

# Shift work, work time control, and informal caregiving as risk factors for sleep disturbances in an ageing municipal workforce <sup>1</sup>

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1. *Supplementary material*

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**Supplementary table S1.** Descriptive statistics at the first survey point for fixed-effect analysis in FPS and FIREA studies

|                                             | FPS study (n=24,418) |               | FIREA study (n=2,838) |             |
|---------------------------------------------|----------------------|---------------|-----------------------|-------------|
|                                             | Women (n=19,709)     | Men (n=4,709) | Women (n=2,274)       | Men (n=564) |
| Age, mean (SD) years                        | 55.0 (3.6)           | 55.0 (3.8)    | 62.4 (1.2)            | 62.5 (1.3)  |
| Socioeconomic status, n (%): high           | 7,578 (38.5)         | 2,248 (47.7)  | 743 (32.7)            | 289 (51.2)  |
| intermediate                                | 5,244 (26.6)         | 1,156 (24.6)  | 787 (34.6)            | 104 (18.4)  |
| low                                         | 6,887 (34.9)         | 1,305 (27.7)  | 744 (32.7)            | 171 (30.3)  |
| Shift work, n (%): no                       | 15,353 (81.2)        | 3,684 (86.3)  | 1,531 (75.9)          | 430 (91.1)  |
| yes, without nights                         | 2,370 (12.5)         | 325 (7.6)     | 296 (14.7)            | 21 (4.5)    |
| yes, with nights                            | 1,190 (6.3)          | 262 (6.1)     | 189 (9.4)             | 21 (4.5)    |
| Informal caregiving, n (%): no              | 16,290 (83.4)        | 4,114 (88.4)  | 1,849 (82.6)          | 473 (86.5)  |
| yes                                         | 3,242 (16.6)         | 542 (11.6)    | 390 (17.4)            | 74 (13.5)   |
| Work time control (WTC), n (%): high        | 9,735 (49.8)         | 2,696 (57.7)  | 889 (49.4)            | 287 (61.7)  |
| low                                         | 9,822 (50.2)         | 1,980 (42.3)  | 909 (50.6)            | 178 (38.3)  |
| Any sleep disturbances, n (%): no           | 13,648 (69.6)        | 3,584 (76.7)  | 1,618 (71.6)          | 436 (78.0)  |
| yes                                         | 5,966 (30.4)         | 1,090 (23.3)  | 642 (28.4)            | 123 (22.0)  |
| Difficulty in falling asleep, n (%): no     | 18,327 (94.2)        | 4,455 (95.8)  | 2,140 (95.7)          | 537 (97.5)  |
| yes                                         | 1,133 (5.8)          | 197 (4.2)     | 97 (4.3)              | 14 (2.5)    |
| Frequent awakenings, n (%): no              | 14,575 (75.1)        | 3,782 (81.8)  | 1,675 (74.9)          | 436 (79.7)  |
| yes                                         | 4,825 (24.9)         | 844 (18.2)    | 562 (25.1)            | 111 (20.3)  |
| Early awakenings, n (%): no                 | 16,437 (84.6)        | 4,074 (87.8)  | 1,948 (88.0)          | 485 (89.2)  |
| yes                                         | 2,992 (15.4)         | 568 (12.2)    | 267 (12.1)            | 59 (10.9)   |
| Feeling tired after normal sleep, n (%): no | 16,741 (85.9)        | 4,148 (89.1)  | 2,037 (91.2)          | 521 (95.1)  |
| yes                                         | 2,748 (14.1)         | 506 (10.9)    | 197 (8.8)             | 27 (4.9)    |
| Physical activity, n (%): intermediate/high | 12,161 (62.0)        | 2,986 (64.0)  | 1,420 (63.0)          | 355 (64.1)  |
| low                                         | 7,443 (38.0)         | 1,678 (36.0)  | 835 (37.0)            | 199 (35.9)  |
| Overweight/obesity, n (%): no               | 8,906 (47.5)         | 1,457 (32.2)  | 939 (42.2)            | 165 (29.9)  |
| yes                                         | 9,828 (52.5)         | 3,064 (67.8)  | 1,288 (57.8)          | 387 (70.1)  |
| Smoking, n (%): no                          | 16,693 (86.5)        | 3,853 (83.4)  | 2,013 (90.8)          | 497 (89.4)  |
| yes                                         | 2,617 (13.6)         | 768 (16.6)    | 205 (9.2)             | 59 (10.6)   |
| Risky alcohol use, n (%): no                | 17,965 (91.6)        | 4,248 (91.1)  | 2,073 (91.6)          | 491 (87.8)  |
| yes                                         | 1,644 (8.4)          | 413 (8.9)     | 190 (8.4)             | 68 (12.2)   |
| Self-rated health, n (%): optimal           | 13,815 (70.6)        | 3,260 (69.8)  | 1,808 (79.7)          | 427 (76.8)  |
| non-optimal                                 | 5,757 (29.4)         | 1,413 (30.2)  | 460 (20.3)            | 129 (23.2)  |

**Supplementary table S2.** Study-specific results from within-individual analyses of the association of shift work, work time control (WTC) and informal caregiving with sleep disturbances, and heterogeneity estimates from meta-analyses pooling FPS and FIREA data

|                                       | FPS study |             |       | FIREA study |               |      | Meta-analysis      |         |
|---------------------------------------|-----------|-------------|-------|-------------|---------------|------|--------------------|---------|
|                                       | OR        | (95% CI)    | n     | OR          | 95% CI        | n    | I <sup>2</sup> (%) | P value |
| Outcome: any sleep disturbances       |           |             |       |             |               |      |                    |         |
| Shift work without nights vs day work | 1.13      | (0.85-1.50) | 14679 | 1.29        | (0.36- 4.58)  | 947  | 0.0                | 0.842   |
| Shift work with nights vs day work    | 1.30      | (0.87-1.93) | 14679 | 1.08        | (0.25- 4.74)  | 947  | 0.0                | 0.812   |
| Low WTC vs high                       | 1.19      | (1.07-1.32) | 15667 | 1.04        | (0.68- 1.60)  | 937  | 0.0                | 0.549   |
| Informal caregiving vs not            | 1.15      | (1.02-1.29) | 15578 | 0.92        | (0.60- 1.42)  | 1562 | 0.0                | 0.327   |
| Cumulative exposure                   |           |             |       |             |               |      |                    |         |
| 1 risk factor vs 0                    | 1.12      | (1.00-1.25) | 14400 | 1.04        | (0.68- 1.60)  | 872  | 0.0                | 0.743   |
| 2-3 risk factors vs 0                 | 1.30      | (1.10-1.53) | 14400 | 0.90        | (0.42- 1.93)  | 872  | 0.0                | 0.356   |
| Outcome: difficulty in falling asleep |           |             |       |             |               |      |                    |         |
| Shift work without nights vs day work | 1.58      | (0.95-2.63) | 4031  | 2.34        | (0.26- 21.41) | 195  | 0.0                | 0.734   |
| Shift work with nights vs day work    | 1.62      | (0.80-3.27) | 4031  | 0.71        | (0.07- 7.54)  | 195  | 0.0                | 0.508   |
| Low WTC vs high                       | 1.29      | (1.06-1.56) | 4339  | 1.46        | (0.53- 4.05)  | 206  | 0.0                | 0.815   |
| Informal caregiving vs not            | 1.28      | (1.02-1.60) | 4306  | 1.14        | (0.40- 3.26)  | 317  | 0.0                | 0.832   |
| Cumulative exposure                   |           |             |       |             |               |      |                    |         |
| 1 risk factor vs 0                    | 1.13      | (0.91-1.41) | 3931  | 0.96        | (0.29- 3.18)  | 182  | 0.0                | 0.793   |
| 2-3 risk factors vs 0                 | 1.66      | (1.22-2.26) | 3931  | 1.40        | (0.28- 7.02)  | 182  | 0.0                | 0.839   |
| Outcome: frequent awakenings          |           |             |       |             |               |      |                    |         |
| Shift work without nights vs day work | 1.07      | (0.79-1.45) | 12627 | 1.25        | (0.33- 4.69)  | 871  | 0.0                | 0.823   |
| Shift work with nights vs day work    | 1.21      | (0.78-1.88) | 12627 | 0.84        | (0.19- 3.66)  | 871  | 0.0                | 0.643   |
| Low WTC vs high                       | 1.22      | (1.09-1.37) | 13462 | 0.79        | (0.50- 1.24)  | 851  | 69.8               | 0.069   |
| Informal caregiving vs not            | 1.13      | (1.00-1.28) | 13399 | 0.92        | (0.59- 1.44)  | 1467 | 0.0                | 0.384   |
| Cumulative exposure                   |           |             |       |             |               |      |                    |         |
| 1 risk factor vs 0                    | 1.09      | (0.96-1.23) | 12392 | 0.81        | (0.52- 1.26)  | 803  | 37.6               | 0.205   |
| 2-3 risk factors vs 0                 | 1.31      | (1.09-1.56) | 12392 | 0.67        | (0.30- 1.51)  | 803  | 60.3               | 0.112   |
| Outcome: early awakenings             |           |             |       |             |               |      |                    |         |
| Shift work without nights vs day work | 1.28      | (0.91-1.82) | 9513  | 0.85        | (0.15- 4.74)  | 500  | 0.0                | 0.649   |
| Shift work with nights vs day work    | 1.34      | (0.82-2.22) | 9513  | 0.84        | (0.13- 5.27)  | 500  | 0.0                | 0.633   |
| Low WTC vs high                       | 1.27      | (1.12-1.45) | 10208 | 1.05        | (0.56- 1.94)  | 501  | 0.0                | 0.557   |
| Informal caregiving vs not            | 1.20      | (1.04-1.38) | 10154 | 1.28        | (0.72- 2.27)  | 809  | 0.0                | 0.831   |
| Cumulative exposure                   |           |             |       |             |               |      |                    |         |
| 1 risk factor vs 0                    | 1.12      | (0.98-1.29) | 9334  | 0.85        | (0.46- 1.57)  | 466  | 0.0                | 0.390   |
| 2-3 risk factors vs 0                 | 1.44      | (1.18-1.76) | 9334  | 1.08        | (0.38- 3.05)  | 466  | 0.0                | 0.595   |
| Outcome: non-restorative sleep        |           |             |       |             |               |      |                    |         |
| Shift work without nights vs day work | 1.19      | (0.84-1.70) | 8713  | 0.24        | (0.02- 2.35)  | 343  | 41.1               | 0.193   |
| Shift work with nights vs day work    | 1.16      | (0.68-2.00) | 8713  | 0.12        | (0.01- 2.71)  | 343  | 58.8               | 0.119   |
| Low WTC vs high                       | 1.47      | (1.29-1.69) | 9386  | 1.62        | (0.77- 3.40)  | 354  | 0.0                | 0.801   |
| Informal caregiving vs not            | 1.18      | (1.02-1.36) | 9332  | 1.54        | (0.72- 3.29)  | 548  | 0.0                | 0.500   |
| Cumulative exposure                   |           |             |       |             |               |      |                    |         |
| 1 risk factor vs 0                    | 1.37      | (1.18-1.60) | 8567  | 1.72        | (0.79- 3.72)  | 322  | 0.0                | 0.572   |
| 2-3 risk factors vs 0                 | 1.60      | (1.30-1.97) | 8567  | 1.94        | (0.55- 6.91)  | 322  | 0.0                | 0.768   |

**Supplementary table S3.** Study-specific results from between-individuals analyses of the association of shift work, work time control (WTC) and informal caregiving with sleep disturbances, and heterogeneity estimates from meta-analyses pooling FPS and FIREA data

|                                       | FPS study       |                       |                               |                             |                               |                             | FIREA study     |                     |                               |                             |                               |                             | Meta-analysis      |         |
|---------------------------------------|-----------------|-----------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|-----------------|---------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|--------------------|---------|
|                                       | OR <sup>a</sup> | (95% CI) <sup>a</sup> | N <sub>exposed</sub><br>cases | N <sub>exposed</sub><br>all | N <sub>exposed</sub><br>cases | N <sub>exposed</sub><br>all | OR <sup>a</sup> | 95% CI <sup>a</sup> | N <sub>exposed</sub><br>cases | N <sub>exposed</sub><br>all | N <sub>exposed</sub><br>cases | N <sub>exposed</sub><br>all | I <sup>2</sup> (%) | P value |
| Outcome: any sleep disturbances       |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| Shift work without nights vs day work | 1.01            | (0.90- 1.14)          | 435                           | 2355                        | 3070                          | 17921                       | 1.73            | (1.21-2.47)         | 50                            | 270                         | 206                           | 1787                        | 87.3               | 0.005   |
| Shift work with nights vs day work    | 0.93            | (0.80- 1.08)          | 231                           | 1339                        | 3070                          | 17921                       | 0.58            | (0.32-1.05)         | 13                            | 183                         | 206                           | 1787                        | 56.2               | 0.131   |
| Low WTC vs average/high               | 1.20            | (1.12- 1.30)          | 1310                          | 6799                        | 2583                          | 15761                       | 1.04            | (0.79-1.37)         | 114                           | 934                         | 135                           | 1178                        | 0.0                | 0.325   |
| Informal caregiving vs not            | 1.16            | (1.05- 1.27)          | 664                           | 3429                        | 3240                          | 19095                       | 0.93            | (0.67-1.29)         | 49                            | 429                         | 286                           | 2375                        | 38.0               | 0.204   |
| Cumulative exposure                   |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| 1 risk factor vs 0                    | 1.16            | (1.07- 1.25)          | 1699                          | 9472                        | 1295                          | 8339                        | 1.00            | (0.77-1.28)         | 117                           | 992                         | 171                           | 1456                        | 16.5               | 0.274   |
| 2-3 risk factors vs 0                 | 1.25            | (1.12- 1.39)          | 695                           | 3554                        | 1295                          | 8339                        | 1.14            | (0.81-1.61)         | 52                            | 390                         | 171                           | 1456                        | 0.0                | 0.616   |
| P-value for trend                     | <0.0001         |                       |                               |                             |                               |                             | 0.55            |                     |                               |                             |                               |                             |                    |         |
| Outcome: difficulty in falling asleep |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| Shift work without nights vs day work | 1.41            | (1.08- 1.85)          | 74                            | 2335                        | 348                           | 17802                       | 2.30            | (0.79-6.69)         | 5                             | 263                         | 13                            | 1770                        | 0.0                | 0.384   |
| Shift work with nights vs day work    | 1.49            | (1.07- 2.08)          | 45                            | 1333                        | 348                           | 17802                       | 1.23            | (0.23-6.61)         | 2                             | 182                         | 13                            | 1770                        | 0.0                | 0.826   |
| Low WTC vs average/high               | 1.25            | (1.03- 1.51)          | 174                           | 6751                        | 323                           | 15659                       | 0.53            | (0.20-1.45)         | 7                             | 919                         | 13                            | 1171                        | 64.0               | 0.096   |
| Informal caregiving vs not            | 1.14            | (0.90- 1.44)          | 86                            | 3407                        | 414                           | 18968                       | 0.73            | (0.26-2.07)         | 4                             | 428                         | 28                            | 2343                        | 0.0                | 0.411   |
| Cumulative exposure                   |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| 1 risk factor vs 0                    | 1.42            | (1.13- 1.79)          | 216                           | 9398                        | 130                           | 8295                        | 0.52            | (0.23-1.18)         | 8                             | 976                         | 19                            | 1442                        | 81.4               | 0.020   |
| 2-3 risk factors vs 0                 | 1.87            | (1.43- 2.45)          | 114                           | 3531                        | 130                           | 8295                        | 0.69            | (0.24-1.98)         | 5                             | 386                         | 19                            | 1442                        | 68.9               | 0.073   |
| P-value for trend                     | <0.0001         |                       |                               |                             |                               |                             | 0.29            |                     |                               |                             |                               |                             |                    |         |
| Outcome: frequent awakenings          |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| Shift work without nights vs day work | 0.97            | (0.85- 1.10)          | 318                           | 2327                        | 2262                          | 17694                       | 1.83            | (1.25-2.69)         | 42                            | 267                         | 166                           | 1766                        | 89.4               | 0.002   |
| Shift work with nights vs day work    | 0.95            | (0.80- 1.12)          | 178                           | 1323                        | 2262                          | 17694                       | 0.67            | (0.36-1.26)         | 12                            | 180                         | 166                           | 1766                        | 10.2               | 0.291   |
| Low WTC vs high                       | 1.19            | (1.09- 1.30)          | 965                           | 6701                        | 1905                          | 15575                       | 1.05            | (0.77-1.42)         | 92                            | 920                         | 109                           | 1164                        | 0.0                | 0.441   |
| Informal caregiving vs not            | 1.16            | (1.05- 1.29)          | 497                           | 3395                        | 2381                          | 18844                       | 0.89            | (0.62-1.28)         | 39                            | 427                         | 235                           | 2343                        | 47.4               | 0.168   |
| Cumulative exposure                   |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |
| 1 risk factor vs 0                    | 1.10            | (1.01- 1.21)          | 1240                          | 9363                        | 965                           | 8227                        | 0.95            | (0.72-1.26)         | 92                            | 986                         | 141                           | 1435                        | 0.0                | 0.328   |
| 2-3 risk factors vs 0                 | 1.21            | (1.08- 1.37)          | 524                           | 3511                        | 965                           | 8227                        | 1.21            | (0.84-1.75)         | 44                            | 382                         | 141                           | 1435                        | 0.0                | 1.000   |
| P-value for trend                     | 0.001           |                       |                               |                             |                               |                             | 0.52            |                     |                               |                             |                               |                             |                    |         |
| Table continues                       |                 |                       |                               |                             |                               |                             |                 |                     |                               |                             |                               |                             |                    |         |

Table continued

Outcome: early awakenings

|                                       |      |              |     |      |      |       |      |             |    |     |    |      |      |       |
|---------------------------------------|------|--------------|-----|------|------|-------|------|-------------|----|-----|----|------|------|-------|
| Shift work without nights vs day work | 1.06 | (0.90- 1.25) | 184 | 2323 | 1257 | 17766 | 2.45 | (1.35-4.45) | 18 | 266 | 51 | 1767 | 85.8 | 0.008 |
| Shift work with nights vs day work    | 1.03 | (0.83- 1.28) | 103 | 1320 | 1257 | 17766 | 0.90 | (0.34-2.42) | 5  | 180 | 51 | 1767 | 0.0  | 0.792 |
| Low WTC vs high                       | 1.28 | (1.15- 1.43) | 572 | 6730 | 1038 | 15615 | 1.17 | (0.71-1.92) | 35 | 917 | 34 | 1168 | 0.0  | 0.729 |
| Informal caregiving vs not            | 1.19 | (1.04- 1.36) | 284 | 3398 | 1333 | 18913 | 1.14 | (0.64-2.01) | 17 | 429 | 81 | 2334 | 0.0  | 0.886 |

Cumulative exposure

|                       |         |              |     |      |     |      |      |             |    |     |    |      |     |       |
|-----------------------|---------|--------------|-----|------|-----|------|------|-------------|----|-----|----|------|-----|-------|
| 1 risk factor vs 0    | 1.22    | (1.08- 1.37) | 700 | 9385 | 503 | 8272 | 1.11 | (0.69-1.79) | 35 | 980 | 45 | 1433 | 0.0 | 0.706 |
| 2-3 risk factors vs 0 | 1.47    | (1.26- 1.71) | 315 | 3507 | 503 | 8272 | 1.49 | (0.84-2.62) | 19 | 384 | 45 | 1433 | 0.0 | 0.964 |
| P-value for trend     | <0.0001 |              |     |      |     |      | 0.21 |             |    |     |    |      |     |       |

Outcome: non-restorative sleep

|                                       |      |              |     |      |      |       |      |             |    |     |    |      |      |       |
|---------------------------------------|------|--------------|-----|------|------|-------|------|-------------|----|-----|----|------|------|-------|
| Shift work without nights vs day work | 0.99 | (0.83- 1.18) | 166 | 2337 | 1155 | 17819 | 2.10 | (1.01-4.33) | 11 | 267 | 37 | 1775 | 74.2 | 0.049 |
| Shift work with nights vs day work    | 0.81 | (0.64- 1.03) | 80  | 1329 | 1155 | 17819 | n.a. | n.a.        | 18 | 924 | 30 | 1170 | n.a. | n.a.  |
| Low WTC vs high                       | 1.36 | (1.21- 1.52) | 535 | 6756 | 933  | 15667 | 0.72 | (0.39-1.33) | 7  | 427 | 52 | 2349 | 74.9 | 0.046 |
| Informal caregiving vs not            | 1.25 | (1.09- 1.44) | 269 | 3415 | 1198 | 18974 | 0.73 | (0.33-1.60) |    |     |    |      | 42.2 | 0.188 |

Cumulative exposure

|                       |        |              |     |      |     |      |      |             |    |     |    |      |      |       |
|-----------------------|--------|--------------|-----|------|-----|------|------|-------------|----|-----|----|------|------|-------|
| 1 risk factor vs 0    | 1.18   | (1.04- 1.34) | 635 | 9420 | 466 | 8289 | 0.98 | (0.57-1.69) | 21 | 983 | 32 | 1441 | 0.0  | 0.514 |
| 2-3 risk factors vs 0 | 1.34   | (1.14- 1.58) | 278 | 3528 | 466 | 8289 | 0.82 | (0.36-1.87) | 7  | 386 | 32 | 1441 | 23.9 | 0.252 |
| P-value for trend     | 0.0002 |              |     |      |     |      | 0.68 |             |    |     |    |      |      |       |

<sup>a</sup>Adjusted for age, sex and socioeconomic status.

Note. N<sub>exposed cases</sub> is the number of cases among the exposed group and N<sub>exposed all</sub> is the total number of participants among the exposed group.

**Supplementary table S4.** Study-specific results from within-individual analyses of the association of shift work and informal caregiving with sleep disturbances by the level of work time control (WTC), and heterogeneity estimates from meta-analyses pooling FPS and FIREA data

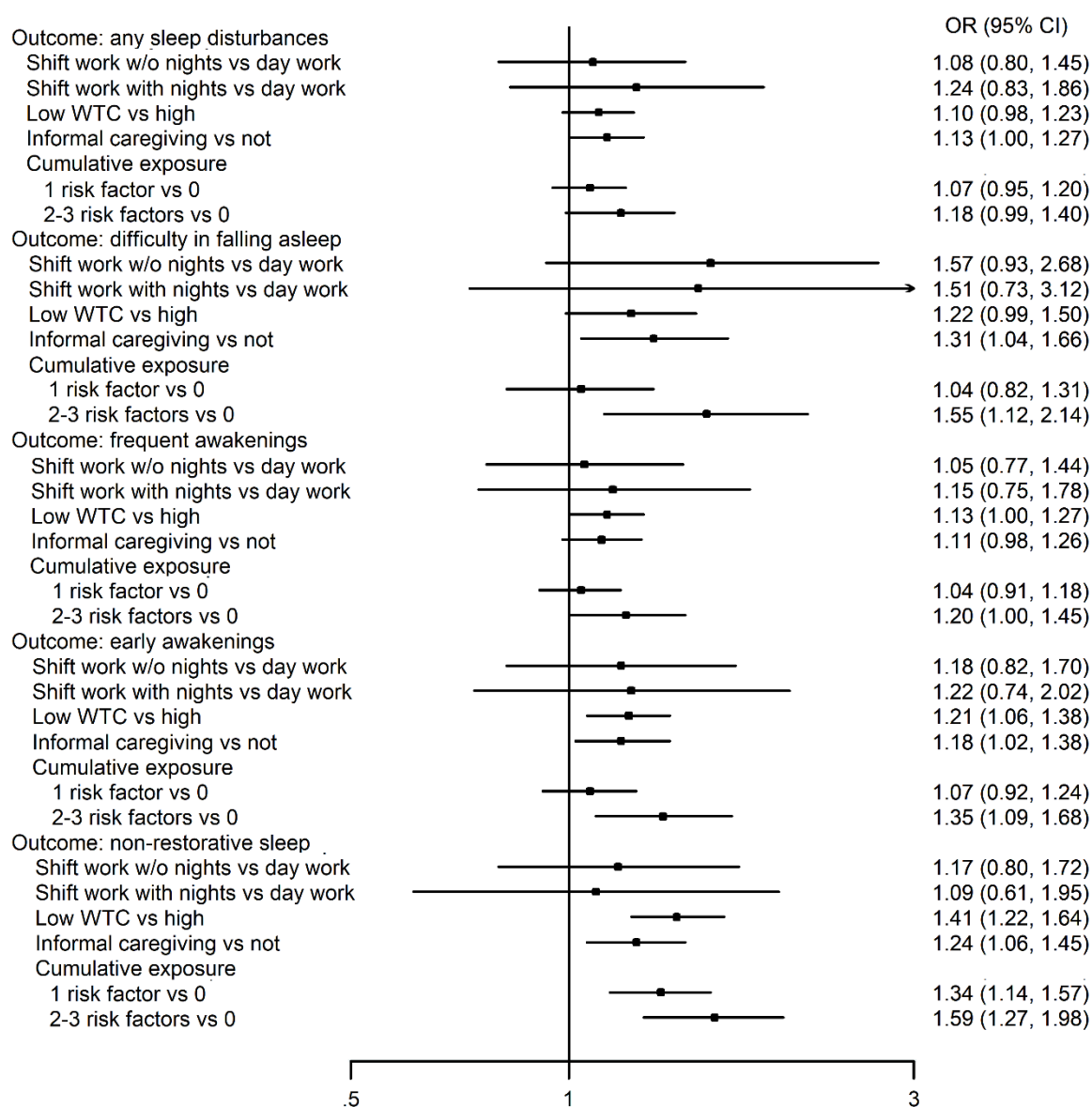
|                                          | FPS study |              |            |      | FIREA study |               |            |     | Meta-analysis      |         |
|------------------------------------------|-----------|--------------|------------|------|-------------|---------------|------------|-----|--------------------|---------|
|                                          | OR        | 95% CI       | n of cases | n    | OR          | 95% CI        | n of cases | n   | I <sup>2</sup> (%) | P value |
| Outcome: any sleep disturbances          |           |              |            |      |             |               |            |     |                    |         |
| Day work + high WTC (ref.)               | 1.00      |              | 2945       | 6160 | 1.00        |               | 208        | 446 |                    |         |
| Shift work + high WTC                    | 1.02      | (0.74-1.40)  | 466        | 997  | 0.90        | (0.24- 3.41)  | 24         | 54  | 0.0                | 0.857   |
| Day work + low WTC                       | 1.11      | (0.98-1.25)  | 2932       | 5944 | 1.10        | (0.67- 1.81)  | 122        | 258 | 0.0                | 0.972   |
| Shift work + low WTC                     | 1.38      | (1.02-1.87)  | 757        | 1509 | 1.19        | (0.34- 4.19)  | 67         | 136 | 0.0                | 0.822   |
| No informal caregiving + high WTC (ref.) | 1.00      |              | 2903       | 6190 | 1.00        |               | 207        | 438 |                    |         |
| Informal caregiving + high WTC           | 1.22      | (1.03-1.43)  | 654        | 1307 | 0.80        | (0.41- 1.54)  | 33         | 76  | 32.1               | 0.225   |
| No informal caregiving + low WTC         | 1.23      | (1.10-1.37)  | 3186       | 6455 | 1.02        | (0.65- 1.60)  | 160        | 340 | 0.0                | 0.429   |
| Informal caregiving + low WTC            | 1.32      | (1.12-1.57)  | 747        | 1486 | 1.18        | (0.50- 2.81)  | 31         | 59  | 0.0                | 0.803   |
| Outcome: difficulty in falling asleep    |           |              |            |      |             |               |            |     |                    |         |
| Day work + high WTC (ref.)               | 1.00      |              | 660        | 1456 | 1.00        |               | 36         | 76  |                    |         |
| Shift work + high WTC                    | 1.55      | (0.87- 2.78) | 134        | 304  | 0.88        | (0.07- 11.87) | 7          | 16  | 0.0                | 0.673   |
| Day work + low WTC                       | 1.25      | (0.99-1.57)  | 766        | 1656 | 1.33        | (0.37- 4.76)  | 31         | 66  | 0.0                | 0.925   |
| Shift work + low WTC                     | 2.08      | (1.21- 3.60) | 284        | 582  | 1.48        | (0.15- 14.66) | 15         | 33  | 0.0                | 0.777   |
| No informal caregiving + high WTC (ref.) | 1.00      |              | 659        | 1478 | 1.00        |               | 37         | 81  |                    |         |
| Informal caregiving + high WTC           | 1.07      | (0.78-1.46)  | 179        | 389  | 0.54        | (0.09- 3.40)  | 4          | 11  | 0.0                | 0.467   |
| No informal caregiving + low WTC         | 1.23      | (1.00-1.52)  | 873        | 1886 | 1.20        | (0.37- 3.87)  | 38         | 86  | 0.0                | 0.968   |
| Informal caregiving + low WTC            | 1.80      | (1.32- 2.47) | 249        | 501  | 2.95        | (0.46- 18.99) | 11         | 19  | 0.0                | 0.608   |
| Outcome: frequent awakenings             |           |              |            |      |             |               |            |     |                    |         |
| Day work + high WTC (ref.)               | 1.00      |              | 2480       | 5248 | 1.00        |               | 190        | 401 |                    |         |
| Shift work + high WTC                    | 0.92      | (0.65-1.31)  | 382        | 850  | 0.99        | (0.26- 3.73)  | 28         | 59  | 0.0                | 0.917   |
| Day work + low WTC                       | 1.12      | (0.98-1.28)  | 2513       | 5122 | 0.86        | (0.50- 1.47)  | 104        | 230 | 0.0                | 0.351   |
| Shift work + low WTC                     | 1.32      | (0.96-1.83)  | 679        | 1341 | 0.89        | (0.25- 3.12)  | 63         | 127 | 0.0                | 0.553   |
| No informal caregiving + high WTC (ref.) | 1.00      |              | 2446       | 5257 | 1.00        |               | 197        | 405 |                    |         |
| Informal caregiving + high WTC           | 1.10      | (0.92-1.30)  | 546        | 1147 | 0.70        | (0.36- 1.38)  | 30         | 70  | 38.7               | 0.202   |
| No informal caregiving + low WTC         | 1.22      | (1.08-1.38)  | 2709       | 5524 | 0.74        | (0.46- 1.19)  | 142        | 313 | 74.9               | 0.046   |
| Informal caregiving + low WTC            | 1.41      | (1.18-1.69)  | 692        | 1343 | 0.75        | (0.28- 1.98)  | 25         | 49  | 35.4               | 0.213   |
| Outcome: early awakenings                |           |              |            |      |             |               |            |     |                    |         |
| Day work + high WTC (ref.)               | 1.00      |              | 1743       | 3825 | 1.00        |               | 108        | 227 |                    |         |
| Shift work + high WTC                    | 1.15      | (0.77-1.71)  | 289        | 643  | 0.32        | (0.06- 1.86)  | 11         | 29  | 50.6               | 0.155   |
| Day work + low WTC                       | 1.22      | (1.05-1.42)  | 1887       | 3912 | 0.88        | (0.42- 1.84)  | 69         | 147 | 0.0                | 0.396   |
| Shift work + low WTC                     | 1.66      | (1.14- 2.40) | 532        | 1081 | 0.74        | (0.14- 3.75)  | 32         | 70  | 0.0                | 0.347   |
| No informal caregiving + high WTC (ref.) | 1.00      |              | 1737       | 3871 | 1.00        |               | 102        | 218 |                    |         |
| Informal caregiving + high WTC           | 1.09      | (0.89-1.33)  | 396        | 839  | 0.96        | (0.37- 2.46)  | 18         | 43  | 0.0                | 0.797   |
| No informal caregiving + low WTC         | 1.22      | (1.07-1.40)  | 2052       | 4286 | 1.00        | (0.53- 1.91)  | 81         | 186 | 0.0                | 0.552   |
| Informal caregiving + low WTC            | 1.59      | (1.29-1.95)  | 541        | 1071 | 2.45        | (0.78- 7.68)  | 25         | 44  | 0.0                | 0.466   |
| Outcome: non-restorative sleep           |           |              |            |      |             |               |            |     |                    |         |
| Day work + high WTC (ref.)               | 1.00      |              | 1589       | 3496 | 1.00        |               | 67         | 153 |                    |         |
| Shift work + high WTC                    | 1.09      | (0.72-1.65)  | 230        | 523  | 0.20        | (0.02- 2.30)  | 5          | 17  | 47.5               | 0.168   |
| Day work + low WTC                       | 1.41      | (1.20-1.65)  | 1791       | 3665 | 1.81        | (0.75- 4.35)  | 56         | 114 | 0.0                | 0.584   |
| Shift work + low WTC                     | 1.65      | (1.13- 2.41) | 492        | 992  | 0.47        | (0.04- 5.32)  | 19         | 44  | 0.0                | 0.320   |
| No informal caregiving + high WTC (ref.) | 1.00      |              | 1518       | 3446 | 1.00        |               | 65         | 155 |                    |         |
| Informal caregiving + high WTC           | 1.29      | (1.06-1.59)  | 394        | 802  | 2.69        | (0.64- 11.42) | 10         | 20  | 0.0                | 0.322   |
| No informal caregiving + low WTC         | 1.51      | (1.31-1.75)  | 1937       | 3977 | 1.61        | (0.74- 3.50)  | 68         | 148 | 0.0                | 0.874   |
| Informal caregiving + low WTC            | 1.63      | (1.32- 2.01) | 522        | 1034 | 3.34        | (0.82- 13.57) | 12         | 22  | 0.0                | 0.322   |

**Supplementary table S5.** Study-specific results from between-individuals analyses of the association of shift work and informal caregiving with sleep disturbances by the level of work time control (WTC), and heterogeneity estimates from meta-analyses pooling FPS and FIREA data

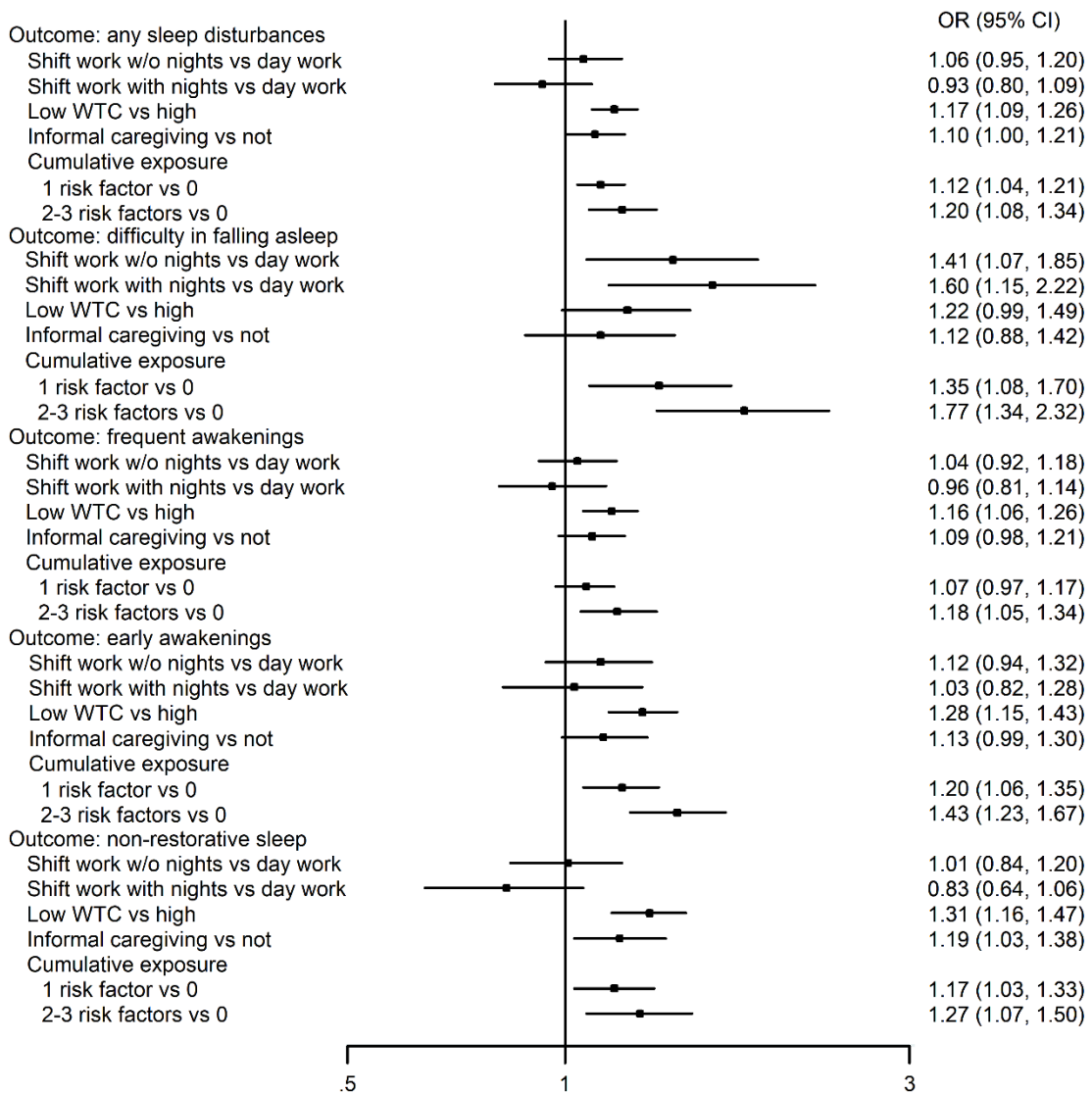
|                                       | FPS study       |                     |            |       | FIREA study     |                     |            |      | Meta-analysis      |         |
|---------------------------------------|-----------------|---------------------|------------|-------|-----------------|---------------------|------------|------|--------------------|---------|
|                                       | OR <sup>a</sup> | 95% CI <sup>a</sup> | n of cases | n     | OR <sup>a</sup> | 95% CI <sup>a</sup> | n of cases | n    | I <sup>2</sup> (%) | P value |
| Outcome: any sleep disturbances       |                 |                     |            |       |                 |                     |            |      |                    |         |
| Day work + high WTC                   | 1.00            |                     | 1549       | 9861  | 1.00            |                     | 117        | 1011 |                    |         |
| Shift work + high WTC                 | 1.04            | (0.90-1.20)         | 276        | 1596  | 1.12            | (0.60- 2.09)        | 14         | 116  | 0.0                | 0.821   |
| Day work + low WTC                    | 1.21            | (1.12-1.31)         | 1503       | 7996  | 0.94            | (0.68- 1.31)        | 69         | 624  | 53.6               | 0.142   |
| Shift work + low WTC                  | 1.13            | (0.99-1.28)         | 386        | 2084  | 1.45            | (0.94- 2.24)        | 39         | 245  | 14.2               | 0.280   |
| No informal caregiving + high WTC     | 1.00            |                     | 1594       | 10040 | 1.00            |                     | 112        | 1001 |                    |         |
| Informal caregiving + high WTC        | 1.07            | (0.93-1.22)         | 301        | 1767  | 1.10            | (0.66- 1.85)        | 20         | 163  | 0.0                | 0.919   |
| No informal caregiving + low WTC      | 1.15            | (1.06-1.24)         | 1618       | 8934  | 1.10            | (0.82- 1.49)        | 97         | 767  | 0.0                | 0.778   |
| Informal caregiving + low WTC         | 1.41            | (1.24-1.60)         | 355        | 1640  | 0.81            | (0.46- 1.45)        | 15         | 154  | 70.7               | 0.065   |
| Outcome: difficulty in falling asleep |                 |                     |            |       |                 |                     |            |      |                    |         |
| Day work + high WTC                   | 1.00            |                     | 162        | 9810  | 1.00            |                     | 11         | 1006 |                    |         |
| Shift work + high WTC                 | 1.55            | (1.10-2.19)         | 46         | 1582  | 0.63            | (0.08- 4.89)        | 1          | 115  | 0.0                | 0.397   |
| Day work + low WTC                    | 1.38            | (1.11-1.73)         | 183        | 7930  | 0.25            | (0.05- 1.29)        | 2          | 613  | 76.0               | 0.041   |
| Shift work + low WTC                  | 1.86            | (1.37-2.52)         | 72         | 2072  | 1.32            | (0.33- 5.30)        | 5          | 241  | 0.0                | 0.636   |
| No informal caregiving + high WTC     | 1.00            |                     | 179        | 9984  | 1.00            |                     | 10         | 994  |                    |         |
| Informal caregiving + high WTC        | 1.28            | (0.91-1.80)         | 41         | 1756  | 1.71            | (0.48- 6.15)        | 3          | 163  | 0.0                | 0.667   |
| No informal caregiving + low WTC      | 1.41            | (1.15-1.74)         | 230        | 8863  | 0.72            | (0.26- 1.99)        | 7          | 753  | 37.9               | 0.205   |
| Informal caregiving + low WTC         | 1.45            | (1.03-2.03)         | 44         | 1630  | n.a.            | n.a. n.a.           | 0          | 154  | na                 | na      |
| Outcome: frequent awakenings          |                 |                     |            |       |                 |                     |            |      |                    |         |
| Day work + high WTC                   | 1.00            |                     | 1152       | 9737  | 1.00            |                     | 94         | 998  |                    |         |
| Shift work + high WTC                 | 0.98            | (0.83-1.16)         | 203        | 1583  | 1.39            | (0.73- 2.66)        | 13         | 116  | 5.0                | 0.305   |
| Day work + low WTC                    | 1.17            | (1.07-1.28)         | 1099       | 7896  | 0.97            | (0.68- 1.39)        | 55         | 616  | 0.0                | 0.319   |
| Shift work + low WTC                  | 1.09            | (0.94-1.26)         | 290        | 2054  | 1.61            | (1.01- 2.58)        | 33         | 239  | 58.7               | 0.120   |
| No informal caregiving + high WTC     | 1.00            |                     | 1182       | 9908  | 1.00            |                     | 90         | 987  |                    |         |
| Informal caregiving + high WTC        | 1.06            | (0.91-1.23)         | 224        | 1753  | 1.14            | (0.65- 2.01)        | 17         | 163  | 0.0                | 0.807   |
| No informal caregiving + low WTC      | 1.11            | (1.01-1.21)         | 1181       | 8819  | 1.11            | (0.80- 1.54)        | 78         | 756  | 0.0                | 1.000   |
| Informal caregiving + low WTC         | 1.39            | (1.20-1.61)         | 268        | 1620  | 0.88            | (0.47- 1.63)        | 13         | 152  | 49.1               | 0.161   |
| Outcome: early awakenings             |                 |                     |            |       |                 |                     |            |      |                    |         |
| Day work + high WTC                   | 1.00            |                     | 605        | 9780  | 1.00            |                     | 28         | 1002 |                    |         |
| Shift work + high WTC                 | 1.06            | (0.86-1.32)         | 109        | 1579  | 2.12            | (0.79- 5.69)        | 6          | 116  | 44.7               | 0.179   |
| Day work + low WTC                    | 1.30            | (1.15-1.46)         | 639        | 7924  | 1.07            | (0.58- 1.98)        | 18         | 613  | 0.0                | 0.542   |
| Shift work + low WTC                  | 1.34            | (1.12-1.62)         | 176        | 2050  | 2.11            | (1.02- 4.38)        | 14         | 239  | 28.7               | 0.236   |
| No informal caregiving + high WTC     | 1.00            |                     | 622        | 9953  | 1.00            |                     | 27         | 991  |                    |         |
| Informal caregiving + high WTC        | 1.10            | (0.89-1.34)         | 120        | 1750  | 1.40            | (0.56- 3.52)        | 6          | 163  | 0.0                | 0.616   |
| No informal caregiving + low WTC      | 1.26            | (1.12-1.41)         | 699        | 8840  | 1.33            | (0.78- 2.27)        | 30         | 750  | 0.0                | 0.846   |
| Informal caregiving + low WTC         | 1.57            | (1.30-1.89)         | 158        | 1626  | 1.04            | (0.39- 2.79)        | 5          | 154  | 0.0                | 0.420   |
| Outcome: non-restorative sleep        |                 |                     |            |       |                 |                     |            |      |                    |         |
| Day work + high WTC                   | 1.00            |                     | 558        | 9773  | 1.00            |                     | 25         | 1005 |                    |         |
| Shift work + high WTC                 | 0.94            | (0.74-1.18)         | 123        | 1953  | 1.40            | (0.44- 4.53)        | 4          | 115  | 0.0                | 0.511   |
| Day work + low WTC                    | 1.26            | (1.12-1.43)         | 590        | 7982  | 0.69            | (0.32- 1.47)        | 11         | 618  | 57.2               | 0.126   |
| Shift work + low WTC                  | 1.15            | (0.95-1.40)         | 190        | 2582  | 0.78            | (0.29- 2.13)        | 5          | 242  | 0.0                | 0.454   |
| No informal caregiving + high WTC     | 1.00            |                     | 570        | 9981  | 1.00            |                     | 26         | 993  |                    |         |
| Informal caregiving + high WTC        | 1.12            | (0.91-1.38)         | 113        | 1760  | 0.95            | (0.34- 2.66)        | 4          | 163  | 0.0                | 0.758   |
| No informal caregiving + low WTC      | 1.22            | (1.08-1.38)         | 620        | 8872  | 0.72            | (0.37- 1.39)        | 15         | 758  | 57.6               | 0.125   |
| Informal caregiving + low WTC         | 1.63            | (1.35-1.97)         | 151        | 1633  | 0.45            | (0.10- 1.96)        | 2          | 153  | 64.7               | 0.093   |

<sup>a</sup>Adjusted for age, sex and socioeconomic status.

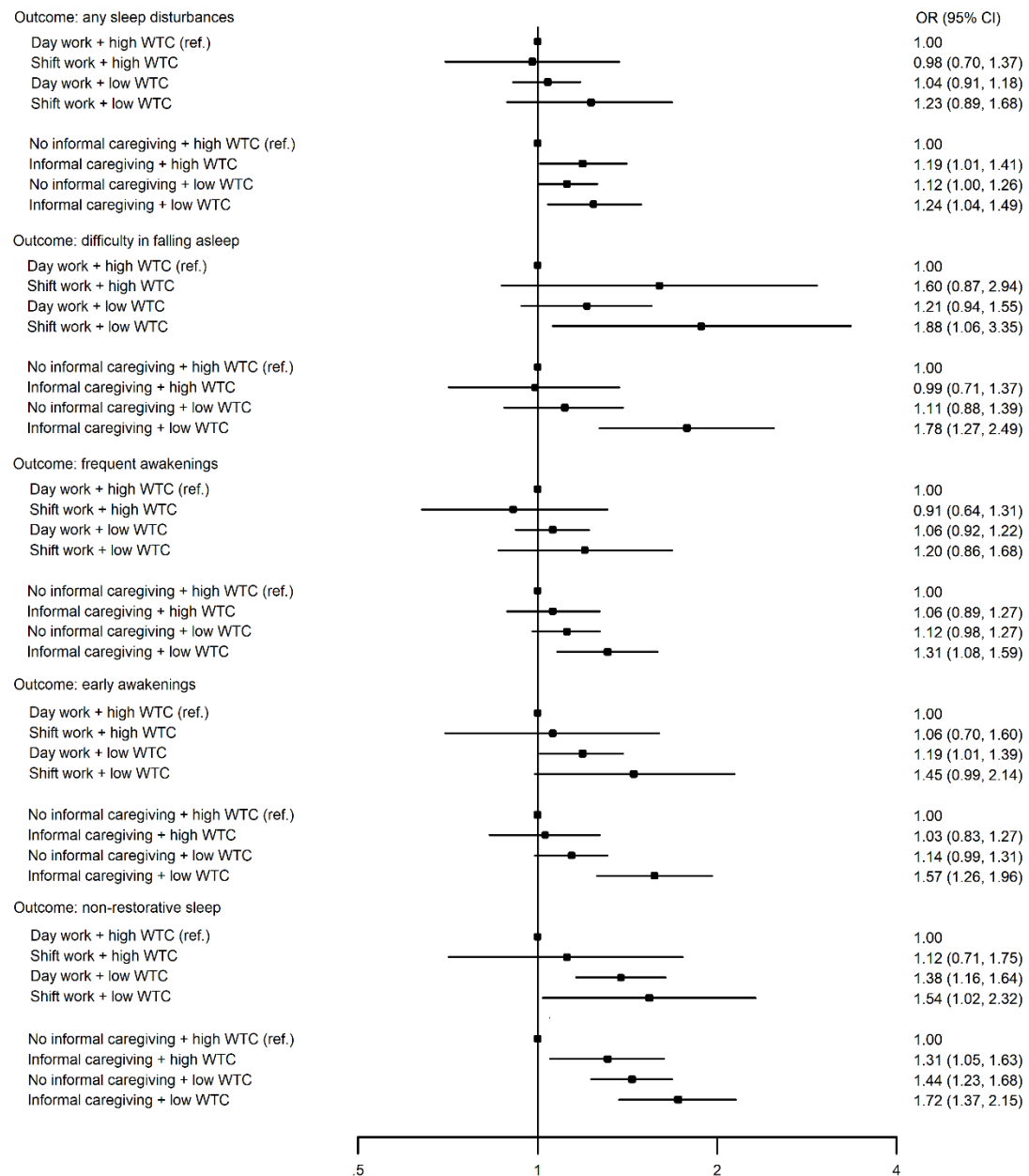
**Supplementary figure S1.** Within-individual associations of shift work, work time control (WTC) and informal care and their accumulation with sleep disturbances; fixed effect conditional logistic regression analysis adjusted for time-dependent health-related covariates



**Supplementary figure S2.** Between-individuals associations of shift work, work time control (WTC) and informal care and their accumulation with onset of sleep disturbances; binary logistic regression analysis adjusted for age, sex, socioeconomic status and health-related covariates at baseline



**Supplementary figure S3.** Within-individual associations of shift work and informal care with sleep disturbances by the level of work time control (WTC); fixed effect conditional logistic regression analysis adjusted for time-dependent health-related covariates



**Supplementary figure S4.** Between-individuals associations of shift work and informal care with sleep disturbances by the level of work time control (WTC); binary logistic regression analysis adjusted for age, sex, socioeconomic status and health-related covariates

