Supplementary file 7

Estimated biases due to sample overlap

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

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 paramet	er (expec	ted value of F statist	ic) = 209.44		

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

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
9.1	0.000	0.05	0.1	0.000	0.05
0.2	0.000	0.05	0.2	0.000	0.05
a.3	0.000	0.05	0.3	0.000	0.05
9.4	0.001	0.05	0.4	0.001	0.05
a.5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
9.7	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
`oncentration narame	ter (expec	ted value of F statist:	ic) = 291 57		

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

	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
).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
).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
0	0.001	0.05	1.0	0.001	0.05

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

		Type 1 error rate			• •
 0.0	0.000	0.05	0.0	0.000	0.05
9.1	0.000	0.05	0.1	0.000	0.05
9.2	0.000	0.05	0.2	0.000	0.05
9.3	0.001	0.05	0.3	0.001	0.05
9.4	0.001	0.05	0.4	0.001	0.05
).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
9.8	0.001	0.05	0.8	0.001	0.05
9.9	0.002	0.05	0.9	0.002	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 stomach/abdominal pain on sleeplessness/insomnia

	Type 1 error rate	Overlap proportion 0.0		
		0.0	0.000	0.05
0.000	0.05	0.1	0.000	0.05
0.000	0.05	0.2	0.000	0.05
0.000	0.05	0.3	0.000	0.05
0.001	0.05	0.4	0.001	0.05
0.001	0.05	0.5	0.001	0.05
0.001	0.05	0.6	0.001	0.05
0.001	0.05	0.7	0.001	0.05
0.001	0.05	0.8	0.001	0.05
0.001	0.05	0.9	0.001	0.05
0.001	0.05	1.0	0.001	0.05
	0.000 0.000 0.001 0.001 0.001 0.001 0.001	0.000 0.05 0.000 0.05 0.001 0.05 0.001 0.05 0.001 0.05 0.001 0.05 0.001 0.05 0.001 0.05	0.000 0.05 0.2 0.000 0.05 0.3 0.001 0.05 0.4 0.001 0.05 0.5 0.001 0.05 0.6 0.001 0.05 0.7 0.001 0.05 0.8 0.001 0.05 0.9	0.000 0.05 0.2 0.000 0.000 0.05 0.3 0.000 0.001 0.05 0.4 0.001 0.001 0.05 0.5 0.001 0.001 0.05 0.6 0.001 0.001 0.05 0.7 0.001 0.001 0.05 0.8 0.001 0.001 0.05 0.9 0.001

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

		ntration parameter	•		•
Overlap proportion	Bias	Type 1 error rate			
 3.0	0.000	0.05	0.0	0.000	0.05
9.1	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
9.6	0.000	0.05	0.6	0.000	0.05
ð.7	0.000	0.05	0.7	0.000	0.05
8.8	0.000	0.05	0.8	0.000	0.05
9.9	0.000	0.05	0.9	0.000	0.05
1.0	0.000	0.05	1.0	0.000	0.05
Concentration paramet	er (expec	ted value of F statisti	.c) = 2356.39		
Conservative value of	concentr	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 2356.38

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

veriap proportion		Type 1 error rate	Overlap proportion		Type 1 error rate
.0	0.000	0.05	0.0	0.000	0.05
.1	0.000	0.05	0.1	0.000	0.05
.2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.000	0.05	0.4	0.000	0.05
.5	0.000	0.05	0.5	0.000	0.05
.6	0.000	0.05	0.6	0.000	0.05
.7	0.000	0.05	0.7	0.000	0.05
.8	0.000	0.05	0.8	0.000	0.05
.9	0.000	0.05	0.9	0.000	0.05
.0	0.000	0.05	1.0	0.000	0.05

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

		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 paramet	ter (expect	ted value of F statist	ic) = 254.73		

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

Verlap 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
).2	0.000	0.05	0.2	0.000	0.05
0.3	0.001	0.05	0.3	0.001	0.05
).4	0.001	0.05	0.4	0.001	0.05
).5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
).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
0	0.002	0.05	1.0	0.002	0.05
oncentration paramet	er (expect	ted value of F statisti	(c) = 209.44		

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

Using specified value o		•	Using conservative value		
Overlap proportion		• •	Overlap proportion		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	(expect	ed value of F statistic)	= 589.08		
Conservative value of c	oncentra	tion parameter (lower li	mit of one-sided 95% con	fidence	interval) = 589.08

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

0.000 0.000	0.05	0.0	0.000	0.05
		0.0	0.000	0.05
	0.05	0.1	0.000	0.05
0.000	0.05	0.2	0.000	0.05
0.000	0.05	0.3	0.000	0.05
0.000	0.05	0.4	0.000	0.05
0.000	0.05	0.5	0.000	0.05
0.000	0.05	0.6	0.000	0.05
0.000	0.05	0.7	0.000	0.05
0.000	0.05	0.8	0.000	0.05
0.000	0.05	0.9	0.000	0.05
0.000	0.05	1.0	0.000	0.05
	0.000 0.000 0.000 0.000 0.000 0.000	0.000 0.05 0.000 0.05 0.000 0.05 0.000 0.05 0.000 0.05 0.000 0.05 0.000 0.05	0.000 0.05 0.3 0.000 0.05 0.4 0.000 0.05 0.5 0.000 0.05 0.6 0.000 0.05 0.7 0.000 0.05 0.8 0.000 0.05 0.9	0.000 0.05 0.3 0.000 0.000 0.05 0.4 0.000 0.000 0.05 0.5 0.000 0.000 0.05 0.6 0.000 0.000 0.05 0.7 0.000 0.000 0.05 0.8 0.000 0.000 0.05 0.9 0.000

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

verlap 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
.1	0.000	0.05	0.1	0.000	0.05
.2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.000	0.05	0.4	0.000	0.05
.5	0.000	0.05	0.5	0.000	0.05
0.6	0.001	0.05	0.6	0.001	0.05
.7	0.001	0.05	0.7	0.001	0.05
.8	0.001	0.05	0.8	0.001	0.05
0.9	0.001	0.05	0.9	0.001	0.05
0	0.001	0.05	1.0	0.001	0.05

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

Overlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
9.0	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
9.4	0.001	0.05	0.4	0.001	0.05
0.5	0.001	0.05	0.5	0.001	0.05
9.6	0.001	0.05	0.6	0.001	0.05
ð.7	0.001	0.05	0.7	0.001	0.05
9.8	0.001	0.05	0.8	0.001	0.05
a.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
Concentration paramet	er (expec	ted value of F statist	ic) = 314.17		

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

		ntration 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
9.1	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
9.4	0.000	0.05	0.4	0.000	0.05
9.5	0.000	0.05	0.5	0.000	0.05
9.6	0.000	0.05	0.6	0.000	0.05
9.7	0.000	0.05	0.7	0.000	0.05
9.8	0.000	0.05	0.8	0.000	0.05
9.9	0.000	0.05	0.9	0.000	0.05
1.0	0.000	0.05	1.0	0.000	0.05
Concentration paramete	er (expec	ted value of F statisti	.c) = 2356.39		
•			limit of one-sided 95% c	c:	:

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

.		ntration 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
9.6	0.000	0.05	0.6	0.000	0.05
ð.7	0.000	0.05	0.7	0.000	0.05
9.8	0.000	0.05	0.8	0.000	0.05
a.9	0.000	0.05	0.9	0.000	0.05
1.0	0.000	0.05	1.0	0.000	0.05
Concentration paramet	er (expec	ed value of F statisti	ic) = 856.86		
Conservative value of	concentra	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 856.85

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

erlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
.0	0.000	0.05	0.0	0.000	0.05
.1	0.000	0.05	0.1	0.000	0.05
. 2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.001	0.05	0.4	0.001	0.05
.5	0.001	0.05	0.5	0.001	0.05
.6	0.001	0.05	0.6	0.001	0.05
.7	0.001	0.05	0.7	0.001	0.05
.8	0.001	0.05	0.8	0.001	0.05
.9	0.001	0.05	0.9	0.001	0.05
.0	0.002	0.05	1.0	0.002	0.05
oncentration paramet	ter (expect	ted value of F statist:	ic) = 254.73		

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

Using specified value	of conce	ntration parameter	Using conservative va	lue of co	ncentration parameter
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 paramete	er (expec	ted value of F statist	ic) = 209.44		
•			limit of one-sided 95% c	onfidence	interval) = 209.43

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

•		ntration parameter Type 1 error rate	Using conservative va Overlap proportion		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
9.8	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

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

Overlap proportion		**	Overlap proportion		Type 1 error rate
9.0	0.000	0.05	0.0	0.000	0.05
9.1	0.000	0.05	0.1	0.000	0.05
9.2	0.000	0.05	0.2	0.000	0.05
9.3	0.000	0.05	0.3	0.000	0.05
9.4	0.000	0.05	0.4	0.000	0.05
9.5	0.000	0.05	0.5	0.000	0.05
9.6	0.000	0.05	0.6	0.000	0.05
a.7	0.000	0.05	0.7	0.000	0.05
9.8	0.000	0.05	0.8	0.000	0.05
9.9	0.000	0.05	0.9	0.000	0.05
1.0	0.000	0.05	1.0	0.000	0.05
Concentration paramet	ter (expect	ted value of F statisti	ic) = 1570.92		

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

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
9.3	0.000	0.05	0.3	0.000	0.05
9.4	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
ð.7	0.001	0.05	0.7	0.001	0.05
8.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05

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

Using specified value	of conce	ntration parameter	Using conservative va	lue of co	ncentration 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 paramet	er (expec	ted value of F statist	ic) = 336.61		
Conservative value of	concentra	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 336.61

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

Overlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
 0.0			0.0		
	0.000	0.05		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
9.6	0.000	0.05	0.6	0.000	0.05
ð.7	0.000	0.05	0.7	0.000	0.05
9.8	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 paramet	er (expec	ted value of F statisti	ic) = 2356.39		

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

		ntration parameter Type 1 error rate	•		
ap proportion			Overlap proportion		* 1
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 paramet	er (expec	ted value of F statist:	ic) = 856.86		

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

Using specified value	of conce	ntration parameter	,			
Overlap proportion	Bias	Type 1 error rate			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	
9.4	0.001	0.05	0.4	0.001	0.05	
0.5	0.001	0.05	0.5	0.001	0.05	
9.6	0.001	0.05	0.6	0.001	0.05	
9.7	0.001	0.05	0.7	0.001	0.05	
9.8	0.001	0.05	0.8	0.001	0.05	
9.9	0.001	0.05	0.9	0.001	0.05	
1.0	0.002	0.05	1.0	0.002	0.05	
`oncentration naramet	er (eynec	ted value of F statist:	ic) - 254 73			

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 paramet		
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

Jsing specified value Overlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
9.0	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
9.4	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
ð.7	0.001	0.05	0.7	0.001	0.05
9.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.002	0.05	1.0	0.002	0.05
Concentration paramete	er (expec	ted value of F statist	ic) = 254.82		

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

verlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
		71			• •
.0	0.000	0.05	0.0	0.000	0.05
.1	0.000	0.05	0.1	0.000	0.05
.2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.001	0.05	0.4	0.001	0.05
.5	0.001	0.05	0.5	0.001	0.05
.6	0.001	0.05	0.6	0.001	0.05
.7	0.001	0.05	0.7	0.001	0.05
.8	0.001	0.05	0.8	0.001	0.05
.9	0.001	0.05	0.9	0.001	0.05
.0	0.001	0.05	1.0	0.001	0.05

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

Overlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
 3.0	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
9.5	0.001	0.05	0.5	0.001	0.05
9.6	0.001	0.05	0.6	0.001	0.05
a.7	0.001	0.05	0.7	0.001	0.05
9.8	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 paramet	er (expect	ted value of F statist:	ic) = 264.47		

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

verlan 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
).5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
).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
.0	0.001	0.05	1.0	0.001	0.05

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

	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
		* '			• •
.0	0.000	0.05	0.0	0.000	0.05
.1	0.000	0.05	0.1	0.000	0.05
.2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.000	0.05	0.4	0.000	0.05
.5	0.000	0.05	0.5	0.000	0.05
.6	0.000	0.05	0.6	0.000	0.05
.7	0.000	0.05	0.7	0.000	0.05
.8	0.000	0.05	0.8	0.000	0.05
.9	0.000	0.05	0.9	0.000	0.05
.0	0.000	0.05	1.0	0.000	0.05

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

Overlap proportion		Type 1 error rate	Overlap proportion		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
ð.7	0.001	0.05	0.7	0.001	0.05
9.8	0.001	0.05	0.8	0.001	0.05
9.9	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 neck/shoulder pain

		ntration parameter	•		
overiap proportion	Blas	Type 1 error rate		Blas	Type 1 error rate
ə.0	0.000	0.05	0.0	0.000	0.05
9.1	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
9.4	0.000	0.05	0.4	0.000	0.05
0.5	0.000	0.05	0.5	0.000	0.05
9.6	0.000	0.05	0.6	0.000	0.05
ð.7	0.000	0.05	0.7	0.000	0.05
9.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
Concentration paramet	er (expect	ted value of F statist	ic) = 573.38		

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

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 0.7 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	Jsing specified value			Using conservative va		
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 0.001 0.05			• •	Overlap proportion	Blas	Type I error rate
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 0.7 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				0 0	9.999	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 0.001 0.05	9.1					
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 0.001 0.05	9.2	0.000	0.05	0.2	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	0.3	0.000	0.05	0.3	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	9.4	0.001	0.05	0.4	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	9.5	0.001	0.05	0.5	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	9.6	0.001	0.05	0.6	0.001	0.05
0.9 0.001 0.05 0.9 0.001 0.05	9.7	0.001	0.05	0.7	0.001	0.05
	9.8	0.001	0.05	0.8	0.001	0.05
0 0.001 0.05 1.0 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

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

wonlan proportion	Pioc	Type 1 error rate	Using conservative va Overlap proportion	Pioc	Type 1 error rate
Mentab broboncion	DIAS	Type I error rate	Overlap proportion	DIAS	Type I 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
).2	0.000	0.05	0.2	0.000	0.05
).3	0.000	0.05	0.3	0.000	0.05
0.4	0.001	0.05	0.4	0.001	0.05
).5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
).7	0.001	0.05	0.7	0.001	0.05
0.8	0.001	0.05	0.8	0.001	0.05
).9	0.001	0.05	0.9	0.001	0.05
0	0.002	0.05	1.0	0.002	0.05
`ancontration nament	on (ovnos	ted value of F statist:	ic) - 254 68		

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

Overlap proportion	Ricc	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
ap proportion		* 1	Overlap proportion		
ð.0	0.000	0.05	0.0	0.000	0.05
9.1	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
a.7	0.000	0.05	0.7	0.000	0.05
9.8	0.001	0.05	0.8	0.001	0.05
a.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
Concentration paramet	er (expec	ted value of F statist	ic) = 573.38		

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

• • •				•	
Using specified value	of conce	ntration parameter	Using conservative va	lue of co	ncentration paramete
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
a.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
Concentration paramete	er (expec	ted value of F statist	ic) = 295.22		
Conservative value of	concentr	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 295.21

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

.0	0.000	0.05	0.0	0.000	0.05
.1	0.000	0.05	0.1	0.000	0.05
.2	0.000	0.05	0.2	0.000	0.05
.3	0.000	0.05	0.3	0.000	0.05
.4	0.001	0.05	0.4	0.001	0.05
.5	0.001	0.05	0.5	0.001	0.05
.6	0.001	0.05	0.6	0.001	0.05
.7	0.001	0.05	0.7	0.001	0.05
.8	0.001	0.05	0.8	0.001	0.05
.9	0.001	0.05	0.9	0.001	0.05
.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 stomach/abdominal pain

•		ntration parameter	•		·
Overlap proportion	Bias	Type 1 error rate	Overlap proportion	Bias	Type 1 error rate
	0.000	0.05	0.0	0.000	0.05
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
9.6	0.001	0.05	0.6	0.001	0.05
9.7	0.001	0.05	0.7	0.001	0.05
8.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.002	0.05	1.0	0.002	0.05
Concentration paramet	er (expec	ted value of F statisti	.c) = 254.68		
onservative value of	concentn	ation parameter (lower	limit of one-sided 95% c	onfidonco	intonvol) - 254 67

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

Using specified value			Using conservative va		•
Overlap proportion			Overlap proportion		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
9.2	0.000	0.05	0.2	0.000	0.05
9.3	0.000	0.05	0.3	0.000	0.05
9.4	0.001	0.05	0.4	0.001	0.05
9.5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
).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
oncentration paramet	er (expec	ted value of F statist:	ic) = 295.22		
Conservative value of	concentra	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 295.21

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

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
ð.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 paramet	er (expect	ted value of F statist	ic) = 254.68		

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

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 paramet	er (expec	ted value of F statist:	ic) = 573.38		

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

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
9.3	0.000	0.05	0.3	0.000	0.05
0.4	0.001	0.05	0.4	0.001	0.05
9.5	0.001	0.05	0.5	0.001	0.05
9.6	0.001	0.05	0.6	0.001	0.05
ð.7	0.001	0.05	0.7	0.001	0.05
8.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05

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

					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
).7	0.001	0.05	0.7	0.001	0.05
0.8	0.001	0.05	0.8	0.001	0.05
).9	0.001	0.05	0.9	0.001	0.05
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 knee pain ${\bf r}$

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
.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
.5	0.000	0.05	0.5	0.000	0.05
.6	0.000	0.05	0.6	0.000	0.05
.7	0.000	0.05	0.7	0.000	0.05
.8	0.001	0.05	0.8	0.001	0.05
.9	0.001	0.05	0.9	0.001	0.05
.0	0.001	0.05	1.0	0.001	0.05
oncentration paramet	er (expec	ted value of F statist	ic) = 573.38		

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

Jsing specified value	Bias Type 1 error rate		_	Bias Type 1 error rat	
		Type I error rate	Overlap proportion		* 1
0.0	0.000	0.05	0.0	0.000	0.05
9.1	0.000	0.05	0.1	0.000	0.05
0.2	0.000	0.05	0.2	0.000	0.05
ð.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
ð.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 paramete	er (expec	ted value of F statist	ic) = 295.22		

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

		ntration parameter Type 1 error rate	•		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 paramet	er (expec	ted value of F statist:	ic) = 254.68		
onservative value of	concentr	ation parameter (lower	limit of one-sided 95% c	onfidence	interval) = 254.67

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

Ovenlan prepention	Ricc	Type 1 error rate	Ovenlan prepention	Bias Type 1 error rate	
		Type I error rate	Overlap proportion		
ð.0	0.000	0.05	0.0	0.000	0.05
9.1	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
9.4	0.000	0.05	0.4	0.000	0.05
0.5	0.000	0.05	0.5	0.000	0.05
9.6	0.000	0.05	0.6	0.000	0.05
ð.7	0.000	0.05	0.7	0.000	0.05
9.8	0.001	0.05	0.8	0.001	0.05
9.9	0.001	0.05	0.9	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
1.0	0.001	0.05	1.0	0.001	0.05
Concentration narame	ten (evnec	ted value of F statist	ic) - 573 38		

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

•		ntration parameter	_		
		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
).2	0.000	0.05	0.2	0.000	0.05
).3	0.000	0.05	0.3	0.000	0.05
).4	0.001	0.05	0.4	0.001	0.05
).5	0.001	0.05	0.5	0.001	0.05
0.6	0.001	0.05	0.6	0.001	0.05
).7	0.001	0.05	0.7	0.001	0.05
0.8	0.001	0.05	0.8	0.001	0.05
).9	0.001	0.05	0.9	0.001	0.05
0	0.001	0.05	1.0	0.001	0.05
oncentration paramete	er (exnec	ed value of F statistic	c) = 295 22		
·			limit of one-sided 95% c	6: 4	:-t1) 205 21