Supplementary file 7

Estimated biases due to sample overlap

Bias and type 1 error rate for Mendelian randomization analysis of headache on sleeplessness/insomnia

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
-----------------------------------------------         -----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.001   0.05                    0.3                     0.001   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.002   0.05                    0.8                     0.002   0.05
0.9                     0.002   0.05                    0.9                     0.002   0.05
1.0                     0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 209.44
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 209.43
```

Bias and type 1 error rate for Mendelian randomization analysis of facial pain on sleeplessness/insomnia

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
-----------------------------------------------         -----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 291.57
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 291.56
```

Bias and type 1 error rate for Mendelian randomization analysis of neck/shoulder pain on sleeplessness/insomnia

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
-----------------------------------------------         -----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.000   0.05                    0.4                     0.000   0.05
0.5                     0.000   0.05                    0.5                     0.000   0.05
0.6                     0.000   0.05                    0.6                     0.000   0.05
0.7                     0.000   0.05                    0.7                     0.000   0.05
0.8                     0.000   0.05                    0.8                     0.000   0.05
0.9                     0.000   0.05                    0.9                     0.000   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 777.53
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 777.52
```

Bias and type 1 error rate for Mendelian randomization analysis of back pain on sleeplessness/insomnia

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------          ---------------------------------------------------
0.0                   0.000   0.05                        0.0                      0.000   0.05
0.1                   0.000   0.05                        0.1                      0.000   0.05
0.2                   0.000   0.05                        0.2                      0.000   0.05
0.3                   0.001   0.05                        0.3                      0.001   0.05
0.4                   0.001   0.05                        0.4                      0.001   0.05
0.5                   0.001   0.05                        0.5                      0.001   0.05
0.6                   0.001   0.05                        0.6                      0.001   0.05
0.7                   0.001   0.05                        0.7                      0.001   0.05
0.8                   0.001   0.05                        0.8                      0.001   0.05
0.9                   0.002   0.05                        0.9                      0.002   0.05
1.0                   0.002   0.05                        1.0                      0.002   0.05


Concentration parameter (expected value of F statistic) = 233.25
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 233.25
```

Bias and type 1 error rate for Mendelian randomization analysis of stomach/abdominal pain on sleeplessness/insomnia

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------          ---------------------------------------------------
0.0                   0.000   0.05                        0.0                      0.000   0.05
0.1                   0.000   0.05                        0.1                      0.000   0.05
0.2                   0.000   0.05                        0.2                      0.000   0.05
0.3                   0.000   0.05                        0.3                      0.000   0.05
0.4                   0.001   0.05                        0.4                      0.001   0.05
0.5                   0.001   0.05                        0.5                      0.001   0.05
0.6                   0.001   0.05                        0.6                      0.001   0.05
0.7                   0.001   0.05                        0.7                      0.001   0.05
0.8                   0.001   0.05                        0.8                      0.001   0.05
0.9                   0.001   0.05                        0.9                      0.001   0.05
1.0                   0.001   0.05                        1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 314.17
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 314.16
```

Bias and type 1 error rate for Mendelian randomization analysis of hip pain on sleeplessness/insomnia

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------          ---------------------------------------------------
0.0                   0.000   0.05                        0.0                      0.000   0.05
0.1                   0.000   0.05                        0.1                      0.000   0.05
0.2                   0.000   0.05                        0.2                      0.000   0.05
0.3                   0.000   0.05                        0.3                      0.000   0.05
0.4                   0.000   0.05                        0.4                      0.000   0.05
0.5                   0.000   0.05                        0.5                      0.000   0.05
0.6                   0.000   0.05                        0.6                      0.000   0.05
0.7                   0.000   0.05                        0.7                      0.000   0.05
0.8                   0.000   0.05                        0.8                      0.000   0.05
0.9                   0.000   0.05                        0.9                      0.000   0.05
1.0                   0.000   0.05                        1.0                      0.000   0.05


Concentration parameter (expected value of F statistic) = 2356.39
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 2356.38
```

Bias and type 1 error rate for Mendelian randomization analysis of knee pain on sleeplessness/insomnia

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion     Bias    Type 1 error rate
---------------------------------------------             ---------------------------------------------
0.0                    0.000   0.05                       0.0                    0.000   0.05
0.1                    0.000   0.05                       0.1                    0.000   0.05
0.2                    0.000   0.05                       0.2                    0.000   0.05
0.3                    0.000   0.05                       0.3                    0.000   0.05
0.4                    0.000   0.05                       0.4                    0.000   0.05
0.5                    0.000   0.05                       0.5                    0.000   0.05
0.6                    0.000   0.05                       0.6                    0.000   0.05
0.7                    0.000   0.05                       0.7                    0.000   0.05
0.8                    0.000   0.05                       0.8                    0.000   0.05
0.9                    0.000   0.05                       0.9                    0.000   0.05
1.0                    0.000   0.05                       1.0                    0.000   0.05


Concentration parameter (expected value of F statistic) = 856.86
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 856.85
```

Bias and type 1 error rate for Mendelian randomization analysis of no pain on sleeplessness/insomnia

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion     Bias    Type 1 error rate
---------------------------------------------             ---------------------------------------------
0.0                    0.000   0.05                       0.0                    0.000   0.05
0.1                    0.000   0.05                       0.1                    0.000   0.05
0.2                    0.000   0.05                       0.2                    0.000   0.05
0.3                    0.000   0.05                       0.3                    0.000   0.05
0.4                    0.001   0.05                       0.4                    0.001   0.05
0.5                    0.001   0.05                       0.5                    0.001   0.05
0.6                    0.001   0.05                       0.6                    0.001   0.05
0.7                    0.001   0.05                       0.7                    0.001   0.05
0.8                    0.001   0.05                       0.8                    0.001   0.05
0.9                    0.001   0.05                       0.9                    0.001   0.05
1.0                    0.002   0.05                       1.0                    0.002   0.05


Concentration parameter (expected value of F statistic) = 254.73
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.72
```

Bias and type 1 error rate for Mendelian randomization analysis of headache on anxiety/panic attacks

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion     Bias    Type 1 error rate
---------------------------------------------             ---------------------------------------------
0.0                    0.000   0.05                       0.0                    0.000   0.05
0.1                    0.000   0.05                       0.1                    0.000   0.05
0.2                    0.000   0.05                       0.2                    0.000   0.05
0.3                    0.001   0.05                       0.3                    0.001   0.05
0.4                    0.001   0.05                       0.4                    0.001   0.05
0.5                    0.001   0.05                       0.5                    0.001   0.05
0.6                    0.001   0.05                       0.6                    0.001   0.05
0.7                    0.001   0.05                       0.7                    0.001   0.05
0.8                    0.002   0.05                       0.8                    0.002   0.05
0.9                    0.002   0.05                       0.9                    0.002   0.05
1.0                    0.002   0.05                       1.0                    0.002   0.05


Concentration parameter (expected value of F statistic) = 209.44
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 209.43
```

Bias and type 1 error rate for Mendelian randomization analysis of facial pain on anxiety/panic attacks

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate     Overlap proportion      Bias    Type 1 error rate
---------------------------------------------------   ---------------------------------------------------
0.0                     0.000   0.05                  0.0                     0.000   0.05
0.1                     0.000   0.05                  0.1                     0.000   0.05
0.2                     0.000   0.05                  0.2                     0.000   0.05
0.3                     0.000   0.05                  0.3                     0.000   0.05
0.4                     0.000   0.05                  0.4                     0.000   0.05
0.5                     0.000   0.05                  0.5                     0.000   0.05
0.6                     0.000   0.05                  0.6                     0.000   0.05
0.7                     0.000   0.05                  0.7                     0.000   0.05
0.8                     0.001   0.05                  0.8                     0.001   0.05
0.9                     0.001   0.05                  0.9                     0.001   0.05
1.0                     0.001   0.05                  1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 589.08
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 589.08
```

Bias and type 1 error rate for Mendelian randomization analysis of neck/shoulder pain on anxiety/panic attacks

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate     Overlap proportion      Bias    Type 1 error rate
---------------------------------------------------   ---------------------------------------------------
0.0                     0.000   0.05                  0.0                     0.000   0.05
0.1                     0.000   0.05                  0.1                     0.000   0.05
0.2                     0.000   0.05                  0.2                     0.000   0.05
0.3                     0.000   0.05                  0.3                     0.000   0.05
0.4                     0.000   0.05                  0.4                     0.000   0.05
0.5                     0.000   0.05                  0.5                     0.000   0.05
0.6                     0.000   0.05                  0.6                     0.000   0.05
0.7                     0.000   0.05                  0.7                     0.000   0.05
0.8                     0.000   0.05                  0.8                     0.000   0.05
0.9                     0.000   0.05                  0.9                     0.000   0.05
1.0                     0.000   0.05                  1.0                     0.000   0.05


Concentration parameter (expected value of F statistic) = 1570.92
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 1570.91
```

Bias and type 1 error rate for Mendelian randomization analysis of back pain on anxiety/panic attacks

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate     Overlap proportion      Bias    Type 1 error rate
---------------------------------------------------   ---------------------------------------------------
0.0                     0.000   0.05                  0.0                     0.000   0.05
0.1                     0.000   0.05                  0.1                     0.000   0.05
0.2                     0.000   0.05                  0.2                     0.000   0.05
0.3                     0.000   0.05                  0.3                     0.000   0.05
0.4                     0.000   0.05                  0.4                     0.000   0.05
0.5                     0.000   0.05                  0.5                     0.000   0.05
0.6                     0.001   0.05                  0.6                     0.001   0.05
0.7                     0.001   0.05                  0.7                     0.001   0.05
0.8                     0.001   0.05                  0.8                     0.001   0.05
0.9                     0.001   0.05                  0.9                     0.001   0.05
1.0                     0.001   0.05                  1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 471.26
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 471.26
```

Bias and type 1 error rate for Mendelian randomization analysis of stomach/abdominal pain on anxiety/panic attacks

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate           Overlap proportion    Bias    Type 1 error rate
------------------------------------------------          -------------------------------------------------
0.0                   0.000   0.05                         0.0                  0.000   0.05
0.1                   0.000   0.05                         0.1                  0.000   0.05
0.2                   0.000   0.05                         0.2                  0.000   0.05
0.3                   0.000   0.05                         0.3                  0.000   0.05
0.4                   0.001   0.05                         0.4                  0.001   0.05
0.5                   0.001   0.05                         0.5                  0.001   0.05
0.6                   0.001   0.05                         0.6                  0.001   0.05
0.7                   0.001   0.05                         0.7                  0.001   0.05
0.8                   0.001   0.05                         0.8                  0.001   0.05
0.9                   0.001   0.05                         0.9                  0.001   0.05
1.0                   0.001   0.05                         1.0                  0.001   0.05


Concentration parameter (expected value of F statistic) = 314.17
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 314.16
```

Bias and type 1 error rate for Mendelian randomization analysis of hip pain on anxiety/panic attacks

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate           Overlap proportion    Bias    Type 1 error rate
------------------------------------------------          -------------------------------------------------
0.0                   0.000   0.05                         0.0                  0.000   0.05
0.1                   0.000   0.05                         0.1                  0.000   0.05
0.2                   0.000   0.05                         0.2                  0.000   0.05
0.3                   0.000   0.05                         0.3                  0.000   0.05
0.4                   0.000   0.05                         0.4                  0.000   0.05
0.5                   0.000   0.05                         0.5                  0.000   0.05
0.6                   0.000   0.05                         0.6                  0.000   0.05
0.7                   0.000   0.05                         0.7                  0.000   0.05
0.8                   0.000   0.05                         0.8                  0.000   0.05
0.9                   0.000   0.05                         0.9                  0.000   0.05
1.0                   0.000   0.05                         1.0                  0.000   0.05


Concentration parameter (expected value of F statistic) = 2356.39
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 2356.38
```

Bias and type 1 error rate for Mendelian randomization analysis of knee pain on anxiety/panic attacks

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate           Overlap proportion    Bias    Type 1 error rate
------------------------------------------------          -------------------------------------------------
0.0                   0.000   0.05                         0.0                  0.000   0.05
0.1                   0.000   0.05                         0.1                  0.000   0.05
0.2                   0.000   0.05                         0.2                  0.000   0.05
0.3                   0.000   0.05                         0.3                  0.000   0.05
0.4                   0.000   0.05                         0.4                  0.000   0.05
0.5                   0.000   0.05                         0.5                  0.000   0.05
0.6                   0.000   0.05                         0.6                  0.000   0.05
0.7                   0.000   0.05                         0.7                  0.000   0.05
0.8                   0.000   0.05                         0.8                  0.000   0.05
0.9                   0.000   0.05                         0.9                  0.000   0.05
1.0                   0.000   0.05                         1.0                  0.000   0.05


Concentration parameter (expected value of F statistic) = 856.86
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 856.85
```

Bias and type 1 error rate for Mendelian randomization analysis of no pain on anxiety/panic attacks

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
---------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 254.73
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.72
```

Bias and type 1 error rate for Mendelian randomization analysis of headache on depression

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
---------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.001   0.05                    0.3                     0.001   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.002   0.05                    0.8                     0.002   0.05
0.9                     0.002   0.05                    0.9                     0.002   0.05
1.0                     0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 209.44
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 209.43
```

Bias and type 1 error rate for Mendelian randomization analysis of facial pain on depression

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
---------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.000   0.05                    0.4                     0.000   0.05
0.5                     0.000   0.05                    0.5                     0.000   0.05
0.6                     0.000   0.05                    0.6                     0.000   0.05
0.7                     0.000   0.05                    0.7                     0.000   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 589.08
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 589.08
```

Bias and type 1 error rate for Mendelian randomization analysis of neck/shoulder pain on depression

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion    Bias    Type 1 error rate
-----------------------------------------------       -----------------------------------------------
0.0                   0.000   0.05                     0.0                   0.000   0.05
0.1                   0.000   0.05                     0.1                   0.000   0.05
0.2                   0.000   0.05                     0.2                   0.000   0.05
0.3                   0.000   0.05                     0.3                   0.000   0.05
0.4                   0.000   0.05                     0.4                   0.000   0.05
0.5                   0.000   0.05                     0.5                   0.000   0.05
0.6                   0.000   0.05                     0.6                   0.000   0.05
0.7                   0.000   0.05                     0.7                   0.000   0.05
0.8                   0.000   0.05                     0.8                   0.000   0.05
0.9                   0.000   0.05                     0.9                   0.000   0.05
1.0                   0.000   0.05                     1.0                   0.000   0.05


Concentration parameter (expected value of F statistic) = 1570.92
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 1570.91
```

Bias and type 1 error rate for Mendelian randomization analysis of back pain on depression

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion    Bias    Type 1 error rate
-----------------------------------------------       -----------------------------------------------
0.0                   0.000   0.05                     0.0                   0.000   0.05
0.1                   0.000   0.05                     0.1                   0.000   0.05
0.2                   0.000   0.05                     0.2                   0.000   0.05
0.3                   0.000   0.05                     0.3                   0.000   0.05
0.4                   0.000   0.05                     0.4                   0.000   0.05
0.5                   0.000   0.05                     0.5                   0.000   0.05
0.6                   0.000   0.05                     0.6                   0.000   0.05
0.7                   0.001   0.05                     0.7                   0.001   0.05
0.8                   0.001   0.05                     0.8                   0.001   0.05
0.9                   0.001   0.05                     0.9                   0.001   0.05
1.0                   0.001   0.05                     1.0                   0.001   0.05


Concentration parameter (expected value of F statistic) = 496.07
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 496.06
```

Bias and type 1 error rate for Mendelian randomization analysis of stomach/abdominal pain on depression

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion    Bias    Type 1 error rate
-----------------------------------------------       -----------------------------------------------
0.0                   0.000   0.05                     0.0                   0.000   0.05
0.1                   0.000   0.05                     0.1                   0.000   0.05
0.2                   0.000   0.05                     0.2                   0.000   0.05
0.3                   0.000   0.05                     0.3                   0.000   0.05
0.4                   0.000   0.05                     0.4                   0.000   0.05
0.5                   0.001   0.05                     0.5                   0.001   0.05
0.6                   0.001   0.05                     0.6                   0.001   0.05
0.7                   0.001   0.05                     0.7                   0.001   0.05
0.8                   0.001   0.05                     0.8                   0.001   0.05
0.9                   0.001   0.05                     0.9                   0.001   0.05
1.0                   0.001   0.05                     1.0                   0.001   0.05


Concentration parameter (expected value of F statistic) = 336.61
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 336.61
```

Bias and type 1 error rate for Mendelian randomization analysis of hip pain on depression

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate           Overlap proportion    Bias   Type 1 error rate
-------------------------------------------------         -------------------------------------------------
0.0                   0.000  0.05                         0.0                   0.000  0.05
0.1                   0.000  0.05                         0.1                   0.000  0.05
0.2                   0.000  0.05                         0.2                   0.000  0.05
0.3                   0.000  0.05                         0.3                   0.000  0.05
0.4                   0.000  0.05                         0.4                   0.000  0.05
0.5                   0.000  0.05                         0.5                   0.000  0.05
0.6                   0.000  0.05                         0.6                   0.000  0.05
0.7                   0.000  0.05                         0.7                   0.000  0.05
0.8                   0.000  0.05                         0.8                   0.000  0.05
0.9                   0.000  0.05                         0.9                   0.000  0.05
1.0                   0.000  0.05                         1.0                   0.000  0.05


Concentration parameter (expected value of F statistic) = 2356.39
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 2356.38
```

Bias and type 1 error rate for Mendelian randomization analysis of knee pain on depression

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate           Overlap proportion    Bias   Type 1 error rate
-------------------------------------------------         -------------------------------------------------
0.0                   0.000  0.05                         0.0                   0.000  0.05
0.1                   0.000  0.05                         0.1                   0.000  0.05
0.2                   0.000  0.05                         0.2                   0.000  0.05
0.3                   0.000  0.05                         0.3                   0.000  0.05
0.4                   0.000  0.05                         0.4                   0.000  0.05
0.5                   0.000  0.05                         0.5                   0.000  0.05
0.6                   0.000  0.05                         0.6                   0.000  0.05
0.7                   0.000  0.05                         0.7                   0.000  0.05
0.8                   0.000  0.05                         0.8                   0.000  0.05
0.9                   0.000  0.05                         0.9                   0.000  0.05
1.0                   0.000  0.05                         1.0                   0.000  0.05


Concentration parameter (expected value of F statistic) = 856.86
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 856.85
```

Bias and type 1 error rate for Mendelian randomization analysis of no pain on depression

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate           Overlap proportion    Bias   Type 1 error rate
-------------------------------------------------         -------------------------------------------------
0.0                   0.000  0.05                         0.0                   0.000  0.05
0.1                   0.000  0.05                         0.1                   0.000  0.05
0.2                   0.000  0.05                         0.2                   0.000  0.05
0.3                   0.000  0.05                         0.3                   0.000  0.05
0.4                   0.001  0.05                         0.4                   0.001  0.05
0.5                   0.001  0.05                         0.5                   0.001  0.05
0.6                   0.001  0.05                         0.6                   0.001  0.05
0.7                   0.001  0.05                         0.7                   0.001  0.05
0.8                   0.001  0.05                         0.8                   0.001  0.05
0.9                   0.001  0.05                         0.9                   0.001  0.05
1.0                   0.002  0.05                         1.0                   0.002  0.05


Concentration parameter (expected value of F statistic) = 254.73
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.72
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on headache

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
--------------------------------------------------          --------------------------------------------------
0.0                    0.000   0.05                        0.0                      0.000   0.05
0.1                    0.000   0.05                        0.1                      0.000   0.05
0.2                    0.000   0.05                        0.2                      0.000   0.05
0.3                    0.000   0.05                        0.3                      0.000   0.05
0.4                    0.001   0.05                        0.4                      0.001   0.05
0.5                    0.001   0.05                        0.5                      0.001   0.05
0.6                    0.001   0.05                        0.6                      0.001   0.05
0.7                    0.001   0.05                        0.7                      0.001   0.05
0.8                    0.001   0.05                        0.8                      0.001   0.05
0.9                    0.001   0.05                        0.9                      0.001   0.05
1.0                    0.002   0.05                        1.0                      0.002   0.05
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on headache

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
--------------------------------------------------          --------------------------------------------------
0.0                    0.000   0.05                        0.0                      0.000   0.05
0.1                    0.000   0.05                        0.1                      0.000   0.05
0.2                    0.000   0.05                        0.2                      0.000   0.05
0.3                    0.000   0.05                        0.3                      0.000   0.05
0.4                    0.001   0.05                        0.4                      0.001   0.05
0.5                    0.001   0.05                        0.5                      0.001   0.05
0.6                    0.001   0.05                        0.6                      0.001   0.05
0.7                    0.001   0.05                        0.7                      0.001   0.05
0.8                    0.001   0.05                        0.8                      0.001   0.05
0.9                    0.001   0.05                        0.9                      0.001   0.05
1.0                    0.002   0.05                        1.0                      0.002   0.05


Concentration parameter (expected value of F statistic) = 254.82
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.82
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on headache

```
Using specified value of concentration parameter          Using conservative value of concentration parameter
Overlap proportion     Bias    Type 1 error rate          Overlap proportion       Bias    Type 1 error rate
--------------------------------------------------          --------------------------------------------------
0.0                    0.000   0.05                        0.0                      0.000   0.05
0.1                    0.000   0.05                        0.1                      0.000   0.05
0.2                    0.000   0.05                        0.2                      0.000   0.05
0.3                    0.000   0.05                        0.3                      0.000   0.05
0.4                    0.001   0.05                        0.4                      0.001   0.05
0.5                    0.001   0.05                        0.5                      0.001   0.05
0.6                    0.001   0.05                        0.6                      0.001   0.05
0.7                    0.001   0.05                        0.7                      0.001   0.05
0.8                    0.001   0.05                        0.8                      0.001   0.05
0.9                    0.001   0.05                        0.9                      0.001   0.05
1.0                    0.001   0.05                        1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on facial pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------            ---------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 264.47
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 264.47
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on facial pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------            ---------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.000   0.05                    0.4                     0.000   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 377.88
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 377.88
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on facial pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------            ---------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.000   0.05                    0.4                     0.000   0.05
0.5                     0.000   0.05                    0.5                     0.000   0.05
0.6                     0.000   0.05                    0.6                     0.000   0.05
0.7                     0.000   0.05                    0.7                     0.000   0.05
0.8                     0.000   0.05                    0.8                     0.000   0.05
0.9                     0.000   0.05                    0.9                     0.000   0.05
1.0                     0.000   0.05                    1.0                     0.000   0.05


Concentration parameter (expected value of F statistic) = 860.08
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 860.07
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on neck/shoulder pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------      ----------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on neck/shoulder pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------      ----------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.000   0.05                    0.4                     0.000   0.05
0.5                     0.000   0.05                    0.5                     0.000   0.05
0.6                     0.000   0.05                    0.6                     0.000   0.05
0.7                     0.000   0.05                    0.7                     0.000   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 573.38
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 573.37
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on neck/shoulder pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------      ----------------------------------------------------
0.0                     0.000   0.05                    0.0                     0.000   0.05
0.1                     0.000   0.05                    0.1                     0.000   0.05
0.2                     0.000   0.05                    0.2                     0.000   0.05
0.3                     0.000   0.05                    0.3                     0.000   0.05
0.4                     0.001   0.05                    0.4                     0.001   0.05
0.5                     0.001   0.05                    0.5                     0.001   0.05
0.6                     0.001   0.05                    0.6                     0.001   0.05
0.7                     0.001   0.05                    0.7                     0.001   0.05
0.8                     0.001   0.05                    0.8                     0.001   0.05
0.9                     0.001   0.05                    0.9                     0.001   0.05
1.0                     0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on back pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate        Overlap proportion       Bias    Type 1 error rate
----------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                     0.0                      0.000   0.05
0.1                     0.000   0.05                     0.1                      0.000   0.05
0.2                     0.000   0.05                     0.2                      0.000   0.05
0.3                     0.000   0.05                     0.3                      0.000   0.05
0.4                     0.001   0.05                     0.4                      0.001   0.05
0.5                     0.001   0.05                     0.5                      0.001   0.05
0.6                     0.001   0.05                     0.6                      0.001   0.05
0.7                     0.001   0.05                     0.7                      0.001   0.05
0.8                     0.001   0.05                     0.8                      0.001   0.05
0.9                     0.001   0.05                     0.9                      0.001   0.05
1.0                     0.002   0.05                     1.0                      0.002   0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on back pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate        Overlap proportion       Bias    Type 1 error rate
----------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                     0.0                      0.000   0.05
0.1                     0.000   0.05                     0.1                      0.000   0.05
0.2                     0.000   0.05                     0.2                      0.000   0.05
0.3                     0.000   0.05                     0.3                      0.000   0.05
0.4                     0.000   0.05                     0.4                      0.000   0.05
0.5                     0.000   0.05                     0.5                      0.000   0.05
0.6                     0.000   0.05                     0.6                      0.000   0.05
0.7                     0.000   0.05                     0.7                      0.000   0.05
0.8                     0.001   0.05                     0.8                      0.001   0.05
0.9                     0.001   0.05                     0.9                      0.001   0.05
1.0                     0.001   0.05                     1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 573.38
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 573.37
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on back pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate        Overlap proportion       Bias    Type 1 error rate
----------------------------------------------           ----------------------------------------------
0.0                     0.000   0.05                     0.0                      0.000   0.05
0.1                     0.000   0.05                     0.1                      0.000   0.05
0.2                     0.000   0.05                     0.2                      0.000   0.05
0.3                     0.000   0.05                     0.3                      0.000   0.05
0.4                     0.001   0.05                     0.4                      0.001   0.05
0.5                     0.001   0.05                     0.5                      0.001   0.05
0.6                     0.001   0.05                     0.6                      0.001   0.05
0.7                     0.001   0.05                     0.7                      0.001   0.05
0.8                     0.001   0.05                     0.8                      0.001   0.05
0.9                     0.001   0.05                     0.9                      0.001   0.05
1.0                     0.001   0.05                     1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on stomach/abdominal pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate          Overlap proportion       Bias   Type 1 error rate
------------------------------------------------        ---------------------------------------------------
0.0                   0.000  0.05                        0.0                      0.000  0.05
0.1                   0.000  0.05                        0.1                      0.000  0.05
0.2                   0.000  0.05                        0.2                      0.000  0.05
0.3                   0.000  0.05                        0.3                      0.000  0.05
0.4                   0.001  0.05                        0.4                      0.001  0.05
0.5                   0.001  0.05                        0.5                      0.001  0.05
0.6                   0.001  0.05                        0.6                      0.001  0.05
0.7                   0.001  0.05                        0.7                      0.001  0.05
0.8                   0.001  0.05                        0.8                      0.001  0.05
0.9                   0.001  0.05                        0.9                      0.001  0.05
1.0                   0.002  0.05                        1.0                      0.002  0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on stomach/abdominal pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate          Overlap proportion       Bias   Type 1 error rate
------------------------------------------------        ---------------------------------------------------
0.0                   0.000  0.05                        0.0                      0.000  0.05
0.1                   0.000  0.05                        0.1                      0.000  0.05
0.2                   0.000  0.05                        0.2                      0.000  0.05
0.3                   0.000  0.05                        0.3                      0.000  0.05
0.4                   0.001  0.05                        0.4                      0.001  0.05
0.5                   0.001  0.05                        0.5                      0.001  0.05
0.6                   0.001  0.05                        0.6                      0.001  0.05
0.7                   0.001  0.05                        0.7                      0.001  0.05
0.8                   0.001  0.05                        0.8                      0.001  0.05
0.9                   0.001  0.05                        0.9                      0.001  0.05
1.0                   0.002  0.05                        1.0                      0.002  0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on stomach/abdominal pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion    Bias   Type 1 error rate          Overlap proportion       Bias   Type 1 error rate
------------------------------------------------        ---------------------------------------------------
0.0                   0.000  0.05                        0.0                      0.000  0.05
0.1                   0.000  0.05                        0.1                      0.000  0.05
0.2                   0.000  0.05                        0.2                      0.000  0.05
0.3                   0.000  0.05                        0.3                      0.000  0.05
0.4                   0.001  0.05                        0.4                      0.001  0.05
0.5                   0.001  0.05                        0.5                      0.001  0.05
0.6                   0.001  0.05                        0.6                      0.001  0.05
0.7                   0.001  0.05                        0.7                      0.001  0.05
0.8                   0.001  0.05                        0.8                      0.001  0.05
0.9                   0.001  0.05                        0.9                      0.001  0.05
1.0                   0.001  0.05                        1.0                      0.001  0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on hip pain

```
Using specified value of concentration parameter     Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate    Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------      ------------------------------------------------
0.0                     0.000   0.05                 0.0                      0.000   0.05
0.1                     0.000   0.05                 0.1                      0.000   0.05
0.2                     0.000   0.05                 0.2                      0.000   0.05
0.3                     0.000   0.05                 0.3                      0.000   0.05
0.4                     0.001   0.05                 0.4                      0.001   0.05
0.5                     0.001   0.05                 0.5                      0.001   0.05
0.6                     0.001   0.05                 0.6                      0.001   0.05
0.7                     0.001   0.05                 0.7                      0.001   0.05
0.8                     0.001   0.05                 0.8                      0.001   0.05
0.9                     0.001   0.05                 0.9                      0.001   0.05
1.0                     0.002   0.05                 1.0                      0.002   0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on hip pain

```
Using specified value of concentration parameter     Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate    Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------      ------------------------------------------------
0.0                     0.000   0.05                 0.0                      0.000   0.05
0.1                     0.000   0.05                 0.1                      0.000   0.05
0.2                     0.000   0.05                 0.2                      0.000   0.05
0.3                     0.000   0.05                 0.3                      0.000   0.05
0.4                     0.000   0.05                 0.4                      0.000   0.05
0.5                     0.000   0.05                 0.5                      0.000   0.05
0.6                     0.000   0.05                 0.6                      0.000   0.05
0.7                     0.000   0.05                 0.7                      0.000   0.05
0.8                     0.001   0.05                 0.8                      0.001   0.05
0.9                     0.001   0.05                 0.9                      0.001   0.05
1.0                     0.001   0.05                 1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 573.38
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 573.37
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on hip pain

```
Using specified value of concentration parameter     Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate    Overlap proportion       Bias    Type 1 error rate
-----------------------------------------------      ------------------------------------------------
0.0                     0.000   0.05                 0.0                      0.000   0.05
0.1                     0.000   0.05                 0.1                      0.000   0.05
0.2                     0.000   0.05                 0.2                      0.000   0.05
0.3                     0.000   0.05                 0.3                      0.000   0.05
0.4                     0.001   0.05                 0.4                      0.001   0.05
0.5                     0.001   0.05                 0.5                      0.001   0.05
0.6                     0.001   0.05                 0.6                      0.001   0.05
0.7                     0.001   0.05                 0.7                      0.001   0.05
0.8                     0.001   0.05                 0.8                      0.001   0.05
0.9                     0.001   0.05                 0.9                      0.001   0.05
1.0                     0.001   0.05                 1.0                      0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on knee pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
----------------------------------------------          ----------------------------------------------
0.0                     0.000   0.05                     0.0                     0.000   0.05
0.1                     0.000   0.05                     0.1                     0.000   0.05
0.2                     0.000   0.05                     0.2                     0.000   0.05
0.3                     0.000   0.05                     0.3                     0.000   0.05
0.4                     0.001   0.05                     0.4                     0.001   0.05
0.5                     0.001   0.05                     0.5                     0.001   0.05
0.6                     0.001   0.05                     0.6                     0.001   0.05
0.7                     0.001   0.05                     0.7                     0.001   0.05
0.8                     0.001   0.05                     0.8                     0.001   0.05
0.9                     0.001   0.05                     0.9                     0.001   0.05
1.0                     0.002   0.05                     1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on knee pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
----------------------------------------------          ----------------------------------------------
0.0                     0.000   0.05                     0.0                     0.000   0.05
0.1                     0.000   0.05                     0.1                     0.000   0.05
0.2                     0.000   0.05                     0.2                     0.000   0.05
0.3                     0.000   0.05                     0.3                     0.000   0.05
0.4                     0.000   0.05                     0.4                     0.000   0.05
0.5                     0.000   0.05                     0.5                     0.000   0.05
0.6                     0.000   0.05                     0.6                     0.000   0.05
0.7                     0.000   0.05                     0.7                     0.000   0.05
0.8                     0.001   0.05                     0.8                     0.001   0.05
0.9                     0.001   0.05                     0.9                     0.001   0.05
1.0                     0.001   0.05                     1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 573.38
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 573.37
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on knee pain

```
Using specified value of concentration parameter        Using conservative value of concentration parameter
Overlap proportion      Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
----------------------------------------------          ----------------------------------------------
0.0                     0.000   0.05                     0.0                     0.000   0.05
0.1                     0.000   0.05                     0.1                     0.000   0.05
0.2                     0.000   0.05                     0.2                     0.000   0.05
0.3                     0.000   0.05                     0.3                     0.000   0.05
0.4                     0.001   0.05                     0.4                     0.001   0.05
0.5                     0.001   0.05                     0.5                     0.001   0.05
0.6                     0.001   0.05                     0.6                     0.001   0.05
0.7                     0.001   0.05                     0.7                     0.001   0.05
0.8                     0.001   0.05                     0.8                     0.001   0.05
0.9                     0.001   0.05                     0.9                     0.001   0.05
1.0                     0.001   0.05                     1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```

Bias and type 1 error rate for Mendelian randomization analysis of sleeplessness/insomnia on no pain

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------    ---------------------------------------------------
0.0                   0.000   0.05                    0.0                     0.000   0.05
0.1                   0.000   0.05                    0.1                     0.000   0.05
0.2                   0.000   0.05                    0.2                     0.000   0.05
0.3                   0.000   0.05                    0.3                     0.000   0.05
0.4                   0.001   0.05                    0.4                     0.001   0.05
0.5                   0.001   0.05                    0.5                     0.001   0.05
0.6                   0.001   0.05                    0.6                     0.001   0.05
0.7                   0.001   0.05                    0.7                     0.001   0.05
0.8                   0.001   0.05                    0.8                     0.001   0.05
0.9                   0.001   0.05                    0.9                     0.001   0.05
1.0                   0.002   0.05                    1.0                     0.002   0.05


Concentration parameter (expected value of F statistic) = 254.68
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 254.67
```

Bias and type 1 error rate for Mendelian randomization analysis of anxiety/panic attacks on no pain

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------    ---------------------------------------------------
0.0                   0.000   0.05                    0.0                     0.000   0.05
0.1                   0.000   0.05                    0.1                     0.000   0.05
0.2                   0.000   0.05                    0.2                     0.000   0.05
0.3                   0.000   0.05                    0.3                     0.000   0.05
0.4                   0.000   0.05                    0.4                     0.000   0.05
0.5                   0.000   0.05                    0.5                     0.000   0.05
0.6                   0.000   0.05                    0.6                     0.000   0.05
0.7                   0.000   0.05                    0.7                     0.000   0.05
0.8                   0.001   0.05                    0.8                     0.001   0.05
0.9                   0.001   0.05                    0.9                     0.001   0.05
1.0                   0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 573.38
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 573.37
```

Bias and type 1 error rate for Mendelian randomization analysis of depression on no pain

```
Using specified value of concentration parameter      Using conservative value of concentration parameter
Overlap proportion    Bias    Type 1 error rate       Overlap proportion      Bias    Type 1 error rate
--------------------------------------------------    ---------------------------------------------------
0.0                   0.000   0.05                    0.0                     0.000   0.05
0.1                   0.000   0.05                    0.1                     0.000   0.05
0.2                   0.000   0.05                    0.2                     0.000   0.05
0.3                   0.000   0.05                    0.3                     0.000   0.05
0.4                   0.001   0.05                    0.4                     0.001   0.05
0.5                   0.001   0.05                    0.5                     0.001   0.05
0.6                   0.001   0.05                    0.6                     0.001   0.05
0.7                   0.001   0.05                    0.7                     0.001   0.05
0.8                   0.001   0.05                    0.8                     0.001   0.05
0.9                   0.001   0.05                    0.9                     0.001   0.05
1.0                   0.001   0.05                    1.0                     0.001   0.05


Concentration parameter (expected value of F statistic) = 295.22
Conservative value of concentration parameter (lower limit of one-sided 95% confidence interval) = 295.21
```