

Figure S1 PRISMA flow-chart summarizing the search strategy for relevant publications.

Table S1 Study data							
Primary author	Study period	Institution	Country/region	Patient cohort	Total patients	Mean follow up time (months)	Device name
Akbulut	2012–2018	Department of Cardiovascular Surgery, Kosuyolu Kartal Training and Research Hospital	Turkey	Mixed	139	65.9±2.5	E-vita Open Plus
Arnold	2005–2023	Department of Cardiovascular Surgery, Clinic Floridsdorf	Austria	Mixed	187	50.4±49.2	E-vita Open
Berdajs	2008–2018	Department of Cardiac Surgery, University Hospital	Switzerland	AD	100	46.8±37.2	NR
Biancari	2005–2021	ERTAAD registry—multicentre (18 European cardiac surgery centres)	Belgium, Czech Republic, Finland, France, Germany, Italy, Spain & UK	AD	128	56.4±54.0	Thoraflex Hybrid (n=120) E-Vita Hybrid (n=7) NR (n=1)
Chiu	2011–2020	Taiwan's National Health Insurance Research Database (NHIRD)	Taiwan	AD	1,225	33.6±26.4	NR
Doonan	2010–2019	McGill University Health Centre	Canada	Mixed	158	46±29	E-vita open (n=51) Thoraflex (n=107)
Jin	2013–2014	Beijing Anzhen Hospital	China	AD	121	26±9.5	NR
Kimura	2014–2023	Shizuoka Prefecture General Hospital	Japan	Mixed	107	27.3±28.2	Frozenix
Lee	2014–2021	Queen Mary Hospital	Hong Kong	Mixed	100	32.3±22.4	E-vita open, E-vita open neo, Thoraflex
Leone	2007–2017	S. Orsola Hospital	Italy	Mixed	437	31.2±21.6	Chavan-Haverich (n=27) Jotec E-vita open (n=192) Thoraflex (n=218)
Li	2014–2020	Beijing Anzhen Hospital	China	AD	518	31.6±13.6	NR
Ma	2003–2012	Beijing Aortic Disease Center	China	AD	518	108±58	Cronus
Nakao	2014–2023	New Tokyo Hospital	Japan	Mixed	353	29.6±28.8	Frozenix
Okamura	2014–2023	Nerima Hikarigaoka Hospital	Japan	AD	150	28±27.8	Frozenix
Pfeiffer	2016–2023	University Medical Center Mainz	Germany	Mixed	243	29.2±12.0	E-vita open (n=154) E-vita open neo (n=78) Thoraflex (n=11)
Shimamura	1994–2004	General Medical Center Osaka	Japan	Mixed	126	60.4±36.5	NR
Shrestha	2001–2016	Hannover Medical School	Germany	Mixed	251	43.9±44.0	Chavan–Haverich (n=66) Jotec E-vita (n=31) Vascutek Thoraflex hybrid (n=154)
Tan	Unspecified–2019	Multi-centre, international	Multicenter, UK and India	Mixed	931	NR	Thoraflex hybrid
Tsagakis, 2020	2005–2018	Multicenter, Europe (19 centers); International E-vita Open registry	Multicenter, Europe	Mixed	1,165	3.2±2.8	E-vita open hybrid

Table S1 (continued)

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Primary author	Study period	Institution	Country/region	Patient cohort	Total patients	Mean follow up time (months)	Device name
Tsagakis, 2021	2005–2020	West German Heart and Vascular Center Essen, University Hospital Essen	Germany	Mixed	357	49.6±47.2	E-vita open/E-vita open plus (n=354) Thoraflex (n=3)
Uchida	1997–2008	Asa General Hospital	Japan	Mixed	156	63.3±39.2	Frozenix
Wada	2014–2021	Akita University Hospital	Japan	AD	196	36.3±14.5	Frozenix
Wu	2012–2022	Fujian Medical University	China	Mixed	479	72.0±30.0	Triple stent graft (Yuhengjia Technology Company)
Xue	2002–2018	Nanjing Drum Tower Hospital	China	Mixed	425	45.6±34.8	Cronus
Yoshitake	2014–2023	Saitama Medical University International Medical Center	Japan	Mixed	435	46.6±32.8	Frozenix
Yu	2009–2019	Renmin Hospital of Wuhan University	China	AD	271	49±33	Cronus
Zhang	2010–2022	Fuwai Hospital	China	AD	1,672	53.9 (SD NR)	Cronus
Zhu	2020–2022	Beijing Anzhen Hospital	China	AD	344	32.1±13.6	NR

AD, aortic dissection, NR, not reported.

Table S2 Operative data								
Study	Patients	Extent of proximal aortic surgery	Anastomoses zone	CPB time (mins)	CCT time (mins)	HCA (hypothermic circulatory arrest) time (mins)	ACP (antegrade cerebral perfusion) time (mins)	Temperature
Akbulut	139	Aortic root replacement (Bentalls): 12 (8.6%) Ascending aorta only: NR Valve sparing root replacement: NR CABG: 8 (5.8%)	Zone 0: 58 (41.7%) Zone 3: 81 (58.3%)	194.5±66.5	NR	68.6±26.9	75.6±34.4	25.8±1.6
Arnold	187	Aortic root replacement (Bentalls): 9 (4.8%) Ascending aorta only: 146 (78.1%) Valve sparing root replacement: 12 (6.4%) CABG: 27 (14.4%)	Zone 1: 4 (2.1%) Zone 2: 76 (40.6%) Zone 3: 105 (56.1%) Zone 4: 2 (1.1%)	200±44	108±31	53±17	58±17	NR
Berdajs	100	Aortic root replacement (Bentalls): NR Ascending aorta only: NR Valve sparing root replacement: NR CABG: 6 (6.0%)	Zone 0: 100 (100%)	NR	97.6±35.3	30.3±8.7	22.7±8.1	NR
Biancari	128	Aortic root replacement (Bentalls): NR Ascending aorta only: NR Valve sparing root replacement: NR CABG: 10 (7.8%)	NR	263±110	164±79	NR	NR	NR
Chiu	1225	Aortic root replacement (Bentalls): 90 (7.3%) Ascending aorta only: 0 (0.0%) Valve sparing root replacement: NR CABG: 74 (6.0%)	NR	NR	NR	NR	NR	NR
Doonan	158	Aortic root replacement (Bentalls): 21 (13.9%) Ascending aorta only: 7 (4.43%) Valve sparing root replacement: 2 (1.27%) CABG: NR	Zone 0: 11 (7.0%) Zone 1: 1 (0.6%) Zone 2: 52 (32.9%) Zone 3: 94 (59.5%)	NR	NR	NR	NR	NR
Jin	121	Aortic root replacement (Bentalls): 66 (54.5%) Ascending aorta only: 55 (45.5%) Valve sparing root replacement: NR CABG: 3 (2.48%)	NR	197.9±52.9	114.9±39	27.9±11	NR	23.5±1.4
Kimura	107	Aortic root replacement (Bentalls): NR Ascending aorta only: 8 (7.5%) Valve sparing root replacement: NR CABG: 18 (17%)	Zone 2: 63 (59%) Zone 3: 44 (41%)	207±45.2	134±33.0	NR	NR	NR
Lee	100	NR	Zone 0/1: 67 (67%) Zone 2/3: 33 (33%)	236±57	140±50	NR	NR	23.5±0.45
Leone	437	Aortic root replacement (Bentalls): 80 (18.3%) Ascending aorta only: NR Valve sparing root replacement: 40 (9.2%) CABG: 56 (12.8%)	NR	235±68	NR	NR	87.8±34.3	24.8±1.0
Li	518	Aortic root replacement (Bentalls): 165 (31.9%) Ascending aorta only: NR Valve sparing root replacement: NR CABG: 56 (12.8%)	NR	206±52.6	112±39.3	24±8.15	NR	NR

Table S2 (continued)

Table S2 (continued)								
Study	Patients	Extent of proximal aortic surgery	Anastomoses zone	CPB time (mins)	CCT time (mins)	HCA (hypothermic circulatory arrest) time (mins)	ACP (antegrade cerebral perfusion) time (mins)	Temperature
Ma	518	Aortic root replacement (Bentalls): 153 (29.5%) Ascending aorta only: 22 (4.2%) Valve sparing root replacement: 1 (0.2%) CABG: 43 (8.3%)	NR	201±50	112±34	NR	26.1±10	NR
Nakao	353	NR	Zone 1: 353 (100%)	NR	NR	NR	NR	NR
Okamura	150	NR	Zone 0: 2 (1.3%) Zone 1: 9 (6%) Zone 2: 139 (92.7%)	224± 63	NR	59±23	NR	26.5±0.43
Pfeiffer	243	Aortic root replacement (Bentalls): 29 (11.9%) Ascending aorta only: NR Valve sparing root replacement: 11 (4.5%) CABG: NR	Zone 0: 69 (28.4%) Zone 1: 18 (7.4%) Zone 2: 145 (59.7%) Zone 3: 11 (4.5%)	263.0±60.4	144.1±46.3	29.6±12.7	57.6±20.6	24.5±2.4
Shimamura	126	Aortic root replacement (Bentalls): 4 (3.14%) Ascending aorta only: NR Valve sparing root replacement: NR CABG: 8 (6.35%)	Zone 1: 126 (100%)	147	NR	31	NR	NR
Shrestha	251	Aortic root replacement (Bentalls): NR Ascending aorta only: NR Valve sparing root replacement: 67 (26.7%) CABG: 44 (17.5%)	NR	241±72	125±59	56±30	81±34	NR
Tan	931	NR	NR	202±72	145±63	69±50	90±44	24±3
Tsagakis, 2020	1165	Aortic root replacement (Bentalls): 157 (14%) Ascending aorta only: NR Valve sparing root replacement: 153 (13%) CABG: 161 (14%)	NR	234±72	138±55	58±27	72±37	NR
Tsagakis, 2021	357	Aortic root replacement (Bentalls): 48 (13.4%) Ascending aorta only: NR Valve sparing root replacement: 84 (23.5%) CABG: 82 (22.9%)	Zone 0: 5 (1.4%) Zone 1: 9 (2.5%) Zone 2: 237 (66.4%) Zone 3: 106 (29.7%)	230.8±58.9	129.8±43.0	47.3±22.8	59.2±17.7	26.8±2.4
Uchida	156	Aortic root replacement (Bentalls): 4 (2.6) Ascending aorta only: NR Valve sparing root replacement: NR CABG: 31 (19.2)	NR	155	NR	35	75	NR
Wada	196	Aortic root replacement (Bentalls): 10 (5.1) Ascending aorta only: NR Valve sparing root replacement: 1 (0.5) CABG: 10 (5.1)	Zone 0	214.2±74.4	130.6±51.4	49.0±14.3	99.7±34.3	NR
Wu	479	Aortic root replacement (Bentalls): 95 (19.8) Ascending aorta only: NR Valve sparing root replacement: NR CABG: 35 (7.3)	NR	141.1±35.6	49.5±16.8	3.7±1.4	11.9±3.5	NR

Table S2 (continued)

Table S2 (continued)

Study	Patients	Extent of proximal aortic surgery	Anastomoses zone	CPB time (mins)	CCT time (mins)	HCA (hypothermic circulatory arrest) time (mins)	ACP (antegrade cerebral perfusion) time (mins)	Temperature
Xue	425	Aortic root replacement (Bentalls): 108 (25.4) Ascending aorta only: NR Valve sparing root replacement: 9 (2.1) CABG: 32 (7.5)	NR	260.8±77.3	182.0±69.3	35.4±10.0	NR	NR
Yoshitake	435	Aortic root replacement (Bentalls): NR Ascending aorta only: NR Valve sparing root replacement: NR CABG: 65 (15.0)	Zone 0: 46 (10.6) Zone 1: 17 (3.9) Zone 2: 254 (58.4) Zone 3: 118 (27.1)	210.7±64.3	NR	56.1±18.2	NR	NR
Yu	271	Aortic root replacement (Bentalls): 113 (41.7) Ascending aorta only: NR Valve sparing root replacement: 14 (5.2) CABG: 11 (4.1)	Zone 2	160.8±60.4	91.1±24.5	22.8±5.5	NR	NR
Zhang	1672	Aortic root replacement (Bentalls): 420 (25.1) Ascending aorta only: 848 (50.7) Valve sparing root replacement: 379 (22.7) CABG: 262 (15.7)	Zone 2	187.3±53.4	108.1±32.8	18.3±6.7	NR	24.9±4.1
Zhu	344	Aortic root replacement (Bentalls): 142 (41.28) Ascending aorta only: NR Valve sparing root replacement: 1 (0.29) CABG: 27 (7.85)	NR	195.09±45.27	108.99±30.37	NR	22.55±12.26	25.59±2.47

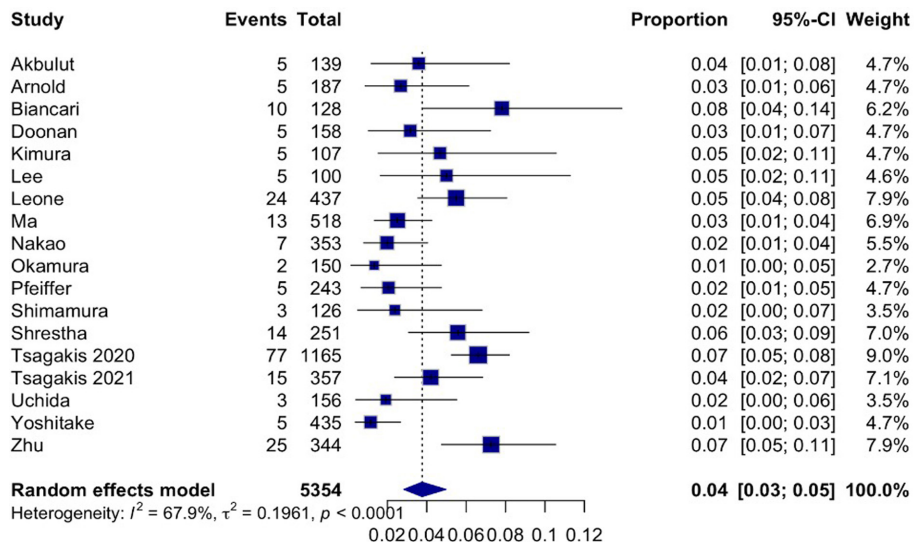


Figure S2 Forest plot: spinal cord ischemia.

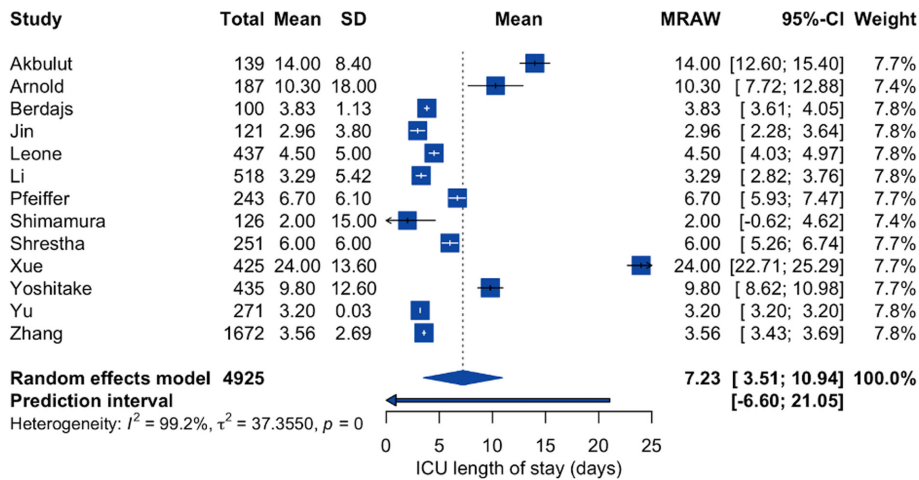


Figure S3 Forest plot: ICU mean length of stay.

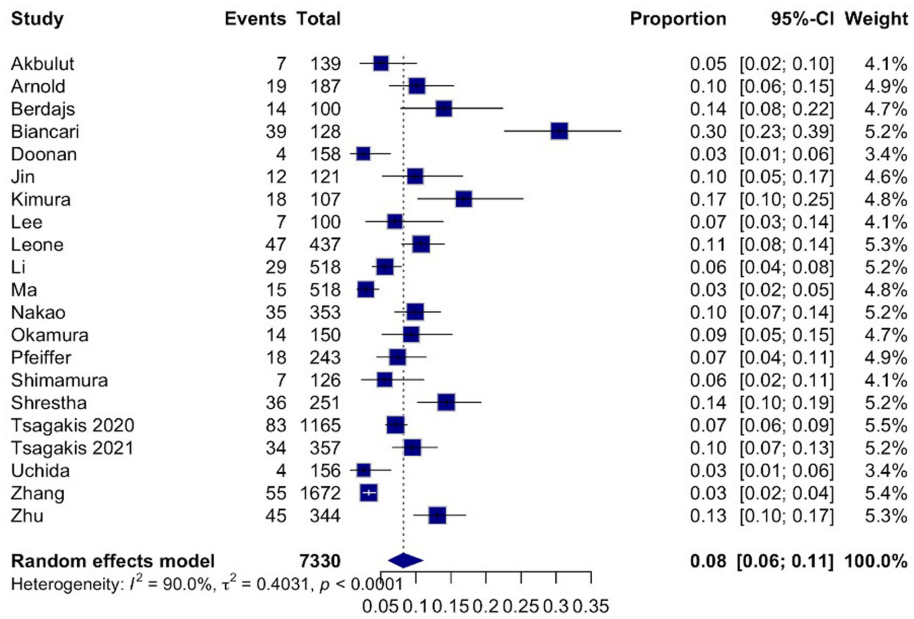


Figure S4 Forest plot: postoperative CVA.

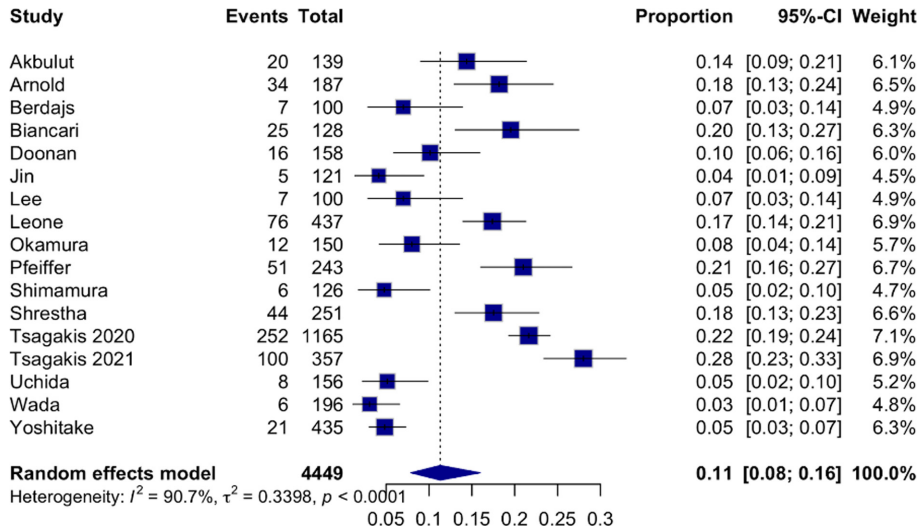


Figure S5 Forest plot: ARF requiring dialysis.

Study omitted	Pooled proportion, %	95% CI, %	I^2 , %	τ^2	Δ vs. full (pp)	ΔI^2
Tan	7.38	5.76–9.40	1	0.356	0.8	0.0
Uchida	6.95	5.17–9.26	1	0.535	0.3	0.0
Xue	6.33	4.65–8.56	1	0.573	-0.3	0.0
Yoshitake	6.86	5.05–9.24	1	0.570	0.3	0.0
Biancari	6.34	4.66–8.57	1	0.574	-0.3	0.0
Leone	6.35	4.66–8.60	1	0.580	-0.2	0.0
Nakao	6.84	5.04–9.23	1	0.574	0.2	0.0
Akbulut	6.37	4.67–8.65	1	0.588	-0.2	0.0
Tsagakis, 2021	6.39	4.67–8.68	1	0.595	-0.2	0.0
Tsagakis, 2020	6.40	4.67–8.70	1	0.599	-0.2	0.0
Kimura	6.77	4.98–9.15	1	0.586	0.2	0.0
Zhu	6.42	4.69–8.74	1	0.603	-0.2	0.0
Wada	6.76	4.95–9.16	1	0.594	0.2	0.0
Li	6.44	4.70–8.78	1	0.609	-0.2	0.0
Pfeiffer	6.46	4.71–8.80	1	0.611	-0.1	0.0
Yu	6.73	4.92–9.13	1	0.602	0.1	0.0
Shrestha	6.49	4.73–8.86	1	0.615	-0.1	0.0
Arnold	6.50	4.73–8.86	1	0.615	-0.1	0.0
Okamura	6.69	4.88–9.09	1	0.607	0.1	0.0
Wu	6.68	4.87–9.10	1	0.612	0.1	0.0
Lee	6.54	4.77–8.92	1	0.615	-0.1	0.0
Berdajs	6.54	4.77–8.92	1	0.615	-0.1	0.0
Doonan	6.55	4.77–8.94	1	0.618	0.0	0.0
Shimamura	6.64	4.84–9.04	1	0.612	0.0	0.0
Zhang	6.59	4.79–9.01	1	0.621	0.0	0.0

Figure S6 Short-term mortality leave-one-out analysis.

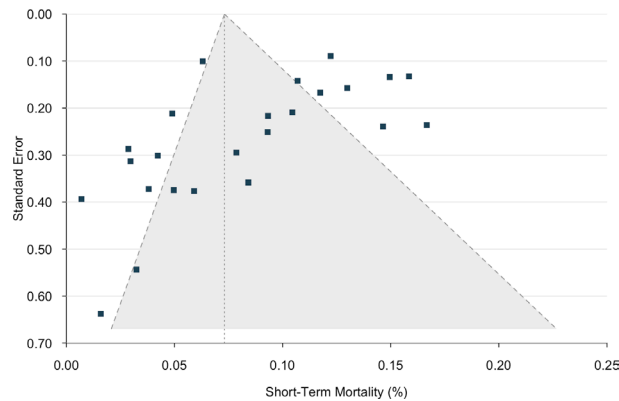


Figure S7 Funnel plot short-term mortality.

Study	Risk of bias domains							Overall
	D1	D2	D3	D4	D5	D6	D7	
Akbulut 2020	⊗	-	+	-	⊗	+	-	⊗
Arnold 2023	⊗	-	+	-	+	+	-	⊗
Berdajs 2022	⊗	-	+	-	⊗	+	-	⊗
Biancari 2024	⊗	-	+	-	+	+	-	⊗
Chiu 2025	⊗	+	-	-	+	+	-	⊗
Dohle 2024	⊗	+	+	-	-	+	-	⊗
Doonan 2024	⊗	+	+	-	+	+	-	⊗
Jin 2017	⊗	⊗	+	+	-	+	-	⊗
Kimura 2025	⊗	+	+	-	-	+	-	⊗
Lee 2024	⊗	+	+	-	+	+	-	⊗
Leone 2020	⊗	-	+	-	+	+	-	⊗
Li 2021	⊗	-	+	-	-	+	-	⊗
Ma 2020	⊗	-	+	-	+	+	-	-
Nakao 2024	⊗	+	+	-	+	+	-	-
Okamura 2024	⊗	+	+	-	+	+	-	-
Shimamura 2008	⊗	-	+	-	+	+	-	-
Shrestha 2017	⊗	+	+	-	+	+	-	-
Tan 2022	⊗	⊗	+	⊗	⊗	⊗	⊗	⊗
Tsagakis 2021	-	+	+	-	+	+	-	-
Tsagakis 2020	⊗	-	+	-	+	+	-	-
Uchida 2010	⊗	-	+	-	+	+	-	-
Wada 2022	⊗	+	+	-	+	+	-	-
Wu 2025	⊗	+	+	-	-	+	-	-
Xue 2020	⊗	-	+	-	+	+	-	⊗
Yoshitake 2025	⊗	+	+	-	+	+	-	-
Yu 2021	⊗	-	+	-	+	+	-	-
Zhang 2024	⊗	+	+	-	+	+	-	-
Zhu 2024	-	+	+	-	+	+	-	-

Domains:
D1: Bias due to confounding.
D2: Bias due to selection of participants.
D3: Bias in classification of interventions.
D4: Bias due to deviations from intended interventions.
D5: Bias due to missing data.
D6: Bias in measurement of outcomes.
D7: Bias in selection of the reported result.

Judgement
⊗ Critical
⊗ Serious
- Moderate
+ Low

Figure S8 ROBINS-I risk of bias.

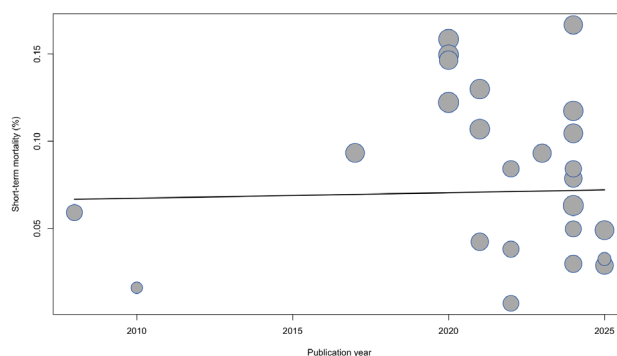


Figure S9 Meta-regression of short-term mortality by publication year.

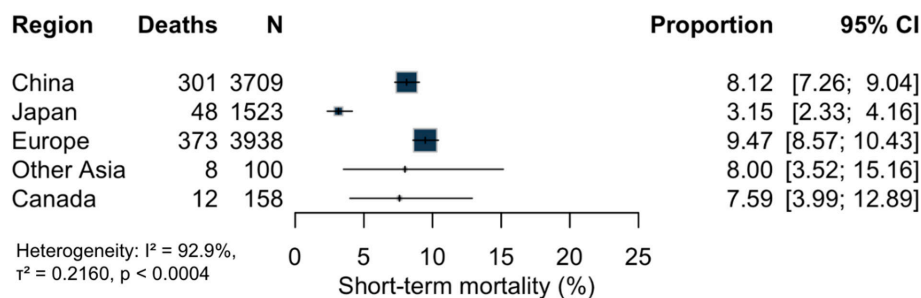


Figure S10 Forest plot: short-term mortality by region.

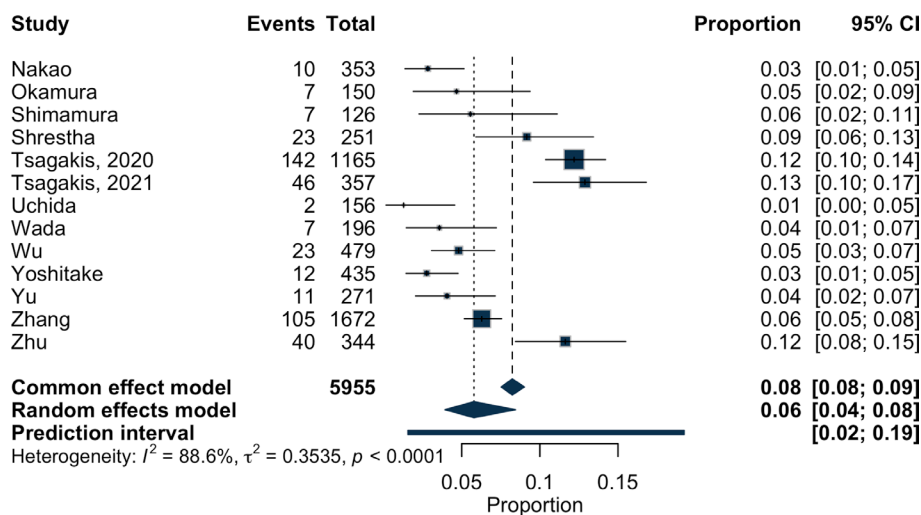


Figure S11 Forest plot: short-term mortality in moderate risk-of-bias studies.