

# Could work-related muscle activity explain sex differences in neck pain? A meta-analysis of a pooled dataset<sup>1</sup>

by Markus Koch, PhD,<sup>2</sup> Lars-Kristian Lunde, PhD, Mikael Forsman, PhD, Lars Louis Andersen, PhD, Markus Due Jakobsen, PhD, Mikkel Brandt, PhD, Henrik Enquist, PhD, Gisela Sjøgaard, PhD, Karen Sjøgaard, PhD, Xuelong Fan, PhD, Kaj Bo Veiersted, PhD

1. Supplementary material
2. Correspondence to: Markus Koch, National Institute of Occupational Health, Research group for Work Psychology and Physiology, Gydas vei 8, 0361 Oslo, Norway. [E-mail: Markus.Koch@stami.no]

**Table S1. Number of participants included specified by occupations according to cross-sectional and longitudinal neck pain.**

|                            | Cross-sectional neck pain |            | Longitudinal neck pain |            |
|----------------------------|---------------------------|------------|------------------------|------------|
|                            | Women                     | Men        | Women                  | Men        |
| <b>Occupation</b>          |                           |            |                        |            |
| Assembly worker            | 9                         | 16         |                        |            |
| Assistant worker           |                           | 3          |                        | 1          |
| Brewery worker             | 4                         |            |                        |            |
| Bricklayer                 |                           | 22         |                        | 1          |
| Carpenter                  |                           | 17         |                        | 10         |
| Cleaner                    | 2                         |            | 2                      |            |
| Concrete worker            |                           | 37         |                        | 5          |
| Cook or kitchen helper     | 4                         | 4          | 2                      |            |
| Electrician                |                           | 16         |                        | 11         |
| Engineer                   | 1                         | 2          | 1                      | 1          |
| Firefighter                |                           | 2          |                        |            |
| Foreman                    |                           | 5          |                        | 3          |
| Gardener / forest worker   | 1                         | 4          |                        |            |
| Hairdresser                | 36                        |            | 29                     |            |
| Harvester / driver         | 2                         | 92         |                        | 84         |
| Health care personal       | 70                        | 6          | 33                     | 2          |
| Helicopter pilot / crew    | 1                         | 17         |                        |            |
| Machine operator           | 3                         | 1          |                        |            |
| Meat cutter                | 6                         | 29         |                        |            |
| Mechanic                   |                           | 4          |                        |            |
| Office worker / secretary  | 79                        | 28         | 25                     | 18         |
| Postal worker              | 1                         | 35         |                        |            |
| Project manager / leader   | 5                         | 8          | 4                      | 3          |
| Retail personal            | 32                        | 13         | 11                     |            |
| Rubber mixing              | 7                         | 1          |                        |            |
| Student                    | 5                         |            | 4                      |            |
| Surgeon                    | 1                         | 11         |                        |            |
| Warehouse worker           | 9                         | 29         |                        |            |
| Windscreen inspection      | 7                         | 3          |                        |            |
| Working with various tasks | 5                         | 2          | 2                      | 1          |
| Other occupations          | 3                         | 11         | 3                      | 3          |
| <b>Total</b>               | <b>293</b>                | <b>418</b> | <b>116</b>             | <b>143</b> |

**Table S2. Regression analysis for individual factors on neck pain variables.**

|              | Cross-sectional<br>neck pain |                |   | Longitudinal<br>neck pain |                |        |
|--------------|------------------------------|----------------|---|---------------------------|----------------|--------|
|              | $\beta$                      | R <sup>2</sup> | p | $\beta$                   | R <sup>2</sup> | p      |
| <b>Women</b> |                              |                |   |                           |                |        |
| Age          | 0.098                        | 0.010          |   | 0.058                     | 0.003          |        |
| Weight       | 0.097                        | 0.009          |   | 0.003                     | 0.000          |        |
| Height       | 0.088                        | 0.008          |   | -0.030                    | 0.001          |        |
| BMI          | 0.082                        | 0.007          |   | 0.083                     | 0.007          |        |
| Smoking      | 0.042                        | 0.002          |   | 0.076                     | 0.006          |        |
| <b>Men</b>   |                              |                |   |                           |                |        |
| Age          | -0.006                       | 0.000          |   | 0.216                     | 0.047          | < 0.01 |
| Weight       | 0.021                        | 0.000          |   | 0.101                     | 0.010          |        |
| Height       | -0.032                       | 0.001          |   | -0.003                    | 0.000          |        |
| BMI          | 0.043                        | 0.002          |   | 0.119                     | 0.014          |        |
| Smoking      | 0.011                        | 0.000          |   | 0.052                     | 0.003          |        |

**Table S3. Distribution of participants according to physical workload intensity categories. The median activity of the right upper trapezius muscle was used to calculate the 33rd and 66<sup>th</sup> percentile across participants. Participants with a median activity below the 33rd were assigned to the light intensity group, participants with a median activity between the 33rd percentile and 66<sup>th</sup> percentile were assigned to the medium intensity group, and participants with a median activity above the 66<sup>th</sup> percentile were assigned to the high intensity group. \*The sex distribution in the different physical workload intensity groups was not significantly different ( $p = 0.346$ ; tested by Pearson's chi-square test).**

| Distribution by occupation | Physical workload |        |      | Total |
|----------------------------|-------------------|--------|------|-------|
|                            | Light             | Medium | High |       |
| Assembly worker            | 2                 | 10     | 13   | 25    |
| Assistant worker           | 1                 | 1      | 1    | 3     |
| Brewery worker             | 0                 | 1      | 3    | 4     |
| Bricklayer                 | 12                | 7      | 3    | 22    |
| Carpenter                  | 5                 | 8      | 4    | 17    |
| Cleaner                    | 0                 | 0      | 2    | 2     |
| Concrete worker            | 15                | 13     | 9    | 37    |
| Cook or kitchen helper     | 2                 | 4      | 2    | 8     |
| Electrician                | 2                 | 8      | 6    | 16    |
| Engineer                   | 1                 | 2      | 0    | 3     |
| Firefighter                | 1                 | 0      | 1    | 2     |
| Foreman                    | 3                 | 2      | 0    | 5     |
| Gardener / forest worker   | 1                 | 0      | 4    | 5     |
| Hairdresser                | 6                 | 10     | 20   | 36    |
| Harvester / driver         | 43                | 33     | 18   | 94    |
| Health care personal       | 23                | 27     | 26   | 76    |
| Helicopter pilot / crew    | 14                | 2      | 2    | 18    |
| Machine operator           | 2                 | 1      | 1    | 4     |
| Meat cutter                | 6                 | 16     | 13   | 35    |
| Mechanic                   | 3                 | 0      | 1    | 4     |
| Office worker / secretary  | 53                | 32     | 22   | 107   |
| Postal worker              | 5                 | 7      | 24   | 36    |
| Project manager / leader   | 3                 | 5      | 5    | 13    |
| Retail personal            | 7                 | 20     | 18   | 45    |
| Rubber mixing              | 3                 | 2      | 3    | 8     |
| Student                    | 4                 | 0      | 1    | 5     |
| Surgeon                    | 1                 | 1      | 10   | 12    |
| Warehouse worker           | 9                 | 12     | 17   | 38    |
| Windscreen inspection      | 6                 | 2      | 2    | 10    |
| Working with various tasks | 5                 | 1      | 1    | 7     |

|                             |            |            |            |            |
|-----------------------------|------------|------------|------------|------------|
| Other occupations           | 3          | 8          | 3          | 14         |
| <b>Distribution by sex*</b> |            |            |            |            |
| Women                       | 98         | 90         | 105        | 293        |
| Men                         | 143        | 145        | 130        | 418        |
| <b>Total</b>                | <b>241</b> | <b>235</b> | <b>235</b> | <b>711</b> |

**Table S4. Regression analysis scores ( $\beta$ -values) of a subanalysis between EMG variables and neck pain in female hairdressers. P-values were corrected for FDR. Gray shading: negative associations. No shading: positive associations. N = 36/29 (cross-sectional / longitudinal analyses).**

|               | Cross-sectional<br>neck pain |                |        | Longitudinal<br>neck pain |                |        |
|---------------|------------------------------|----------------|--------|---------------------------|----------------|--------|
|               | $\beta$                      | R <sup>2</sup> | p      | $\beta$                   | R <sup>2</sup> | p      |
| <b>Left</b>   |                              |                |        |                           |                |        |
| RRT           | 0.176                        | 0.230          |        | -0.225                    | 0.051          |        |
| Gaps          | 0.402                        | 0.361          | < 0.05 | -0.139                    | 0.019          |        |
| Median        | -0.291                       | 0.283          |        | 0.120                     | 0.014          |        |
| <b>SUMA</b>   |                              |                |        |                           |                |        |
| 1.5s - 5s     | 0.430                        | 0.382          | < 0.05 | -0.110                    | 0.012          |        |
| 5s - 10s      | 0.411                        | 0.364          | < 0.05 | -0.185                    | 0.034          |        |
| 10s - 20s     | 0.247                        | 0.259          |        | -0.280                    | 0.079          |        |
| 20s - 60s     | 0.092                        | 0.207          |        | -0.375                    | 0.140          |        |
| 1min - 2min   | 0.084                        | 0.206          |        | -0.288                    | 0.083          |        |
| 2min - 4min   | -0.090                       | 0.207          |        | -0.073                    | 0.005          |        |
| 4min - 8min   | -0.124                       | 0.214          |        | 0.125                     | 0.016          |        |
| 8min - 10min  | -0.120                       | 0.213          |        | -0.027                    | 0.001          |        |
| 10min - 20min | 0.041                        | 0.201          |        | 0.505                     | 0.255          | < 0.05 |
| >20min        | -0.247                       | 0.260          |        | 0.140                     | 0.020          |        |
| <b>Right</b>  |                              |                |        |                           |                |        |
| RRT           | 0.279                        | 0.287          |        | -0.188                    | 0.035          |        |
| Gaps          | 0.324                        | 0.314          |        | -0.138                    | 0.019          |        |
| Median        | -0.429                       | 0.390          | < 0.05 | 0.051                     | 0.003          |        |
| <b>SUMA</b>   |                              |                |        |                           |                |        |
| 1.5s - 5s     | 0.407                        | 0.373          | < 0.05 | -0.254                    | 0.065          |        |
| 5s - 10s      | 0.382                        | 0.353          | < 0.05 | -0.291                    | 0.084          |        |
| 10s - 20s     | 0.332                        | 0.318          |        | -0.350                    | 0.123          |        |
| 20s - 60s     | 0.223                        | 0.258          |        | -0.404                    | 0.163          |        |
| 1min - 2min   | 0.162                        | 0.235          |        | -0.244                    | 0.060          |        |
| 2min - 4min   | -0.008                       | 0.210          |        | 0.080                     | 0.006          |        |
| 4min - 8min   | -0.044                       | 0.211          |        | 0.332                     | 0.110          |        |
| 8min - 10min  | -0.092                       | 0.218          |        | 0.236                     | 0.056          |        |
| 10min - 20min | -0.414                       | 0.377          | < 0.05 | 0.221                     | 0.049          |        |
| >20min        | -0.274                       | 0.280          |        | 0.270                     | 0.073          |        |