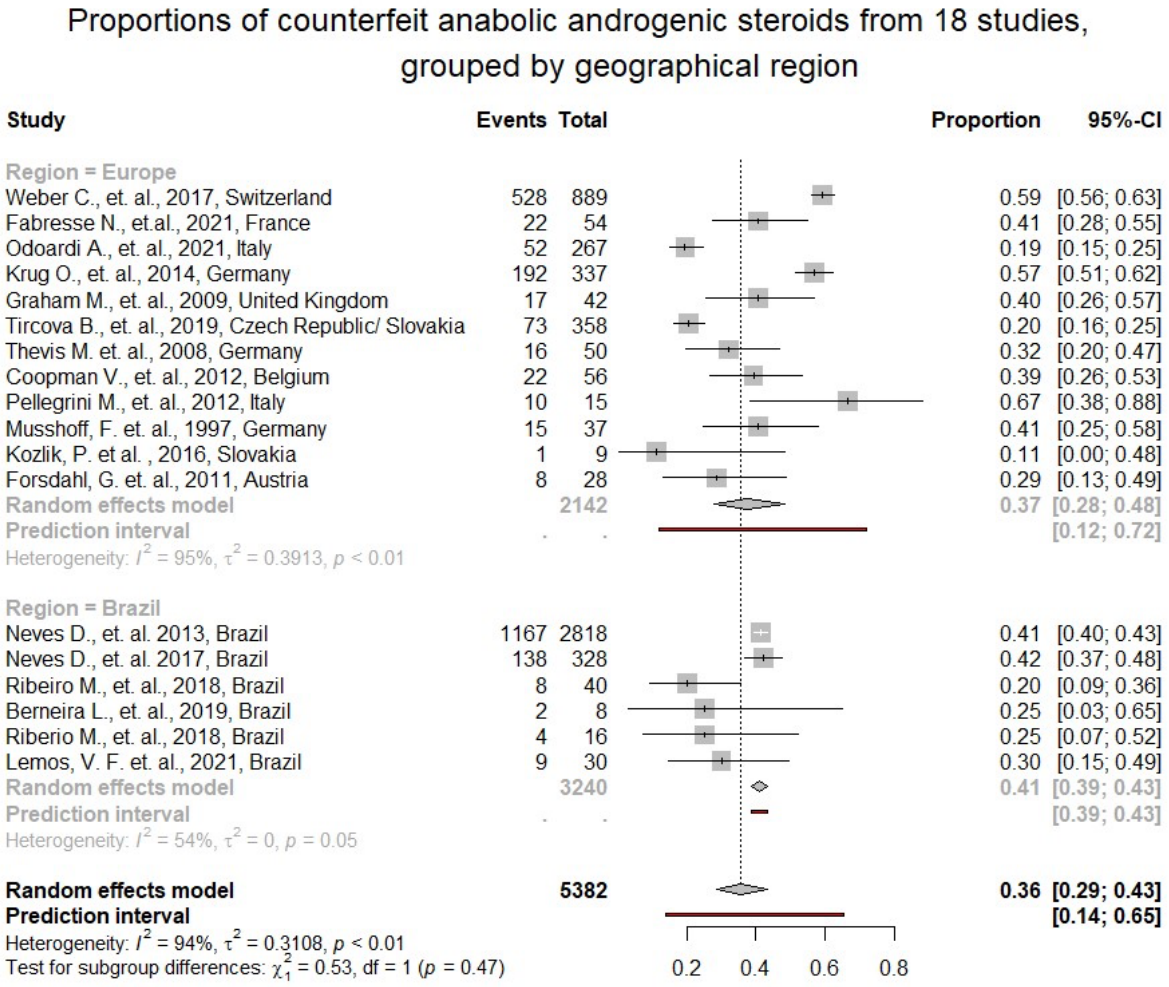
Fake Anabolic Androgenic Steroids on the Black Market – a systematic review and meta-analysis

MAIN OUTCOME 1:
Proportions of counterfeit AAS-samples



Number of studies combined: k = 18
Number of observations: o = 5382
Number of events: e = 2284

	proportion	95%-CI
Random effects model	0.3573	[0.2869; 0.4346]
Prediction interval		[0.1403; 0.6545]

Quantifying heterogeneity:

tau^2 = 0.3108; tau = 0.5575; I^2 = 93.7% [91.4%; 95.4%]; H = 3.98 [3.41; 4.65]

Test of heterogeneity:

Q	d.f.	p-value	Test
269.34	17	< 0.0001	Wald-type
301.17	17	< 0.0001	Likelihood-Ratio

Results for subgroups (random effects model):

	k	proportion	95%-CI	tau^2	tau	Q	I^2
Region = Europe	12	0.3742	[0.2770; 0.4828]	0.3913	0.6256	244.19	95.5%
Region = Brazil	6	0.4099	[0.3879; 0.4323]	0	0	10.94	54.3%

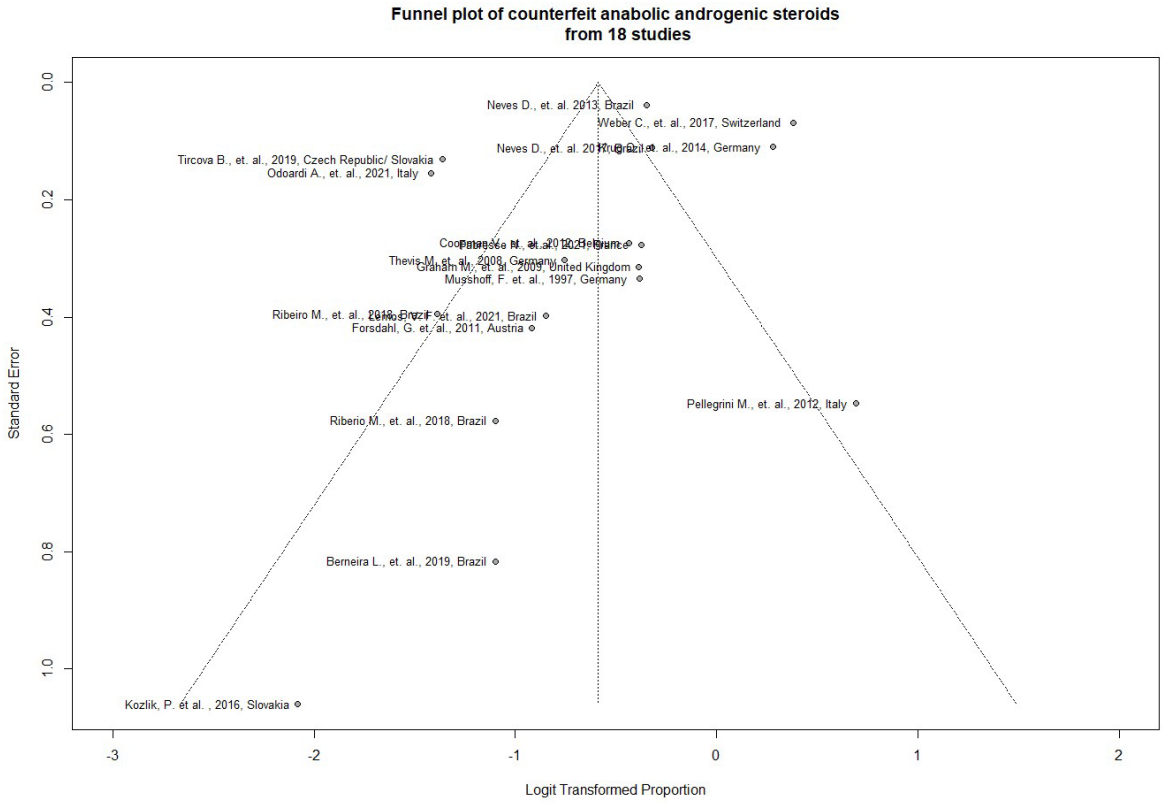
Test for subgroup differences (random effects model):

	Q	d.f.	p-value
Between groups	0.53	1	0.4662

Prediction intervals for subgroups:

	95%-PI
Region = Europe	[0.1214; 0.7213]
Region = Brazil	[0.3861; 0.4341]

Details on meta-analytical method:
- Random intercept logistic regression model
- Maximum-likelihood estimator for tau^2
- Hartung-Knapp adjustment for random effects model
- Logit transformation
- Clopper-Pearson confidence interval for individual studies



Review: Counterfeit

Linear regression test of funnel plot asymmetry

Test result: t = -0.80, df = 16, p-value = 0.4365

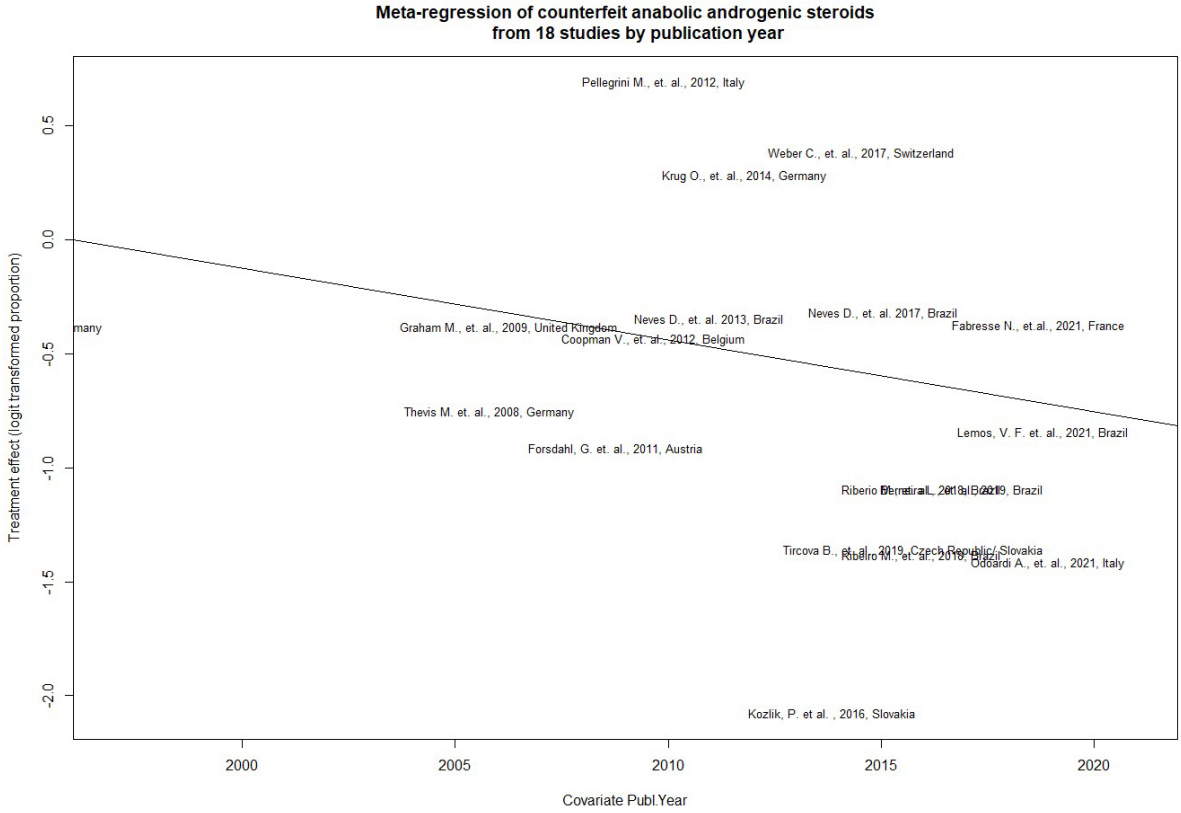
Sample estimates:

bias	se.bias	intercept	se.intercept
-10.3550	12.9735	-0.2476	0.1206

Details:

- multiplicative residual heterogeneity variance (tau^2 = 16.1889)
- predictor: inverse of total sample size
- weight: inverse variance of average event probability
- reference: Peters et al. (2006), JAMA

Meta-regression by publication year



Mixed-Effects Model (k = 18; tau^2 estimator: ML)

tau^2 (estimated amount of residual heterogeneity): 0.2842
tau (square root of estimated tau^2 value): 0.5331
I^2 (residual heterogeneity / unaccounted variability): 92.2615%
H^2 (unaccounted variability / sampling variability): 12.9224

Tests for Residual Heterogeneity:

Wld(df = 16) = 265.3596, p-val < .0001
LRT(df = 16) = 289.6485, p-val < .0001

Test of Moderators (coefficient 2):

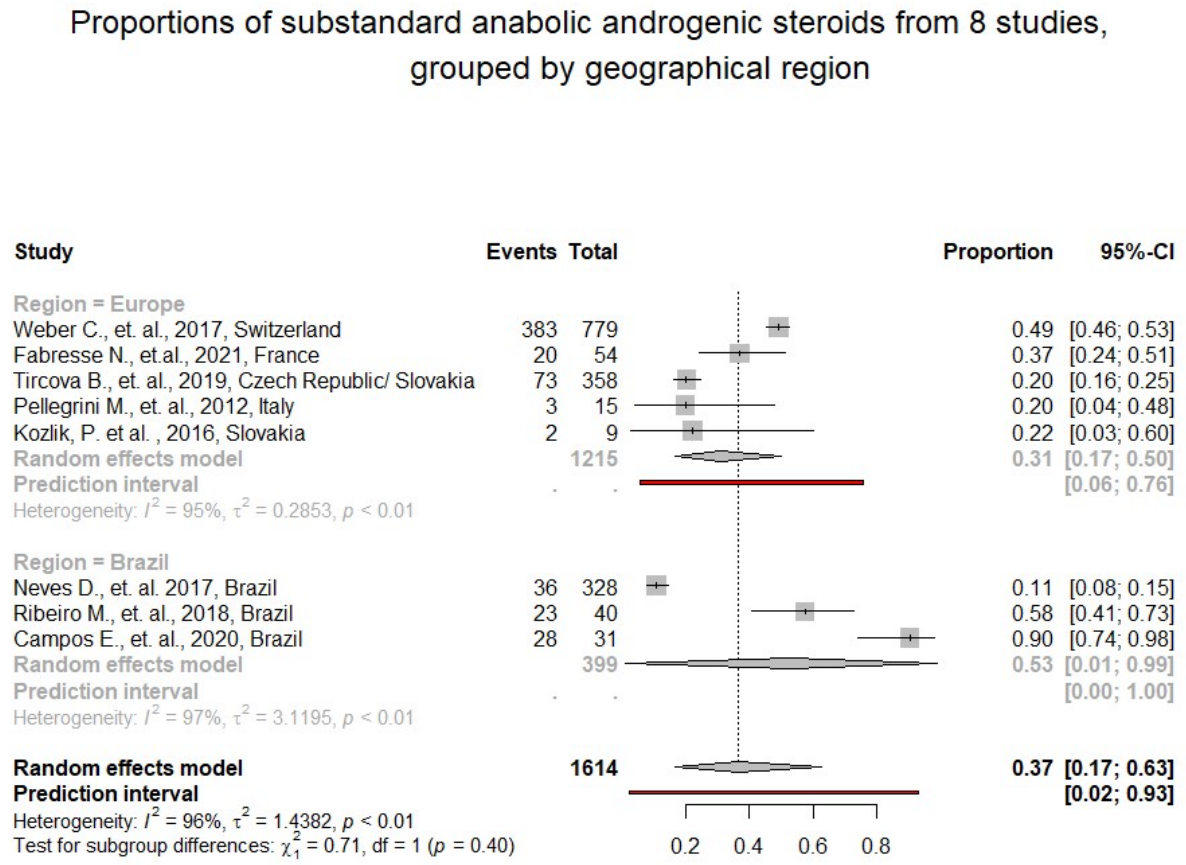
F(df1 = 1, df2 = 16) = 1.5458, p-val = 0.2317

Model Results:

	estimate	se	tval	df	pval	ci.lb	ci.ub
intrcpt	62.8358	51.0089	1.2319	16	0.2358	-45.2983	170.9699
Publ.Year	-0.0315	0.0253	-1.2433	16	0.2317	-0.0852	0.0222

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

MAIN OUTCOME 2:
Proportions of substandard AAS-samples



Number of studies combined: k = 8
Number of observations: o = 1614
Number of events: e = 568

	proportion	95%-CI
Random effects model	0.3683	[0.1681; 0.6273]
Prediction interval		[0.0248; 0.9304]

Quantifying heterogeneity:
tau^2 = 1.4382; tau = 1.1993; I^2 = 96.4% [94.7%; 97.6%]; H = 5.29 [4.33; 6.48]

Test of heterogeneity:

Q	d.f.	p-value	Test
196.24	7	< 0.0001	Wald-type
254.95	7	< 0.0001	Likelihood-Ratio

Results for subgroups (random effects model):

	k	proportion	95%-CI	tau^2	tau	Q	I^2
Region = Europe	5	0.3096	[0.1664; 0.5017]	0.2853	0.5341	83.25	95.2%

Region = Brazil 3 0.5289 [0.0123; 0.9902] 3.1195 1.7662 79.09 97.5%

Test for subgroup differences (random effects model):

Q d.f. p-value

Between groups 0.71 1 0.3981

Prediction intervals for subgroups:

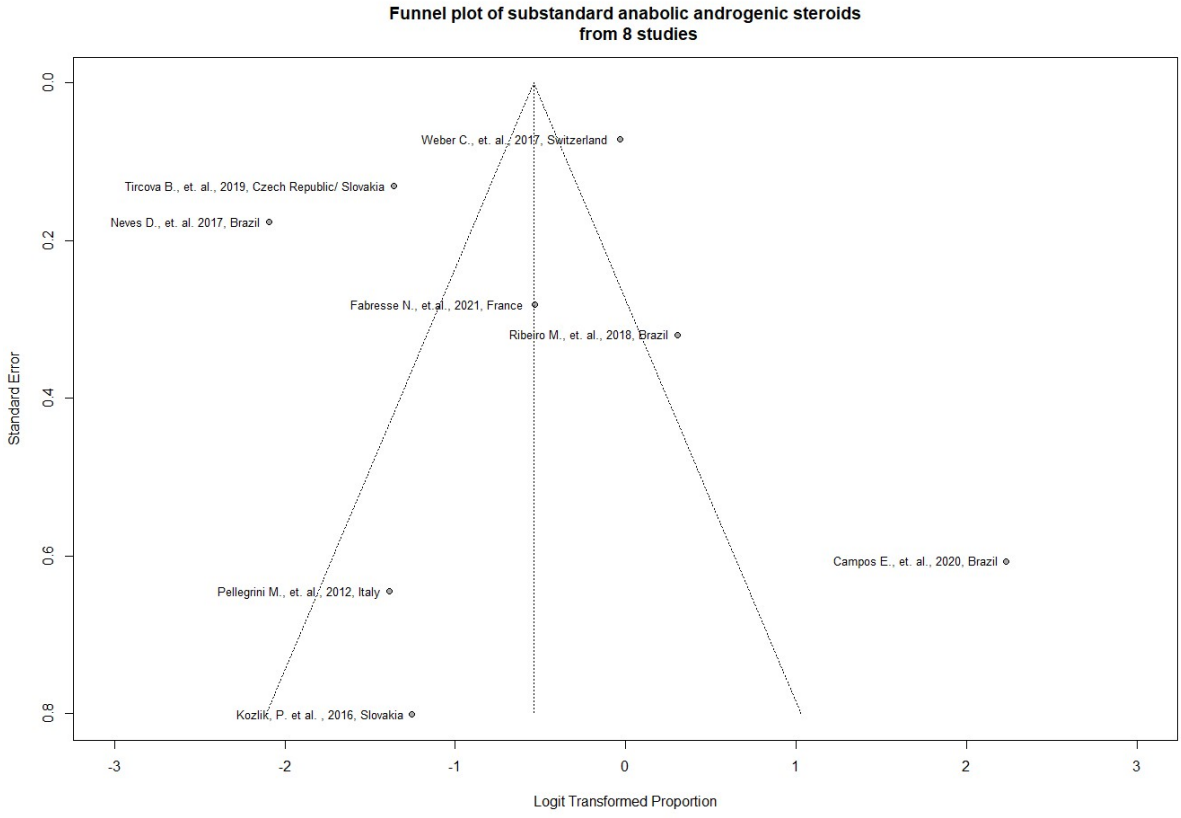
95%-PI

Region = Europe [0.0607; 0.7566]

Region = Brazil [0.0000; 1.0000]

Details on meta-analytical method:

- Random intercept logistic regression model
- Maximum-likelihood estimator for tau^2
- Hartung-Knapp adjustment for random effects model
- Logit transformation
- Clopper-Pearson confidence interval for individual studies



Review: Substandard

Linear regression test of funnel plot asymmetry

Test result: t = -0.03, df = 6, p-value = 0.9803

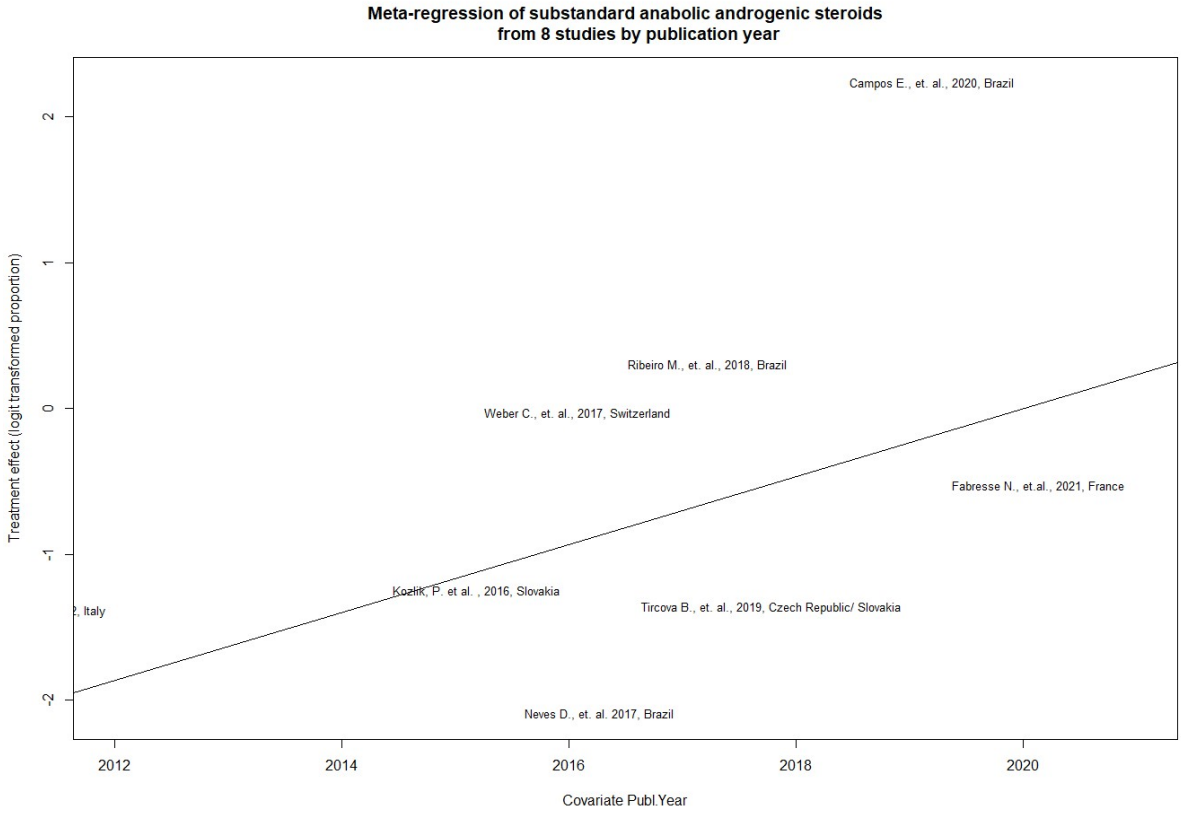
Sample estimates:

bias se.bias intercept se.intercept

-0.7573 29.3840 -0.4926 0.3486

Details:
- multiplicative residual heterogeneity variance (tau^2 = 32.7035)
- predictor: inverse of total sample size
- weight: inverse variance of average event probability
- reference: Peters et al. (2006), JAMA

Meta-regression by publication year



Mixed-Effects Model (k = 8; tau^2 estimator: ML)

tau^2 (estimated amount of residual heterogeneity): 1.1616
tau (square root of estimated tau^2 value): 1.0778
I^2 (residual heterogeneity / unaccounted variability): 96.1925%
H^2 (unaccounted variability / sampling variability): 26.2642

Tests for Residual Heterogeneity:

Wld(df = 6) = 187.8444, p-val < .0001
LRT(df = 6) = 253.3894, p-val < .0001

Test of Moderators (coefficient 2):

F(df1 = 1, df2 = 6) = 1.9481, p-val = 0.2123

Model Results:

	estimate	se	tval	df	pval	ci.lb	ci.ub

```
intrcpt    -469.6791  336.1271  -1.3973   6  0.2118  -1292.1525  352.7943
Publ.Year     0.2325    0.1666   1.3957   6  0.2123     -0.1751    0.6401

---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```