## Supplementary

This document contains supplementary information for Lyne et al "Sleep in early rheumatoid arthritis"

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Supplementary Table S1: Crude and adjusted ORs with disease duration as exposure and sleep domain as outcome in the full cohort with 4131 observations of sleep data from 3265 patients with early RA diagnosed during 1996-2018 in Sweden.

|  | N (\% reporting <br> problems) | Crude odds ratio | Adjusted odds <br> ratio* |
| :--- | :---: | :---: | :---: |
| At least one type of problem <br> (global sleep measure) | $1578(38)$ | $1.04(1.01-1.06)$ | $1.04(1.02-1.07)$ |
| Sleep problems | $1010(25)$ | $1.08(1.00-1.18)$ | $1.09(1.00-1.18)$ |
| Non-restorative sleep | $718(18)$ | $0.98(0.88-1.09)$ | $0.99(0.89-1.10)$ |
| Insomnia | $454(11)$ | $1.09(0.97-1.23)$ | $1.10(0.98-1.24)$ |
| Insufficient sleep | $398(10)$ | $1.10(0.97-1.24)$ | $1.10(0.98-1.25)$ |
| Sleep quality perceived as poor | $775(19)$ | $1.06(0.96-1.16)^{* *}$ | $1.06(0.97-1.17)$ |
| Sleep considered a health <br> problem | $809(20)$ | $1.05(0.96-1.15)$ | $1.07(0.97-1.17)$ |

*Adjusted for sex and age at the time of answering the follow-up questionnaire
** Adjusted for sex as the fully crude model did not converge.

Supplementary Table S2: The crude and adjusted ORs with pain-level as exposure and sleep domain as outcome in full cohort of 3265 individuals diagnosed with RA during 1996-2018 in Sweden and with a disease duration of 1-12 years at the time of data collection.

|  | Pain-level | N (\% reporting problems) | Crude odds ratio | Adjusted odds ratio* |
| :---: | :---: | :---: | :---: | :---: |
| Sleep problems | Low | 349 (17) | Ref | Ref |
|  | Intermediate | 486 (30) | 1.63 (0.96-2.76) | 1.57 (0.93-2.67) |
|  | High-grade | 124 (51) | 3.42 (1.27-9.26) | 3.23 (1.19-8.78) |
| Nonrestorative sleep | Low | 252 (12) | Ref | Ref |
|  | Intermediate | 342 (21) | 1.93 (1.02-3.65) | 1.91 (1.01-3.62) |
|  | High-grade | 93 (38) | 8.40 (3.18-22.22) | 8.44 (3.13-22.78) |
| Insomnia | Low | 117 (6) | Ref | Ref |
|  | Intermediate | 232 (14) | 2.92 (1.30-6.52) | 2.85 (0.93-8.70) |
|  | High-grade | 81 (33) | 3.39 (0.85-13.50) | 3.22 (0.63-16.39) |
| Insufficient sleep | Low | 119 (6) | Ref | Ref |
|  | Intermediate | 191 (12) | 3.09 (1.21-7.88) | 0.83 (0.28-2.47) |
|  | High-grade | 71 (29) | 18.65 (5.82-59.71) | 7.63 (1.45-40.04) |
| Sleep quality perceived as poor | Low | 246 (12) | Ref | Ref |
|  | Intermediate | 385 (24) | 2.64 (1.39-5.01) | 2.55 (1.34-4.85) |
|  | High-grade | 113 (46) | 9.22 (3.38-25.14) | 8.73 (3.18-23.94) |
| Sleep considered a health problem | Low | 250 (12) | Ref | Ref |
|  | Intermediate | 409 (25) | 3.01 (1.61-5.62) | 2.73 (2.73-2.73) |
|  | High-grade | 118 (48) | 14.90 (5.64-39.38) | 8.92 (5.98-13.30) |

*Adjusted for sex, age at the time of answering the questionnaire and disease duration.

Supplementary Table S3: The crude and adjusted ORs with HAQ > 1 as exposure and sleep domain as outcome in full cohort of 3265 individuals diagnosed with RA during 1996-2018 in Sweden and with a disease duration of 1-12 years at the time of data collection.

|  | HAQ-level | N (\% reporting <br> problems) | Crude odds <br> ratio | Adjusted odds <br> ratio* |
| :--- | :---: | :---: | :---: | :---: |
| Sleep problems | Low | $712(21)$ | REF | REF |
|  | High | $227(45)$ | $3.80(1.81-7.99)$ | $3.59(1.68-7.68)$ |
| Non-restorative sleep | Low | $507(15)$ | REF | REF |


|  | High | 159 (32) | $\begin{gathered} 5.03 \\ (2.38-10.62) \end{gathered}$ | $\begin{gathered} 6.09 \\ (2.73-13.59) \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| Insomnia | Low | 279 (8) | REF | REF |
|  | High | 135 (27) | $\begin{gathered} 3.49 \\ (1.34-9.11) \end{gathered}$ | $\begin{gathered} 4.40 \\ (2.11-9.18) \end{gathered}$ |
| Insufficient sleep | Low | 255 (7) | REF | REF |
|  | High | 112 (22) | $\begin{gathered} 6.93 \\ (2.85-16.84) \end{gathered}$ | $\begin{gathered} 6.86 \\ (6.80-6.93) \end{gathered}$ |
| Sleep quality perceived as poor | Low | 528 (15) | REF | REF |
|  | High | 186 (37) | $\begin{gathered} 4.39 \\ (2.02-9.56) \end{gathered}$ | $\begin{gathered} 4.20 \\ (1.89-9.37) \end{gathered}$ |
| Sleep considered a health problem | Low | 542 (16) | REF | REF |
|  | High | 202 (40) | $\begin{gathered} 7.04 \\ (3.41-14.53) \end{gathered}$ | $\begin{gathered} 8.18 \\ (3.75-17.81) \end{gathered}$ |

*Adjusted for sex, age at the time of answering the questionnaire and disease duration.

Supplementary Table S4: The crude and adjusted ORs with disease duration as exposure and sleep domain as outcome in the subcohort consisting of 1837 individuals newly diagnosed with RA during 1996-2008 and that answered the 2008-2009 questionnaire.

|  | N (\% reporting <br> problems) | Crude odds ratio | Adjusted odds <br> ratio* |
| :--- | :---: | :---: | :---: |
| At least one type of problem | $759(42)$ | $1.00(0.97-1.03)$ | $1.01(0.98-1.04)$ |
| Sleep problems | $502(28)$ | $1.03(0.99-1.06)$ | $1.03(1.00-1.07)$ |
| Non-restorative sleep | $349(19)$ | $0.99(0.95-1.02)$ | $1.00(0.96-1.04)$ |
| Insomnia | $219(12)$ | $0.99(0.95-1.04)$ | $1.00(0.96-1.05)$ |
| Insufficient sleep | $184(10)$ | $0.98(0.93-1.03)$ | $0.99(0.94-1.04)$ |
| Sleep quality perceived as poor | $355(19)$ | $0.98(0.95-1.02)$ | $0.99(0.95-1.03)$ |
| Sleep considered a health problem | $382(21)$ | $0.99(0.95-1.03)$ | $1.01(0.97-1.05)$ |

* Adjusted for sex and age at the time of answering the questionnaire.

Supplementary Table S5: The crude and adjusted ORs with pain-level as exposure and sleep domain as outcome in the subcohort consisting of the 1837 individuals newly diagnosed with RA during 1996-2008 and that answered the 2008-2009 questionnaire.

|  | 2008-2009 |  |  | 1-year follow-up |  |  | 3-year follow-up |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pain-level | N (\%) with problems | Crude OR | Adjusted OR* | N (\%) with problems | Crude OR | Adjusted OR* | N (\%) with problems | Crude OR | Adjusted OR* |
| Sleep problems |  |  |  |  |  |  |  |  |  |
| Low | 140 (18) | Ref | Ref | 105 (16) | Ref | Ref | 104 (17) | Ref | Ref |
| Intermediate | 258 (34) | $\begin{gathered} 2.4 \\ (1.9-3.0) \end{gathered}$ | $\begin{gathered} 2.3 \\ (1.8-2.9) \\ \hline \end{gathered}$ | 135 (27) | $\begin{gathered} 2.0 \\ (1.5-2.6) \\ \hline \end{gathered}$ | $\begin{gathered} 1.9 \\ (1.4-2.5) \\ \hline \end{gathered}$ | 93 (28) | $\begin{gathered} 1.9 \\ (1.4-2.6) \end{gathered}$ | $\begin{gathered} 1.8 \\ (1.3-2.5) \end{gathered}$ |
| High-grade | 57 (52) | $\begin{gathered} 5.1 \\ (3.3-7.7) \\ \hline \end{gathered}$ | $\begin{gathered} 4.8 \\ (3.2-7.4) \\ \hline \end{gathered}$ | 34 (52) | $\begin{gathered} \hline 5.7 \\ (3.4-9.7) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 5.4 \\ (3.2-9.3) \\ \hline \end{gathered}$ | 33 (47) | $\begin{gathered} 4.5 \\ (2.7-7.5) \\ \hline \end{gathered}$ | $\begin{gathered} 4.2 \\ (2.5-7.0) \\ \hline \end{gathered}$ |
| Non-restorative sleep |  |  |  |  |  |  |  |  |  |
| Low | 101 (13) | Ref | Ref | 85 (13) | Ref | Ref | 66 (11) | ref | ref |
| Intermediate | 179 (23) | $\begin{gathered} \hline 2.1 \\ (1.6-2.7) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.0 \\ (1.6-2.7) \\ \hline \end{gathered}$ | 102 (20) | $\begin{gathered} \hline 1.7 \\ (1.3-2.4) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 1.7 \\ (1.2-2.3) \\ \hline \end{gathered}$ | 61 (18) | $\begin{gathered} 1.9 \\ (1.3-2.7) \\ \hline \end{gathered}$ | $\begin{gathered} 1.8 \\ (1.3-2.7) \\ \hline \end{gathered}$ |
| High-grade | 41 (37) | $\begin{gathered} 4.1 \\ (2.7-6.4) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 3.9 \\ (2.5-6.1) \\ \hline \end{gathered}$ | 28 (43) | $\begin{gathered} 5.1 \\ (3.0-8.7) \\ \hline \end{gathered}$ | $\begin{gathered} 5.1 \\ (2.9-8.9) \\ \hline \end{gathered}$ | 24 (35) | $\begin{gathered} 4.5 \\ (2.6-7.8) \\ \hline \end{gathered}$ | $\begin{gathered} 4.3 \\ (2.5-7.7) \\ \hline \end{gathered}$ |
| Insomnia |  |  |  |  |  |  |  |  |  |
| Low | 47 (6) | Ref | Ref | 33 (5) | Ref | Ref | 37 (6) | Ref | Ref |
| Intermediate | 111 (14) | $\begin{gathered} \hline 2.7 \\ (1.9-3.9) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.7 \\ (1.9-3.8) \\ \hline \end{gathered}$ | 66 (13) | $\begin{gathered} \hline 2.9 \\ (1.9-4.5) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.7 \\ (1.8-4.2) \\ \hline \end{gathered}$ | 55 (16) | $\begin{gathered} 3.0 \\ (2.0-4.7) \\ \hline \end{gathered}$ | $\begin{gathered} 3.0 \\ (1.9-4.7) \\ \hline \end{gathered}$ |
| High-grade | 70 (36) | $\begin{array}{\|c} \hline 9.2 \\ (5.7-15.0) \\ \hline \end{array}$ | $\begin{gathered} 9.0 \\ (5.5-14.7) \\ \hline \end{gathered}$ | 18 (28) | $\begin{gathered} \hline 7.3 \\ (3.8-13.8) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 6.8 \\ (3.5-13.2) \\ \hline \end{gathered}$ | 23 (33) | $\begin{gathered} \hline 7.7 \\ (4.3-14.1) \\ \hline \end{gathered}$ | $\begin{array}{\|c\|} \hline 7.3 \\ (4.0-13.5) \\ \hline \end{array}$ |
| Insufficient sleep |  |  |  |  |  |  |  |  |  |
| Low | 50 (6) | Ref | Ref | 32 (5) | ref | ref | 37 (6) | ref | ref |
| Intermediate | 91 (12) | $\begin{gathered} 2.0 \\ (1.4-2.9) \end{gathered}$ | $\begin{gathered} 1.9 \\ (1.3-2.8) \\ \hline \end{gathered}$ | 48 (10) | $\begin{gathered} 2.1 \\ (1.3-3.3) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.0 \\ (1.2-3.1) \\ \hline \end{gathered}$ | 52 (15) | $\begin{gathered} 2.9 \\ (1.8-4.5) \\ \hline \end{gathered}$ | $\begin{gathered} 2.8 \\ (1.8-4.4) \\ \hline \end{gathered}$ |
| High-grade | 27 (24) | $\begin{gathered} \hline 4.9 \\ (2.9-8.2) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 4.6 \\ (2.7-7.7) \\ \hline \end{gathered}$ | 22 (34) | $\begin{gathered} 10.0 \\ (5.4-18.8) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 9.5 \\ (5.0-17.9) \\ \hline \end{gathered}$ | 22 (31) | $\begin{gathered} 7.3 \\ (4.0-13.4) \\ \hline \end{gathered}$ | $\begin{array}{\|c\|} \hline 7.0 \\ (3.8-12.9) \\ \hline \end{array}$ |
| Sleep quality perceived as poor |  |  |  |  |  |  |  |  |  |
| Low | 92 (11) | Ref | Ref | 72 (11) | Ref | Ref | 82 (13) | Ref | Ref |
| Intermediate | 188 (24) | $\begin{gathered} 2.5 \\ (1.9-3.2) \\ \hline \end{gathered}$ | $\begin{gathered} 2.4 \\ (1.8-3.1) \\ \hline \end{gathered}$ | 110 (22) | $\begin{gathered} \hline 2.3 \\ (1.7-3.2) \\ \hline \end{gathered}$ | $\begin{gathered} 2.2 \\ (1.6-3.0) \\ \hline \end{gathered}$ | 87 (26) | $\begin{gathered} 2.3 \\ (1.6-3.2) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.2 \\ (1.6-3.1) \\ \hline \end{gathered}$ |
| High-grade | 49 (44) | $\begin{gathered} 6.1 \\ (4.0-9.5) \end{gathered}$ | $\begin{gathered} \hline 5.8 \\ (3.8-9.0) \\ \hline \end{gathered}$ | 32 (49) | $\begin{gathered} 7.9 \\ (4.6-13.7) \end{gathered}$ | $\begin{gathered} 7.7 \\ (4.4-13.3) \end{gathered}$ | 32 (46) | $\begin{gathered} 5.6 \\ (3.3-9.5) \end{gathered}$ | $\begin{gathered} 5.3 \\ (3.1-8.9) \end{gathered}$ |
| Sleep considered a health problem |  |  |  |  |  |  |  |  |  |
| Low | 99 (12) | Ref | Ref | 75 (11) | Ref | Ref | 76 (12) | Ref | Ref |
| Intermediate | 202 (26) | $\begin{gathered} 2.5 \\ (1.9-3.3) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.4 \\ (1.9-3.2) \\ \hline \end{gathered}$ | 125 (25) | $\begin{gathered} \hline 2.6 \\ (1.9-3.5) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 2.5 \\ (1.8-3.5) \\ \hline \end{gathered}$ | 82 (24) | $\begin{gathered} 2.3 \\ (1.6-3.3) \end{gathered}$ | $\begin{gathered} 2.3 \\ (1.6-3.3) \\ \hline \end{gathered}$ |
| High-grade | 53 (48) | $\begin{gathered} 6.5 \\ (4.3-10.0) \end{gathered}$ | $\begin{gathered} 6.3 \\ (4.1-9.8) \end{gathered}$ | 32 (49) | $\begin{gathered} 7.6 \\ (4.4-13.0) \end{gathered}$ | $\begin{gathered} 7.7 \\ (4.4-13.4) \end{gathered}$ | 33 (48) | $\begin{gathered} 6.7 \\ (3.9-11.3) \end{gathered}$ | $\begin{gathered} 6.4 \\ (3.7-10.9) \end{gathered}$ |

*Adjusted for sex and age at the time of answering the questionnaire. The 2008/2009 subcohort was additionally adjusted for disease duration.
Abbreviations: OR, odds ratio.

Supplementary Table S6: The crude and adjusted ORs with HAQ-level as exposure and sleep domain as outcome in the tree cohorts consisting of those that answered the questionnaire in 2008-2009, the questionnaire at 1 year after diagnosis, and at 3 years after diagnosis.

|  | 2008-2009 |  |  | 1-year follow-up |  |  | 3-year follow-up |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N (\%) with problems | Crude OR | Adjusted OR* | $\mathrm{d}(\%)$ <br> with <br> problems | Crude <br> OR | Adjusted OR* | N (\%) <br> with problems | Crude OR | Adjusted OR* |
| Sleep problems |  |  |  |  |  |  |  |  |  |
| Low | 329 (23) | Ref | Ref | 209 (20) | Ref | Ref | 174 (19) | Ref | Ref |
| High | 125 (46) | $\begin{gathered} 2.8 \\ (2.1-3.7) \end{gathered}$ | $\begin{gathered} 2.7 \\ (2.0-3.5) \end{gathered}$ | 55 (44) | $\begin{gathered} \hline 3.3 \\ (2.2-4.8) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 3.3 \\ (2.2-4.9) \\ \hline \end{gathered}$ | 47 (45) | $\begin{gathered} \hline 3.4 \\ (2.3-5.2) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 3.3 \\ (2.2-5.1) \\ \hline \end{gathered}$ |
| Non-restorative sleep |  |  |  |  |  |  |  |  |  |
| Low | 232 (16) | Ref | Ref | 163 (15) | Ref | Ref | 112 (12) | Ref | Ref |
| High | 82 (30) | $\begin{gathered} 2.2 \\ (1.6-2.9) \\ \hline \end{gathered}$ | $\begin{gathered} 2.2 \\ (1.7-3.0) \\ \hline \end{gathered}$ | 44 (35) | $\begin{gathered} 3.1 \\ (2.0-4.5) \\ \hline \end{gathered}$ | $\begin{gathered} 3.4 \\ (2.2-5.2) \\ \hline \end{gathered}$ | 33 (32) | $\begin{gathered} 3.3 \\ (2.1-5.2) \\ \hline \end{gathered}$ | $\begin{gathered} 3.6 \\ (2.2-5.8) \\ \hline \end{gathered}$ |
| Insomnia |  |  |  |  |  |  |  |  |  |
| Low | 123 (9) | Ref | Ref | 80 (7) | Ref | Ref | 76 (8) | Ref | Ref |
| High | 69 (25) | $\begin{gathered} 3.5 \\ (2.5-4.9) \\ \hline \end{gathered}$ | $\begin{gathered} 3.8 \\ (2.7-5.3) \\ \hline \end{gathered}$ | 33 (26) | $\begin{gathered} 4.4 \\ (2.8-7.0) \\ \hline \end{gathered}$ | $\begin{gathered} 4.7 \\ (2.9-7.6) \\ \hline \end{gathered}$ | 33 (32) | $\begin{gathered} 5.0 \\ (3.1-8.1) \\ \hline \end{gathered}$ | $\begin{gathered} 5.2 \\ (3.2-8.6) \\ \hline \end{gathered}$ |
| Insufficient sleep |  |  |  |  |  |  |  |  |  |
| Low | 109 (8) | Ref | Ref | 67 (6) | Ref | Ref | 79 (9) | Ref | Ref |
| High | 57 (20) | $\begin{gathered} \hline 3.1 \\ (2.2-4.4) \\ \hline \end{gathered}$ | $\begin{gathered} 3.2 \\ (2.2-4.5) \end{gathered}$ | 29 (23) | $\begin{gathered} \hline 4.5 \\ (2.8-7.4) \\ \hline \end{gathered}$ | $\begin{gathered} \hline 4.7 \\ (2.8-7.7) \\ \hline \end{gathered}$ | 26 (25) | $\begin{gathered} \hline 3.5 \\ (2.1-5.8) \end{gathered}$ | $\begin{gathered} 3.6 \\ 2.1-6.0) \end{gathered}$ |
| Sleep perceived as poor |  |  |  |  |  |  |  |  |  |
| Low | 218 (15) | Ref | Ref | 157 (15) | Ref | Ref | 153 (17) | Ref | Ref |
| High | 100 (36) | $\begin{gathered} 3.2 \\ (2.3-4.1) \end{gathered}$ | $\begin{gathered} 3.0 \\ (2.3-4.0) \end{gathered}$ | 47 (38) | $\begin{gathered} 3.5 \\ (2.4-5.2) \end{gathered}$ | $\begin{gathered} 3.7 \\ (2.5-5.6) \\ \hline \end{gathered}$ | 39 (38) | $\begin{gathered} 3.0 \\ (1.9-4.6) \end{gathered}$ | $\begin{gathered} \hline 2.8 \\ (1.8-4.4) \\ \hline \end{gathered}$ |
| Sleep considered a health problem |  |  |  |  |  |  |  |  |  |
| Low | 230 (16) | Ref | Ref | 172 (16) | Ref | Ref | 140 (15) | Ref | Ref |
| High | 113 (41) | $\begin{gathered} \hline 3.6 \\ (2.7-4.7) \end{gathered}$ | $\begin{gathered} 3.9 \\ (2.9-5.2) \\ \hline \end{gathered}$ | 47 (38) | $\begin{gathered} 3.2 \\ (2.1-4.7) \end{gathered}$ | $\begin{gathered} 3.6 \\ (2.4-5.4) \\ \hline \end{gathered}$ | 42 (40) | $\begin{gathered} 3.7 \\ (2.4-5.7) \end{gathered}$ | $\begin{gathered} \hline 3.9 \\ (2.5-6.1) \\ \hline \end{gathered}$ |

* Adjusted for sex and age at the time of answering the questionnaire. The 2008/2009 subcohort was additionally adjusted for disease duration.
Abbreviations: OR, odds ratio.

Figure S1: Flowchart of the inclusion and exclusion of patients in each analysis. The light gray boxes represent individuals that were excluded completely from analysis due to either incorrect diagnosis, retracted consent, or missing data on predicting variables as well as covariates. The dark gray boxes represent the number of missing values for each sleep domain, which were excluded in the descriptive statistics and analysis with each individual domain.


Figure S2: Time in bed (proportion of short, normal, long) for full cohort stratified by disease duration for 4131 observations from 3265 individuals newly diagnosed with RA during 1996-2018 in Sweden.
Time in bed $\square$ Short $\square$ Normal $\square$ Long


Figure S3: Proportion experiencing problems with each sleep domain stratified by 10-year interval age groups for 4131 observations from 3265 individuals newly diagnosed with RA during 1996-2018 in Sweden.


Figure S4: Proportion of patients experiencing problems with each sleep domain stratified sex for 4131 observations from 3265 individuals newly diagnosed with RA during 1996-2018 in Sweden.


