR 95% CIa** |
| **1-4 Years** |  |  |  |  |  |  |
| < 0.11 | 426 | 1,281 | 1.00 (ref) | 377 | 1,226 | 1.00 (ref) |
| 0.11-< 0.13 | 390 | 1,122 | 1.06 (0.90, 1.25) | 347 | 1,075 | 1.07 (0.90, 1.28) |
| 0.13-<0.17 | 379 | 1,006 | 1.07 (0.90, 1.26) | 302 | 945 | 1.13 (0.94, 1.35) |
| 0.17-<0.24 | 286 | 605 | **1.24 (1.03**, **1.49)** | 196 | 571 | 1.24 (1.00, 1.53) |
| 0.24+ | 155 | 324 | 1.18 (0.93, 1.48) | 96 | 313 | 1.12 (0.85, 1.47) |
| *p*-value trend |  |  | 0.07 |  |  | 0.24 |
|  |  |  |  |  |  |  |
| **5-9 Years** |  |  |  |  |  |  |
| < 0.11 | 439 | 1,315 | 1.00 (ref) | 418 | 1,258 | 1.00 (ref) |
| 0.11-< 0.13 | 403 | 1,175 | 1.05 (0.89, 1.23) | 393 | 1,129 | 1.04 (0.88, 1.23) |
| 0.13-<0.17 | 408 | 1,060 | 1.08 (0.91, 1.27) | 337 | 1,013 | 1.08 (0.91, 1.29) |
| 0.17-<0.24 | 292 | 707 | 1.10 (0.92, 1.32) | 207 | 668 | 1.02 (0.83, 1.25) |
| 0.24+ | 165 | 367 | 1.08 (0.86, 1.35) | 103 | 351 | 0.94 (0.73, 1.22) |
| *p*-value trend |  |  | 0.47 |  |  | 0.57 |
|  |  |  |  |  |  |  |
| **10+ Years** |  |  |  |  |  |  |
| < 0.11 | 411 | 1,211 | 1.00 (ref) | 406 | 1,174 | 1.00 (ref) |
| 0.11-< 0.13 | 391 | 1,198 | 0.97 (0.82, 1.14) | 397 | 1,169 | 0.97 (0.82, 1.15) |
| 0.13-<0.17 | 497 | 1,366 | 0.93 (0.80, 1.10) | 486 | 1,301 | 1.18 (1.00, 1.39) |
| 0.17-<0.24 | 318 | 834 | 0.93 (0.78, 1.12) | 269 | 793 | 1.09 (0.90, 1.32) |
| 0.24+ | 215 | 567 | 0.83 (0.68, 1.02) | 214 | 531 | 1.13 (0.91, 1.39) |
| *p*-value trend |  |  | 0.08 |  |  | 0.24 |

a OR estimated for each exposure time window separately using conditional logistic regression models stratified by country, region, sex, and 5-year age group at the reference date and adjusted for level of educational attainment. Cut points based on the 25th, 50th, 75th, and, 90th percentile of the overall control population´s exposure distribution. Different numbers of cases/controls in different time windows due to the exclusion of participants from particular time windows where they reported not being employed. Tests for linear trend used Wald *x*2 tests, with categorical medians modeled as ordinal variables.

Supplementary Table S6. Adjusted ORs (95% CIs)a for glioma and meningioma in relation to categorical indicators of maximum ELF exposed job in three separate exposure time windows, 1-4, 5-9, and 10+ years prior to the date of diagnosis/reference date, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Exposure Metric** | **Glioma** | | | **Meningioma** | | |
| **Maximum Exposed Job (µT)** | **Cases** | **Controls** | **OR 95% CIa** | **Cases** | **Controls** | **OR 95% CIa** |
| **1-4 Years** |  |  |  |  |  |  |
| < 0.13 | 748 | 2,209 | 1.00 (ref) | 677 | 2,116 | 1.00 (ref) |
| 0.13-< 0.17 | 361 | 983 | 1.03 (0.88, 1.19) | 297 | 939 | 1.09 (0.93, 1.29) |
| 0.17-< 0.23 | 278 | 614 | 1.17 (0.99, 1.39) | 175 | 572 | 1.05 (0.86, 1.28) |
| 0.23-<0.62 | 192 | 431 | 1.12 (0.92, 1.36) | 121 | 406 | 1.05 (0.83, 1.32) |
| 0.62+ | 57 | 101 | 1.18 (0.83, 1.68) | 48 | 97 | **1.57 (1.07**, **2.32)** |
| *p*-value trend |  |  | 0.19 |  |  | **0.03** |
|  |  |  |  |  |  |  |
| **5-9 Years** |  |  |  |  |  |  |
| < 0.13 | 754 | 2,273 | 1.00 (ref) | 737 | 2,191 | 1.00 (ref) |
| 0.13-< 0.17 | 395 | 1,037 | 1.09 (0.94, 1.26) | 345 | 998 | 1.13 (0.96, 1.32) |
| 0.17-< 0.23 | 281 | 701 | 1.05 (0.89, 1.24) | 205 | 654 | 1.07 (0.89, 1.30) |
| 0.23-<0.62 | 205 | 482 | 1.08 (0.89, 1.31) | 114 | 451 | 0.81 (0.64, 1.02) |
| 0.62+ | 72 | 131 | 1.22 (0.89, 1.67) | 57 | 125 | 1.41 (0.99, 2.00) |
| *p*-value trend |  |  | 0.21 |  |  | 0.27 |
|  |  |  |  |  |  |  |
| **10-Year Lag** |  |  |  |  |  |  |
| < 0.13 | 511 | 1,498 | 1.00 (ref) | 525 | 1,466 | 1.00 (ref) |
| 0.13-< 0.17 | 451 | 1,244 | 0.93 (0.79, 1.08) | 442 | 1,198 | 1.12 (0.96, 1.31) |
| 0.17-< 0.23 | 381 | 1,121 | **0.79 (0.67**, **0.93)** | 340 | 1,066 | 1.04 (0.88, 1.22) |
| 0.23-<0.62 | 309 | 810 | **0.83 (0.70**, **0.99)** | 248 | 756 | 1.07 (0.89, 1.30) |
| 0.62+ | 180 | 503 | **0.70 (0.57**, **0.87)** | 217 | 482 | 1.20 (0.98, 1.48) |
| *p*-value trend |  |  | **0.003** |  |  | 0.15 |

a OR estimated for each exposure time window separately using conditional logistic regression models stratified by country, region, sex, and 5-year age group at the reference date and adjusted for level of educational attainment. Cut points based on the 25th, 50th, 75th, and, 90th percentile of the overall control population´s exposure distribution. Different numbers of cases/controls in different time windows due to the exclusion of participants from particular time windows where they reported not being employed. Tests for linear trend used Wald *x*2 tests, with categorical medians modeled as ordinal variables.

Supplementary Table S7. Adjusted ORs (95% CIs)a for glioma in relation to categorical indicators of cumulative occupational ELF exposure in the 1-4 year time window prior to the date of diagnosis/reference date, adjusting for occupational BAP and PAH chemical exposure, INTEROCC study, 2000-2004, Australia, Canada, France, Germany, Israel, New Zealand, and United Kingdom

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Cumulative Exposure (µT-years) 1-4 Years** | **Cases** | **Controls** | **OR 95% CIa** |  | **Cases** | **Controls** | **OR 95% CIa** |
|  | Overall Results | | |  | Overall Results | | |
| < 0.34 | 132 | 340 | 1.00 (ref) |  | 136 | 345 | 1.00 (ref) |
| 0.34-< 0.46 | 99 | 266 | 0.93 (0.67, 1.28) |  | 98 | 275 | 0.87 (0.63, 1.21) |
| 0.46-< 0.58 | 120 | 306 | 1.01 (0.74, 1.38) |  | 126 | 311 | 1.04 (0.76, 1.41) |
| 0.58-<0.80 | 100 | 195 | 1.21 (0.87, 1.70) |  | 101 | 198 | 1.19 (0.85, 1.65) |
| 0.80+ | 93 | 148 | **1.51 (1.07**, **2.15)** |  | 95 | 152 | **1.49 (1.06**, **2.11)** |
| *p*-value trend |  |  | **0.006** |  |  |  | **0.006** |
|  | +BAP | | |  | +PAH | | |
| < 0.34 | 132 | 340 | 1.00 (ref) |  | 136 | 345 | 1.00 (ref) |
| 0.34-< 0.46 | 99 | 266 | 0.97 (0.70, 1.34) |  | 98 | 275 | 0.91 (0.66, 1.26) |
| 0.46-< 0.58 | 120 | 306 | 1.04 (0.76, 1.42) |  | 126 | 311 | 1.06 (0.78, 1.44) |
| 0.58-<0.80 | 100 | 195 | 1.33 (0.94, 1.88) |  | 101 | 198 | 1.30 (0.93, 1.83) |
| 0.80+ | 93 | 148 | **1.63 (1.15**, **2.33)** |  | 95 | 152 | **1.62 (1.14**, **2.30)** |
| *p*-value trend |  |  | **0.002** |  |  |  | **0.001** |

a OR estimated using conditional logistic regression models stratified by country, region, sex, and 5-year age group at the reference date and adjusted for level of educational attainment. Cut-points from Table 3 used here. Sample size reduced due to exclusion of subjects with uncertain BAP or PAH exposure (with a probability of exposure >5 but <25%). Tests for linear trend used Wald *x*2 tests, with categorical medians modeled as ordinal variables.