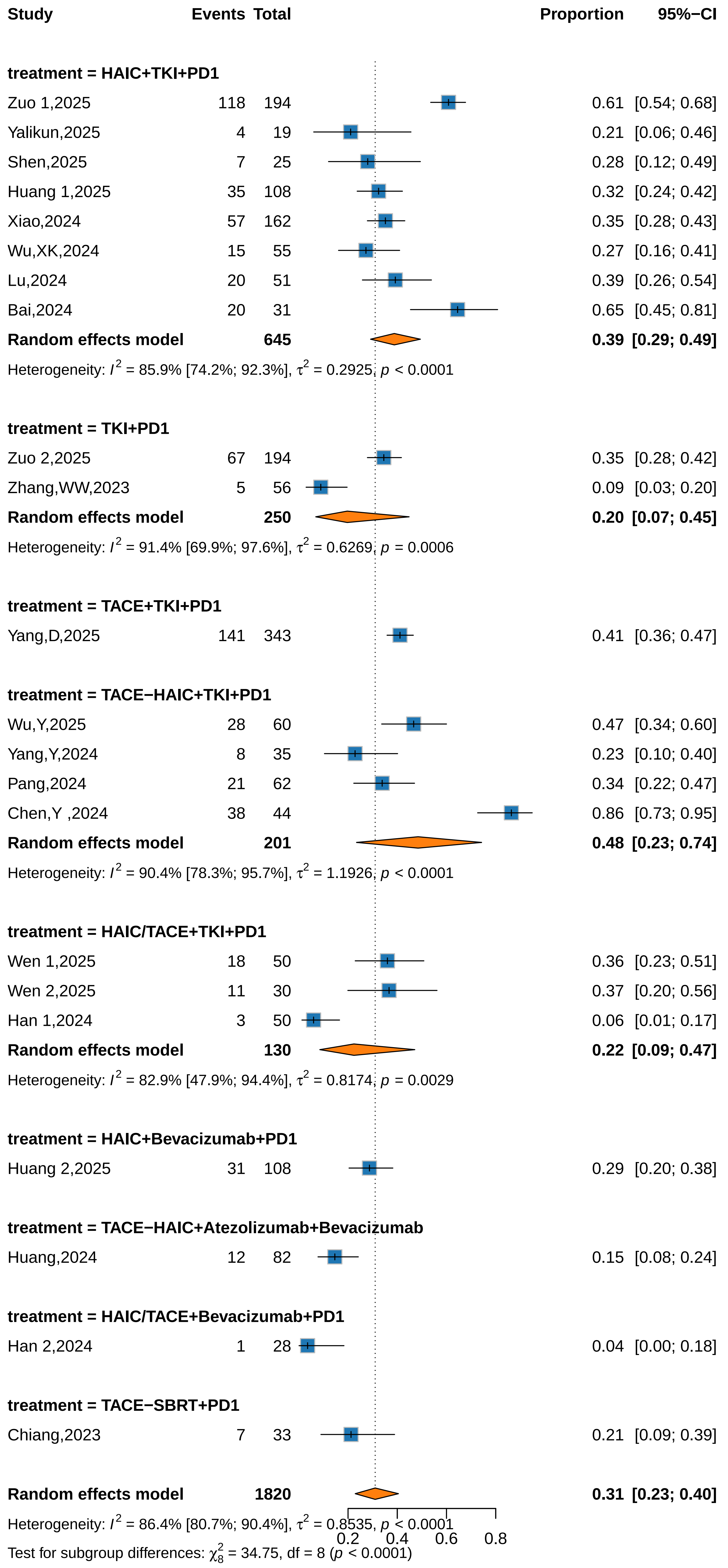
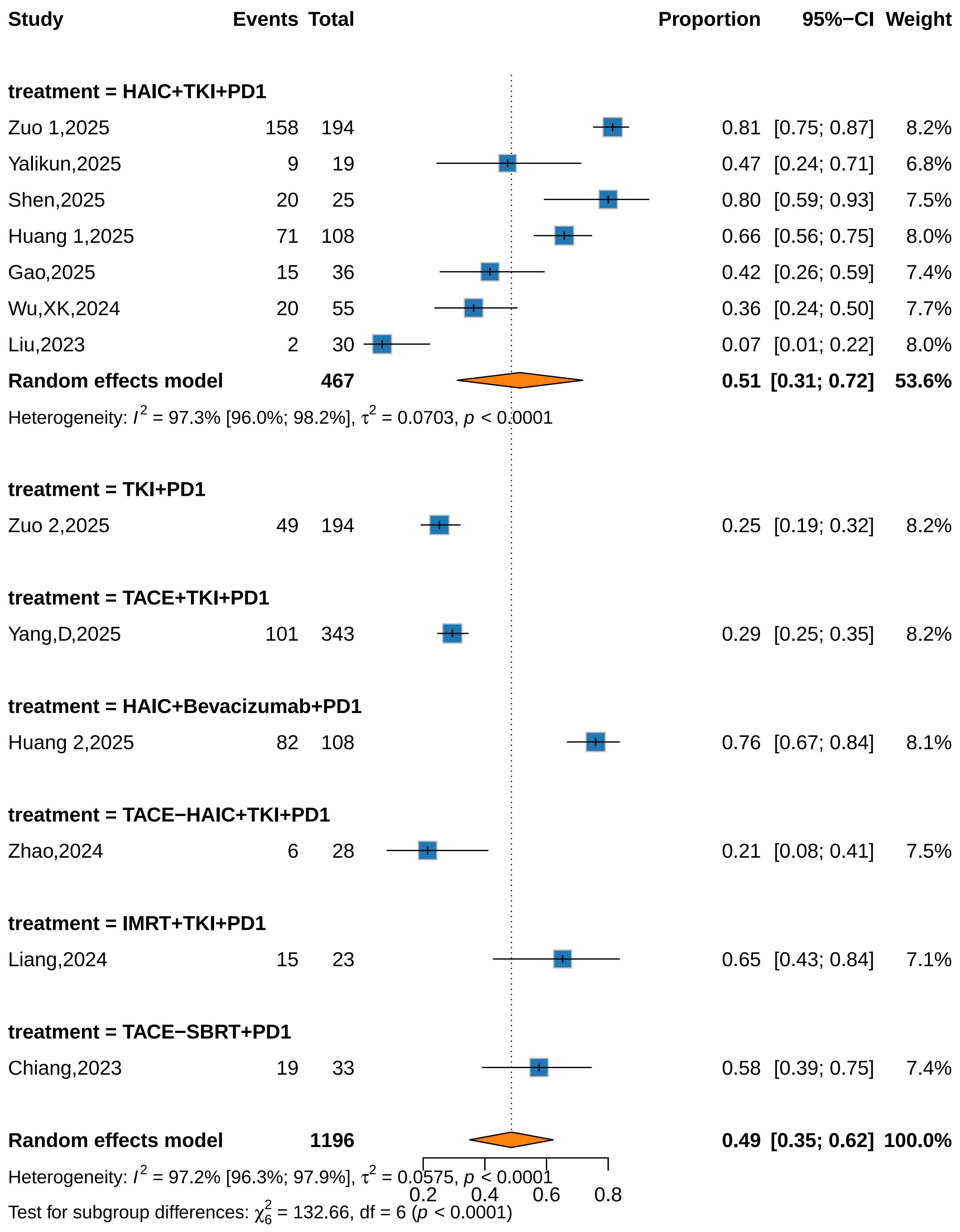
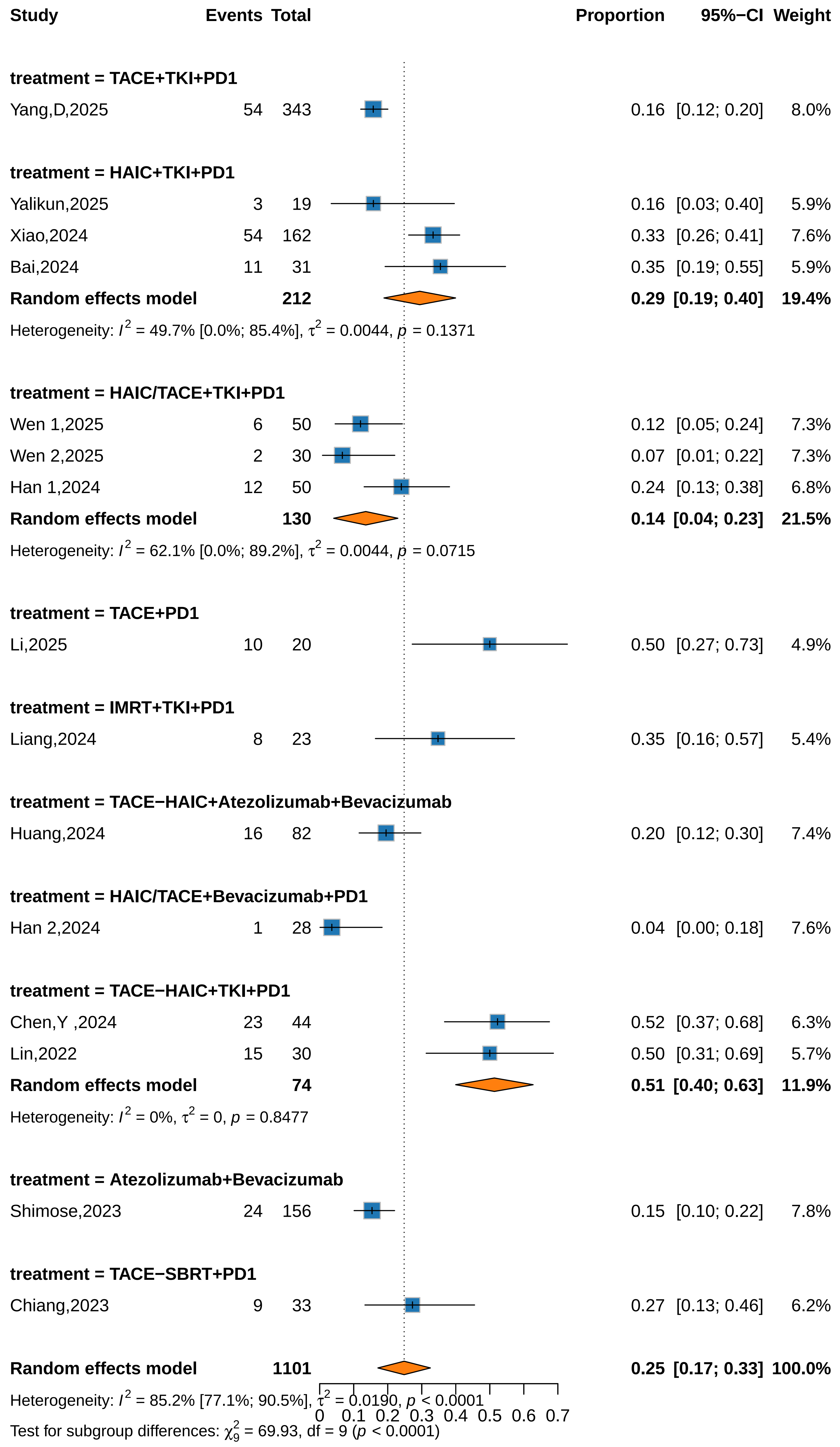


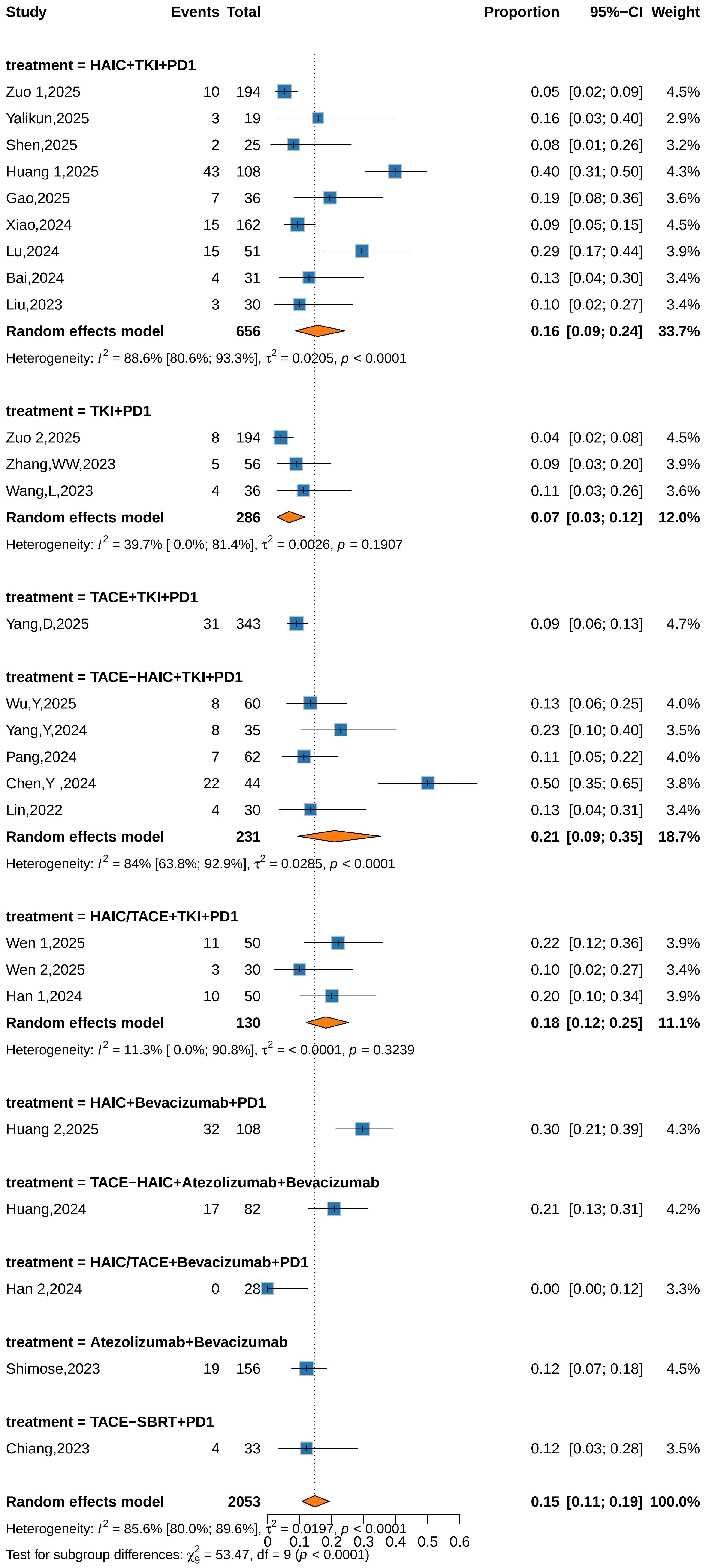
A. Abdominal pain


Study Events Total Proportion 95%−CI Weight
treatment = HAIC+TKI+PD1
Zuo 1,2025 158 194 0.81 [0.75; 0.87] 8.2%
Yalikun,2025 9 19 0.47 [0.24; 0.71] 6.8%
Shen,2025 20 25 0.80 [0.59; 0.93] 7.5%
Huang 1,2025 71 108 0.66 [0.56; 0.75] 8.0%
Gao,2025 15 36 0.42 [0.26; 0.59] 7.4%
Wu,XK,2024 20 55 0.36 [0.24; 0.50] 7.7%
Liu,2023 2 30 0.07 [0.01; 0.22] 8.0%
Random effects model 467 0.51 [0.31; 0.72] 53.6%
Heterogeneity: I^2 = 97.3% [96.0%; 98.2%], τ^2 = 0.0703, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 49 194 0.25 [0.19; 0.32] 8.2%
treatment = TACE+TKI+PD1
Yang,D,2025 101 343 0.29 [0.25; 0.35] 8.2%
treatment = HAIC+Bevacizumab+PD1
Huang 2,2025 82 108 0.76 [0.67; 0.84] 8.1%
treatment = TACE−HAIC+TKI+PD1
Zhao,2024 6 28 0.21 [0.08; 0.41] 7.5%
treatment = IMRT+TKI+PD1
Liang,2024 15 23 0.65 [0.43; 0.84] 7.1%
treatment = TACE−SBRT+PD1
Chiang,2023 19 33 0.58 [0.39; 0.75] 7.4%
Random effects model 1196 0.49 [0.35; 0.62] 100.0%
Heterogeneity: I^2 = 97.2% [96.3%; 97.9%], τ^2 = 0.0575, p < 0.0001
Test for subgroup differences: χ^2_6 = 132.66, df = 6 (p < 0.0001)
0.2
0.4
0.6
0.8

B. Anemia

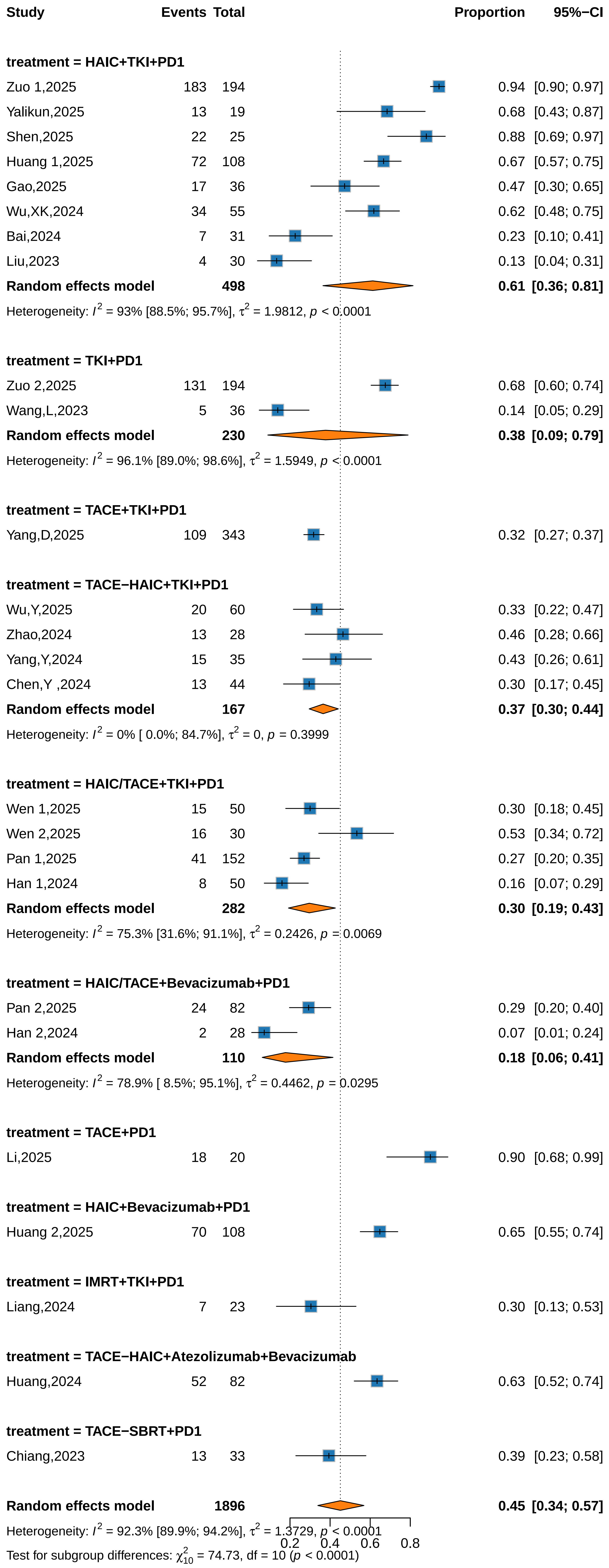


C. Decreased appetite



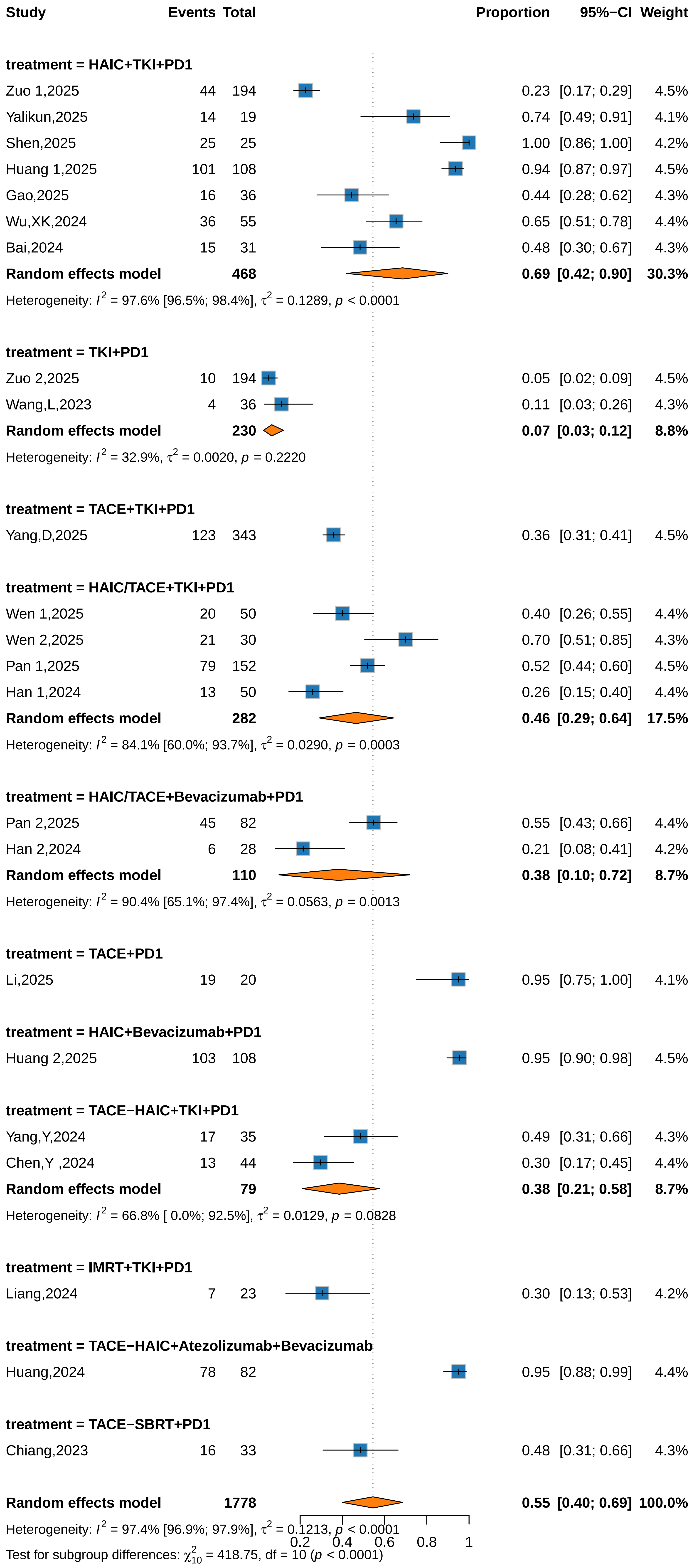
Study	Events	Total	Proportion	95%−CI	Weight
treatment = HAIC+TKI+PD1					
Zuo 1,2025	10	194	0.05	[0.02; 0.09]	4.5%
Yalikun,2025	3	19	0.16	[0.03; 0.40]	2.9%
Shen,2025	2	25	0.08	[0.01; 0.26]	3.2%
Huang 1,2025	43	108	0.40	[0.31; 0.50]	4.3%
Gao,2025	7	36	0.19	[0.08; 0.36]	3.6%
Xiao,2024	15	162	0.09	[0.05; 0.15]	4.5%
Lu,2024	15	51	0.29	[0.17; 0.44]	3.9%
Bai,2024	4	31	0.13	[0.04; 0.30]	3.4%
Liu,2023	3	30	0.10	[0.02; 0.27]	3.4%
Random effects model		**656**	**0.16**	**[0.09; 0.24]**	**33.7%**
Heterogeneity: I^2 = 88.6% [80.6%; 93.3%], τ^2 = 0.0205, p < 0.0001					
treatment = TKI+PD1					
Zuo 2,2025	8	194	0.04	[0.02; 0.08]	4.5%
Zhang,WW,2023	5	56	0.09	[0.03; 0.20]	3.9%
Wang,L,2023	4	36	0.11	[0.03; 0.26]	3.6%
Random effects model		**286**	**0.07**	**[0.03; 0.12]**	**12.0%**
Heterogeneity: I^2 = 39.7% [0.0%; 81.4%], τ^2 = 0.0026, p = 0.1907					
treatment = TACE+TKI+PD1					
Yang,D,2025	31	343	0.09	[0.06; 0.13]	4.7%
treatment = TACE−HAIC+TKI+PD1					
Wu,Y,2025	8	60	0.13	[0.06; 0.25]	4.0%
Yang,Y,2024	8	35	0.23	[0.10; 0.40]	3.5%
Pang,2024	7	62	0.11	[0.05; 0.22]	4.0%
Chen,Y ,2024	22	44	0.50	[0.35; 0.65]	3.8%
Lin,2022	4	30	0.13	[0.04; 0.31]	3.4%
Random effects model		**231**	**0.21**	**[0.09; 0.35]**	**18.7%**
Heterogeneity: I^2 = 84% [63.8%; 92.9%], τ^2 = 0.0285, p < 0.0001					
treatment = HAIC/TACE+TKI+PD1					
Wen 1,2025	11	50	0.22	[0.12; 0.36]	3.9%
Wen 2,2025	3	30	0.10	[0.02; 0.27]	3.4%
Han 1,2024	10	50	0.20	[0.10; 0.34]	3.9%
Random effects model		**130**	**0.18**	**[0.12; 0.25]**	**11.1%**
Heterogeneity: I^2 = 11.3% [0.0%; 90.8%], τ^2 = < 0.0001, p = 0.3239					
treatment = HAIC+Bevacizumab+PD1					
Huang 2,2025	32	108	0.30	[0.21; 0.39]	4.3%
treatment = TACE−HAIC+Atezolizumab+Bevacizumab					
Huang,2024	17	82	0.21	[0.13; 0.31]	4.2%
treatment = HAIC/TACE+Bevacizumab+PD1					
Han 2,2024	0	28	0.00	[0.00; 0.12]	3.3%
treatment = Atezolizumab+Bevacizumab					
Shimose,2023	19	156	0.12	[0.07; 0.18]	4.5%
treatment = TACE−SBRT+PD1					
Chiang,2023	4	33	0.12	[0.03; 0.28]	3.5%
Random effects model		**2053**	**0.15**	**[0.11; 0.19]**	**100.0%**
Heterogeneity: I^2 = 85.6% [80.0%; 89.6%], τ^2 = 0.0197, p < 0.0001					
Test for subgroup differences: χ^2_9 = 53.47, df = 9 (p < 0.0001)					

D. Diarrhea

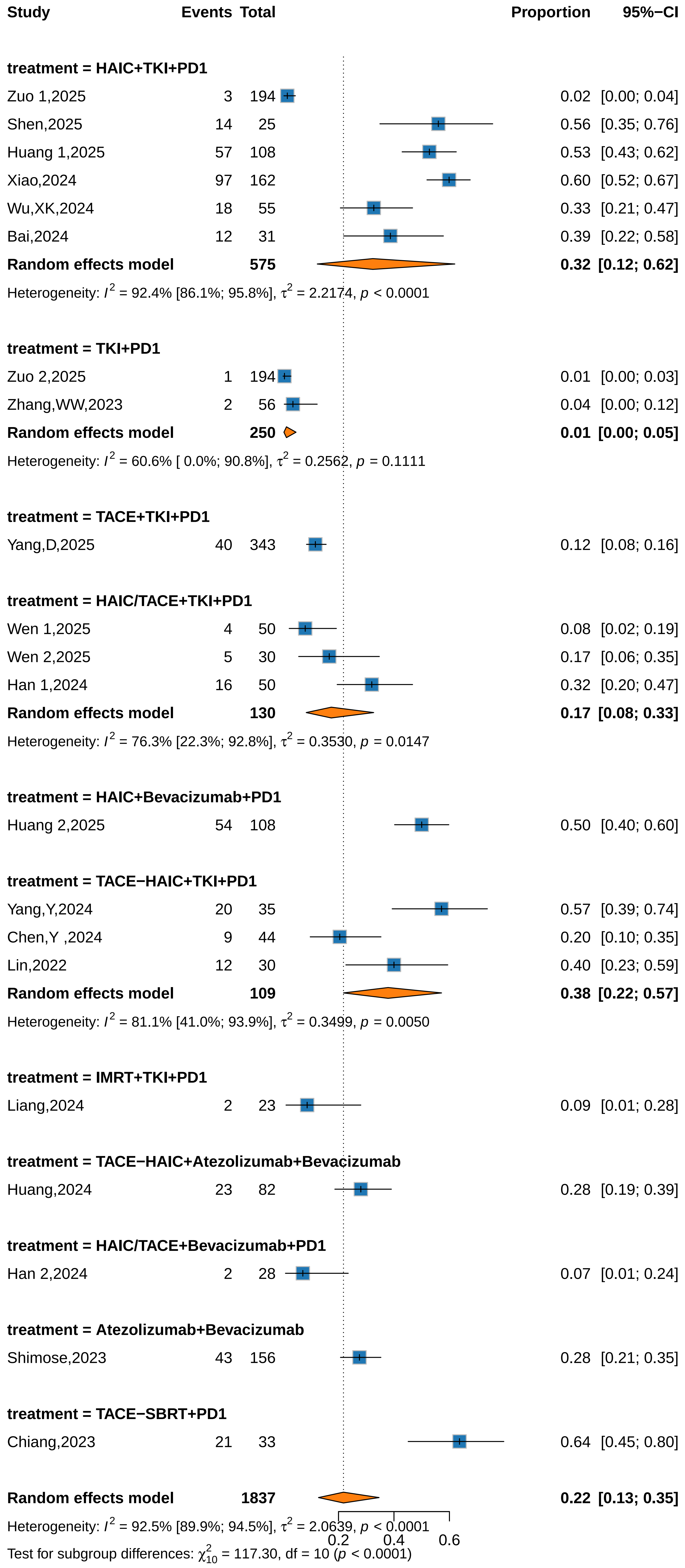


Study	Events	Total	Proportion	95%−CI
treatment = HAIC+TKI+PD1				
Zuo 1,2025	183	194	0.94	[0.90; 0.97]
Yalikun,2025	13	19	0.68	[0.43; 0.87]
Shen,2025	22	25	0.88	[0.69; 0.97]
Huang 1,2025	72	108	0.67	[0.57; 0.75]
Gao,2025	17	36	0.47	[0.30; 0.65]
Wu,XK,2024	34	55	0.62	[0.48; 0.75]
Bai,2024	7	31	0.23	[0.10; 0.41]
Liu,2023	4	30	0.13	[0.04; 0.31]
Random effects model		**498**	**0.61**	**[0.36; 0.81]**
Heterogeneity: $I^2 = 93\%$ [88.5%; 95.7%], $\tau^2 = 1.9812$, $p < 0.0001$				
treatment = TKI+PD1				
Zuo 2,2025	131	194	0.68	[0.60; 0.74]
Wang,L,2023	5	36	0.14	[0.05; 0.29]
Random effects model		**230**	**0.38**	**[0.09; 0.79]**
Heterogeneity: $I^2 = 96.1\%$ [89.0%; 98.6%], $\tau^2 = 1.5949$, $p < 0.0001$				
treatment = TACE+TKI+PD1				
Yang,D,2025	109	343	0.32	[0.27; 0.37]
treatment = TACE−HAIC+TKI+PD1				
Wu,Y,2025	20	60	0.33	[0.22; 0.47]
Zhao,2024	13	28	0.46	[0.28; 0.66]
Yang,Y,2024	15	35	0.43	[0.26; 0.61]
Chen,Y ,2024	13	44	0.30	[0.17; 0.45]
Random effects model		**167**	**0.37**	**[0.30; 0.44]**
Heterogeneity: $I^2 = 0\%$ [0.0%; 84.7%], $\tau^2 = 0$, $p = 0.3999$				
treatment = HAIC/TACE+TKI+PD1				
Wen 1,2025	15	50	0.30	[0.18; 0.45]
Wen 2,2025	16	30	0.53	[0.34; 0.72]
Pan 1,2025	41	152	0.27	[0.20; 0.35]
Han 1,2024	8	50	0.16	[0.07; 0.29]
Random effects model		**282**	**0.30**	**[0.19; 0.43]**
Heterogeneity: $I^2 = 75.3\%$ [31.6%; 91.1%], $\tau^2 = 0.2426$, $p = 0.0069$				
treatment = HAIC/TACE+Bevacizumab+PD1				
Pan 2,2025	24	82	0.29	[0.20; 0.40]
Han 2,2024	2	28	0.07	[0.01; 0.24]
Random effects model		**110**	**0.18**	**[0.06; 0.41]**
Heterogeneity: $I^2 = 78.9\%$ [8.5%; 95.1%], $\tau^2 = 0.4462$, $p = 0.0295$				
treatment = TACE+PD1				
Li,2025	18	20	0.90	[0.68; 0.99]
treatment = HAIC+Bevacizumab+PD1				
Huang 2,2025	70	108	0.65	[0.55; 0.74]
treatment = IMRT+TKI+PD1				
Liang,2024	7	23	0.30	[0.13; 0.53]
treatment = TACE−HAIC+Atezolizumab+Bevacizumab				
Huang,2024	52	82	0.63	[0.52; 0.74]
treatment = TACE−SBRT+PD1				
Chiang,2023	13	33	0.39	[0.23; 0.58]
Random effects model		**1896**	**0.45**	**[0.34; 0.57]**
Heterogeneity: $I^2 = 92.3\%$ [89.9%; 94.2%], $\tau^2 = 1.3729$, $p < 0.0001$				
Test for subgroup differences: $\chi^2_{10} = 74.73$, df = 10 ($p < 0.0001$)				

E. Elevated ALT

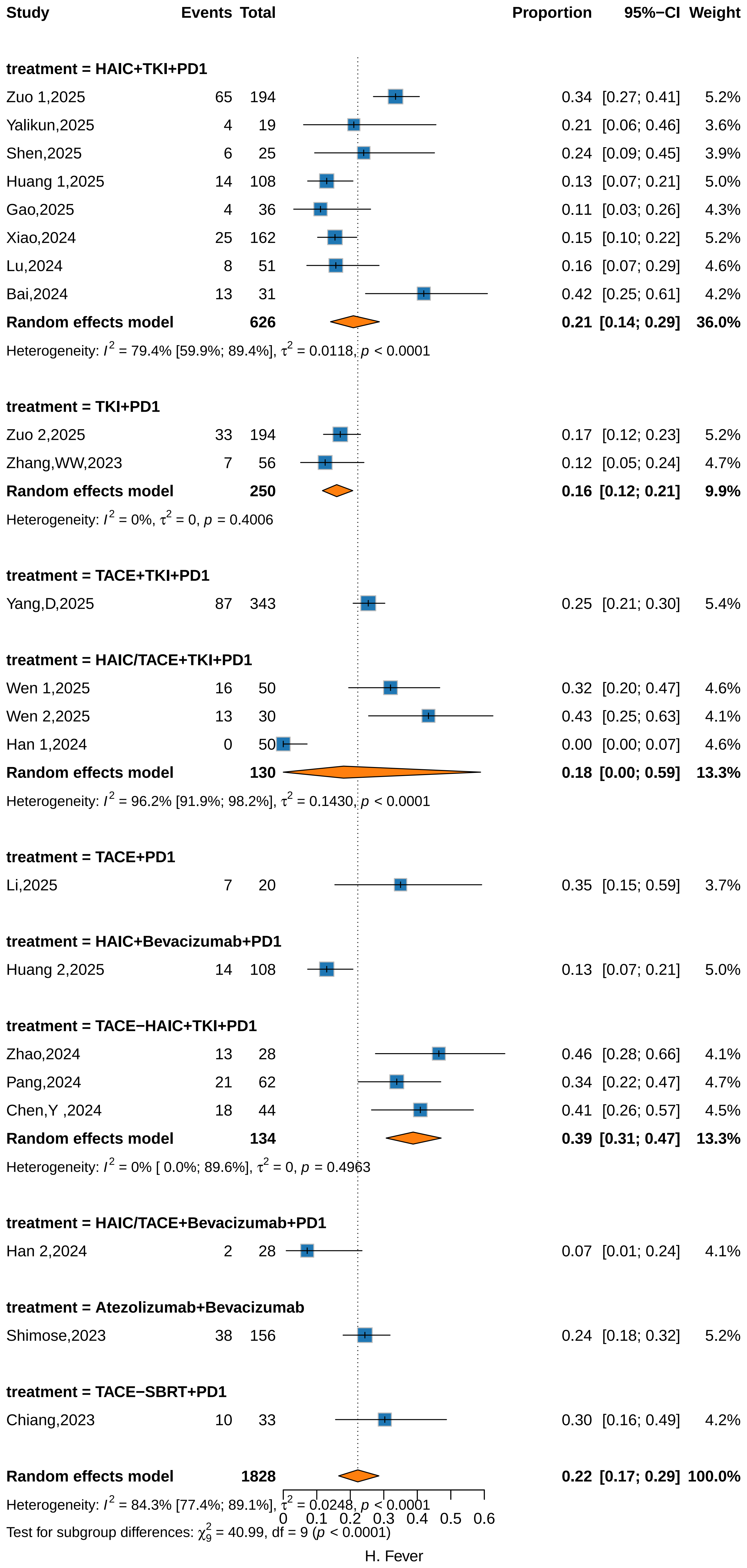


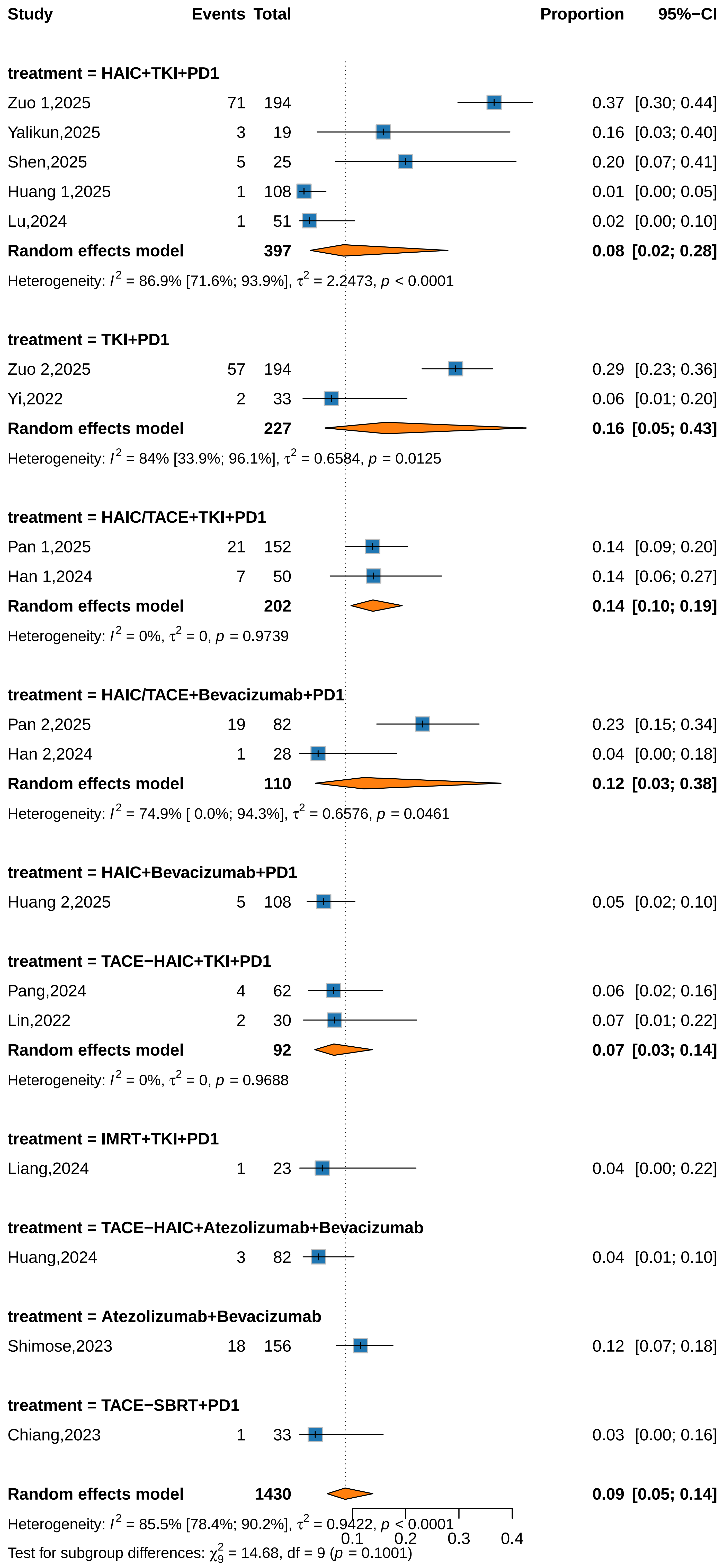
F. Elevated AST



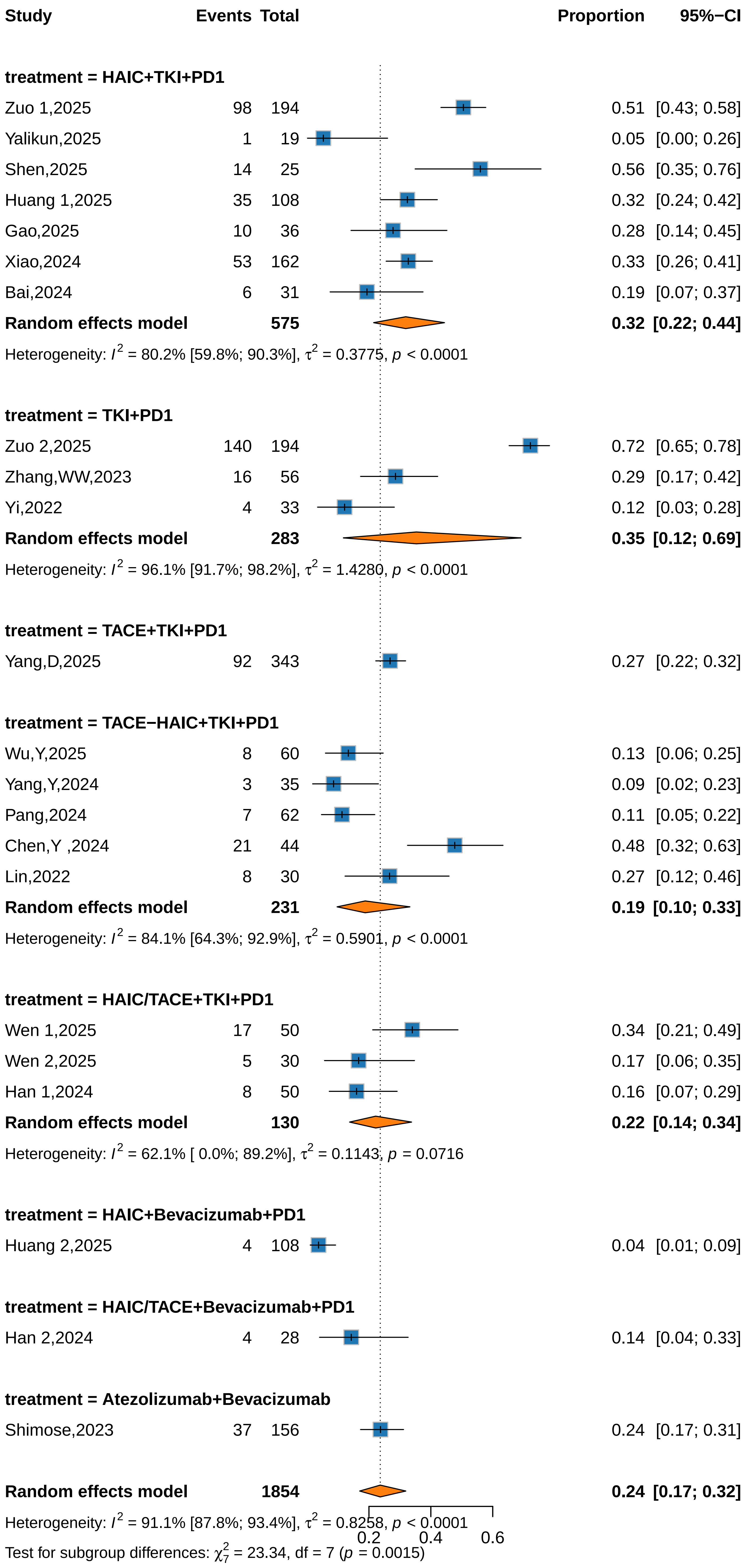
Study	Events	Total	Proportion	95%−CI
treatment = HAIC+TKI+PD1				
Zuo 1,2025	3	194	0.02	[0.00; 0.04]
Shen,2025	14	25	0.56	[0.35; 0.76]
Huang 1,2025	57	108	0.53	[0.43; 0.62]
Xiao,2024	97	162	0.60	[0.52; 0.67]
Wu,XK,2024	18	55	0.33	[0.21; 0.47]
Bai,2024	12	31	0.39	[0.22; 0.58]
Random effects model		**575**	**0.32**	**[0.12; 0.62]**
Heterogeneity: I^2 = 92.4% [86.1%; 95.8%], τ^2 = 2.2174, p < 0.0001				
treatment = TKI+PD1				
Zuo 2,2025	1	194	0.01	[0.00; 0.03]
Zhang,WW,2023	2	56	0.04	[0.00; 0.12]
Random effects model		**250**	**0.01**	**[0.00; 0.05]**
Heterogeneity: I^2 = 60.6% [0.0%; 90.8%], τ^2 = 0.2562, p = 0.1111				
treatment = TACE+TKI+PD1				
Yang,D,2025	40	343	0.12	[0.08; 0.16]
treatment = HAIC/TACE+TKI+PD1				
Wen 1,2025	4	50	0.08	[0.02; 0.19]
Wen 2,2025	5	30	0.17	[0.06; 0.35]
Han 1,2024	16	50	0.32	[0.20; 0.47]
Random effects model		**130**	**0.17**	**[0.08; 0.33]**
Heterogeneity: I^2 = 76.3% [22.3%; 92.8%], τ^2 = 0.3530, p = 0.0147				
treatment = HAIC+Bevacizumab+PD1				
Huang 2,2025	54	108	0.50	[0.40; 0.60]
treatment = TACE−HAIC+TKI+PD1				
Yang,Y,2024	20	35	0.57	[0.39; 0.74]
Chen,Y ,2024	9	44	0.20	[0.10; 0.35]
Lin,2022	12	30	0.40	[0.23; 0.59]
Random effects model		**109**	**0.38**	**[0.22; 0.57]**
Heterogeneity: I^2 = 81.1% [41.0%; 93.9%], τ^2 = 0.3499, p = 0.0050				
treatment = IMRT+TKI+PD1				
Liang,2024	2	23	0.09	[0.01; 0.28]
treatment = TACE−HAIC+Atezolizumab+Bevacizumab				
Huang,2024	23	82	0.28	[0.19; 0.39]
treatment = HAIC/TACE+Bevacizumab+PD1				
Han 2,2024	2	28	0.07	[0.01; 0.24]
treatment = Atezolizumab+Bevacizumab				
Shimose,2023	43	156	0.28	[0.21; 0.35]
treatment = TACE−SBRT+PD1				
Chiang,2023	21	33	0.64	[0.45; 0.80]
Random effects model		**1837**	**0.22**	**[0.13; 0.35]**
Heterogeneity: I^2 = 92.5% [89.9%; 94.5%], τ^2 = 2.0639, p < 0.0001				
Test for subgroup differences: χ^2_{10} = 117.30, df = 10 (p < 0.0001)				

G. Fatigue


Study Events Total Proportion 95%−CI Weight
treatment = HAIC+TKI+PD1
Zuo 1,2025 65 194 0.34 [0.27; 0.41] 5.2%
Yalikun,2025 4 19 0.21 [0.06; 0.46] 3.6%
Shen,2025 6 25 0.24 [0.09; 0.45] 3.9%
Huang 1,2025 14 108 0.13 [0.07; 0.21] 5.0%
Gao,2025 4 36 0.11 [0.03; 0.26] 4.3%
Xiao,2024 25 162 0.15 [0.10; 0.22] 5.2%
Lu,2024 8 51 0.16 [0.07; 0.29] 4.6%
Bai,2024 13 31 0.42 [0.25; 0.61] 4.2%
Random effects model 626 0.21 [0.14; 0.29] 36.0%
Heterogeneity: I^2 = 79.4% [59.9%; 89.4%], τ^2 = 0.0118, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 33 194 0.17 [0.12; 0.23] 5.2%
Zhang,WW,2023 7 56 0.12 [0.05; 0.24] 4.7%
Random effects model 250 0.16 [0.12; 0.21] 9.9%
Heterogeneity: I^2 = 0%, τ^2 = 0, p = 0.4006
treatment = TACE+TKI+PD1
Yang,D,2025 87 343 0.25 [0.21; 0.30] 5.4%
treatment = HAIC/TACE+TKI+PD1
Wen 1,2025 16 50 0.32 [0.20; 0.47] 4.6%
Wen 2,2025 13 30 0.43 [0.25; 0.63] 4.1%
Han 1,2024 0 50 0.00 [0.00; 0.07] 4.6%
Random effects model 130 0.18 [0.00; 0.59] 13.3%
Heterogeneity: I^2 = 96.2% [91.9%; 98.2%], τ^2 = 0.1430, p < 0.0001
treatment = TACE+PD1
Li,2025 7 20 0.35 [0.15; 0.59] 3.7%
treatment = HAIC+Bevacizumab+PD1
Huang 2,2025 14 108 0.13 [0.07; 0.21] 5.0%
treatment = TACE−HAIC+TKI+PD1
Zhao,2024 13 28 0.46 [0.28; 0.66] 4.1%
Pang,2024 21 62 0.34 [0.22; 0.47] 4.7%
Chen,Y ,2024 18 44 0.41 [0.26; 0.57] 4.5%
Random effects model 134 0.39 [0.31; 0.47] 13.3%
Heterogeneity: I^2 = 0% [0.0%; 89.6%], τ^2 = 0, p = 0.4963
treatment = HAIC/TACE+Bevacizumab+PD1
Han 2,2024 2 28 0.07 [0.01; 0.24] 4.1%
treatment = Atezolizumab+Bevacizumab
Shimose,2023 38 156 0.24 [0.18; 0.32] 5.2%
treatment = TACE−SBRT+PD1
Chiang,2023 10 33 0.30 [0.16; 0.49] 4.2%
Random effects model 1828 0.22 [0.17; 0.29] 100.0%
Heterogeneity: I^2 = 84.3% [77.4%; 89.1%], τ^2 = 0.0248, p < 0.0001
Test for subgroup differences: χ^2_9 = 40.99, df = 9 (p < 0.0001)
0 0.1 0.2 0.3 0.4 0.5 0.6
H. Fever

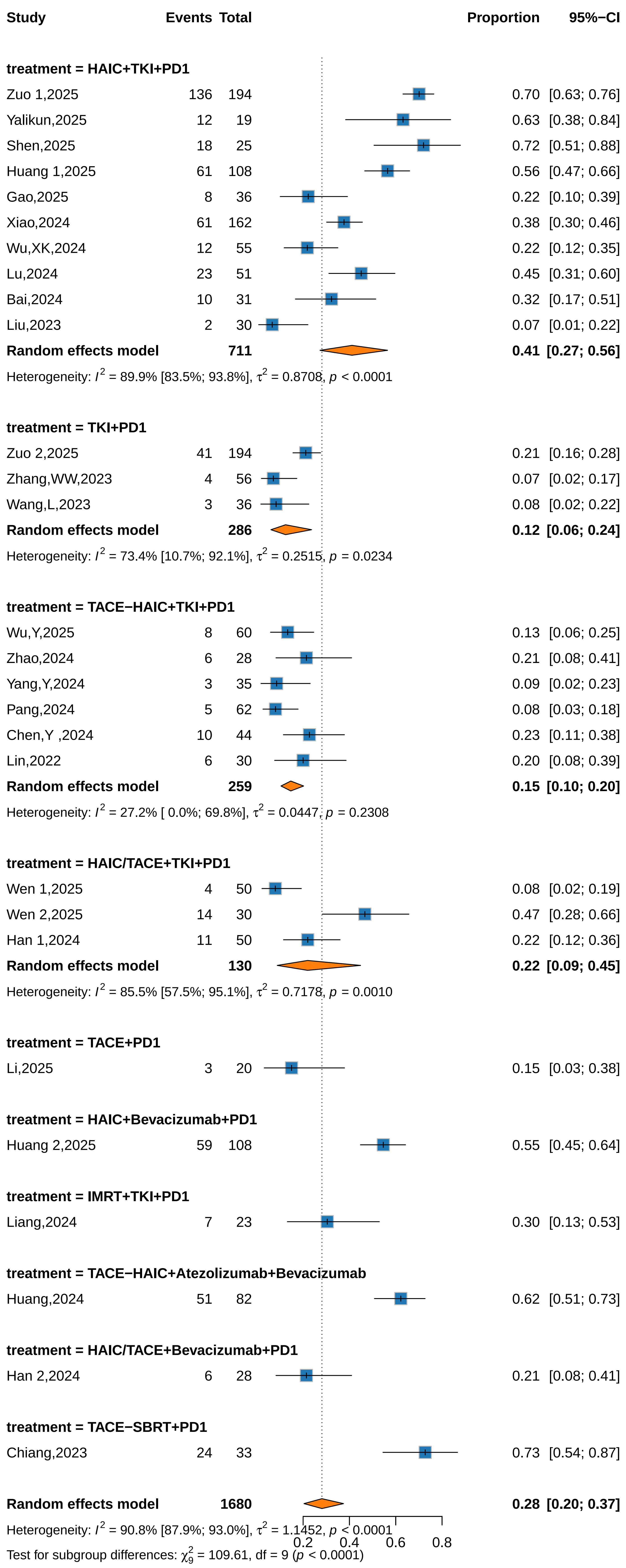


I. Gastrointestinal bleeding

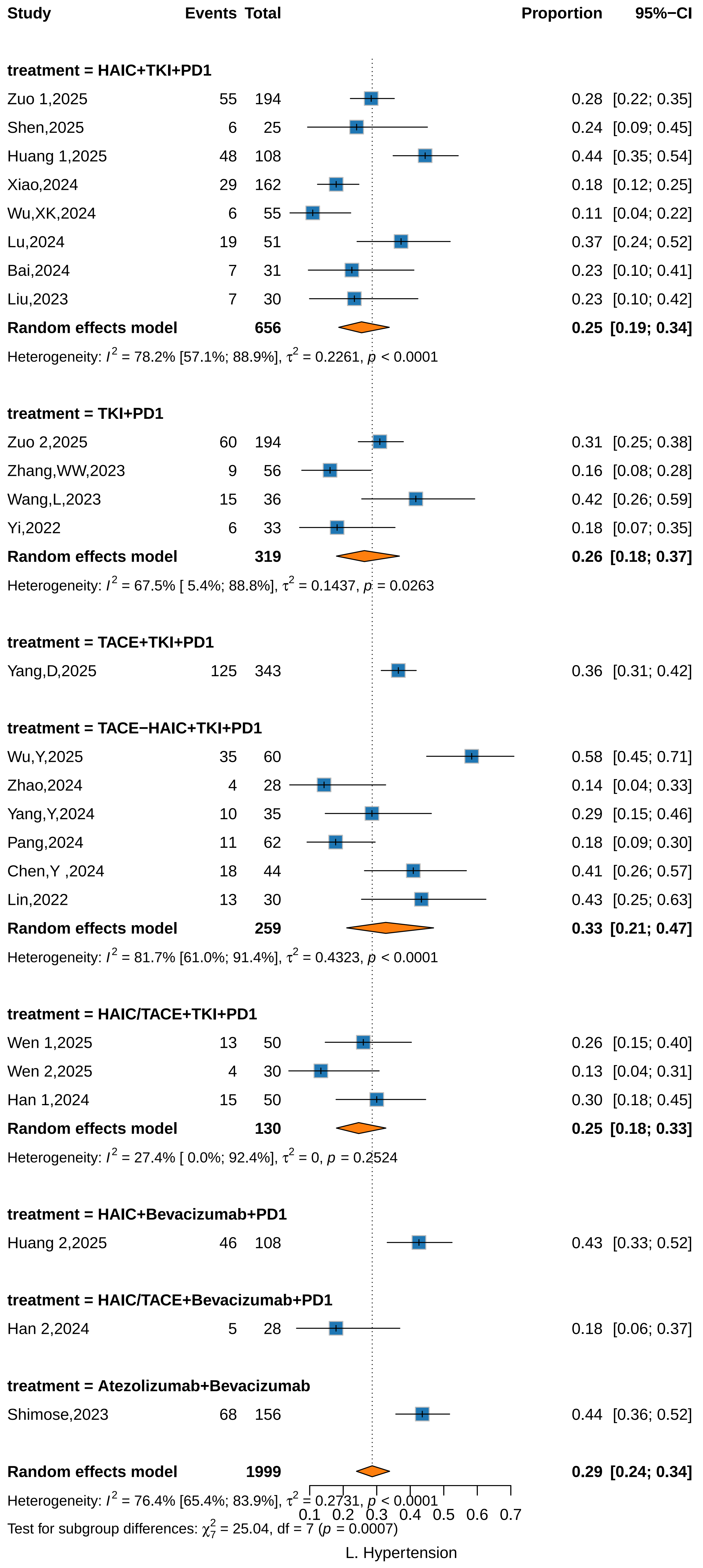


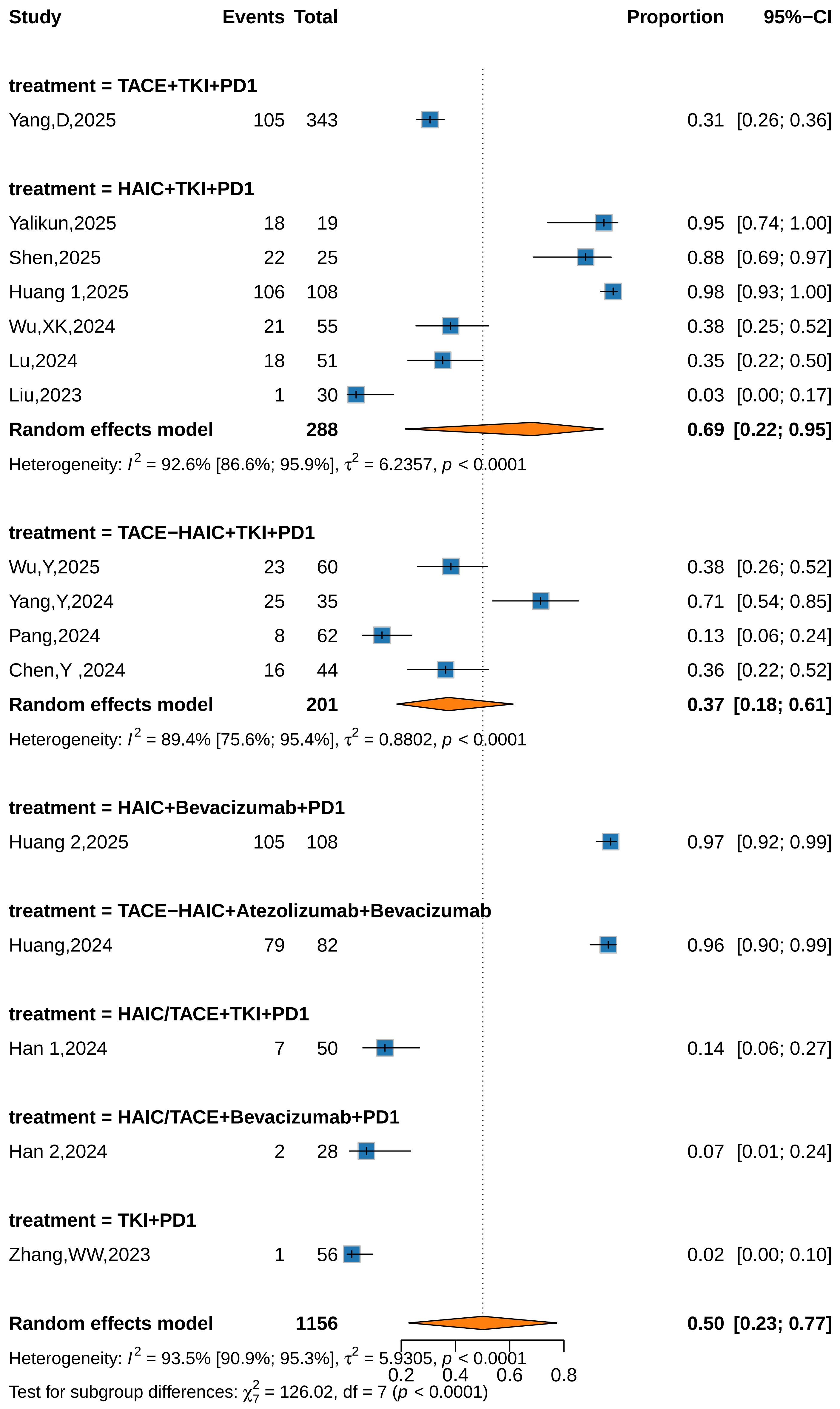
Study	Events	Total	Proportion	95%−CI
treatment = HAIC+TKI+PD1				
Zuo 1,2025	98	194	0.51	[0.43; 0.58]
Yalikun,2025	1	19	0.05	[0.00; 0.26]
Shen,2025	14	25	0.56	[0.35; 0.76]
Huang 1,2025	35	108	0.32	[0.24; 0.42]
Gao,2025	10	36	0.28	[0.14; 0.45]
Xiao,2024	53	162	0.33	[0.26; 0.41]
Bai,2024	6	31	0.19	[0.07; 0.37]
Random effects model		**575**	**0.32**	**[0.22; 0.44]**
Heterogeneity: I^2 = 80.2% [59.8%; 90.3%], τ^2 = 0.3775, p < 0.0001				
treatment = TKI+PD1				
Zuo 2,2025	140	194	0.72	[0.65; 0.78]
Zhang,WW,2023	16	56	0.29	[0.17; 0.42]
Yi,2022	4	33	0.12	[0.03; 0.28]
Random effects model		**283**	**0.35**	**[0.12; 0.69]**
Heterogeneity: I^2 = 96.1% [91.7%; 98.2%], τ^2 = 1.4280, p < 0.0001				
treatment = TACE+TKI+PD1				
Yang,D,2025	92	343	0.27	[0.22; 0.32]
treatment = TACE−HAIC+TKI+PD1				
Wu,Y,2025	8	60	0.13	[0.06; 0.25]
Yang,Y,2024	3	35	0.09	[0.02; 0.23]
Pang,2024	7	62	0.11	[0.05; 0.22]
Chen,Y ,2024	21	44	0.48	[0.32; 0.63]
Lin,2022	8	30	0.27	[0.12; 0.46]
Random effects model		**231**	**0.19**	**[0.10; 0.33]**
Heterogeneity: I^2 = 84.1% [64.3%; 92.9%], τ^2 = 0.5901, p < 0.0001				
treatment = HAIC/TACE+TKI+PD1				
Wen 1,2025	17	50	0.34	[0.21; 0.49]
Wen 2,2025	5	30	0.17	[0.06; 0.35]
Han 1,2024	8	50	0.16	[0.07; 0.29]
Random effects model		**130**	**0.22**	**[0.14; 0.34]**
Heterogeneity: I^2 = 62.1% [0.0%; 89.2%], τ^2 = 0.1143, p = 0.0716				
treatment = HAIC+Bevacizumab+PD1				
Huang 2,2025	4	108	0.04	[0.01; 0.09]
treatment = HAIC/TACE+Bevacizumab+PD1				
Han 2,2024	4	28	0.14	[0.04; 0.33]
treatment = Atezolizumab+Bevacizumab				
Shimose,2023	37	156	0.24	[0.17; 0.31]
Random effects model		**1854**	**0.24**	**[0.17; 0.32]**
Heterogeneity: I^2 = 91.1% [87.8%; 93.4%], τ^2 = 0.8258, p < 0.0001				
Test for subgroup differences: χ^2_7 = 23.34, df = 7 (p = 0.0015)				

J. Hand−foot skin reaction

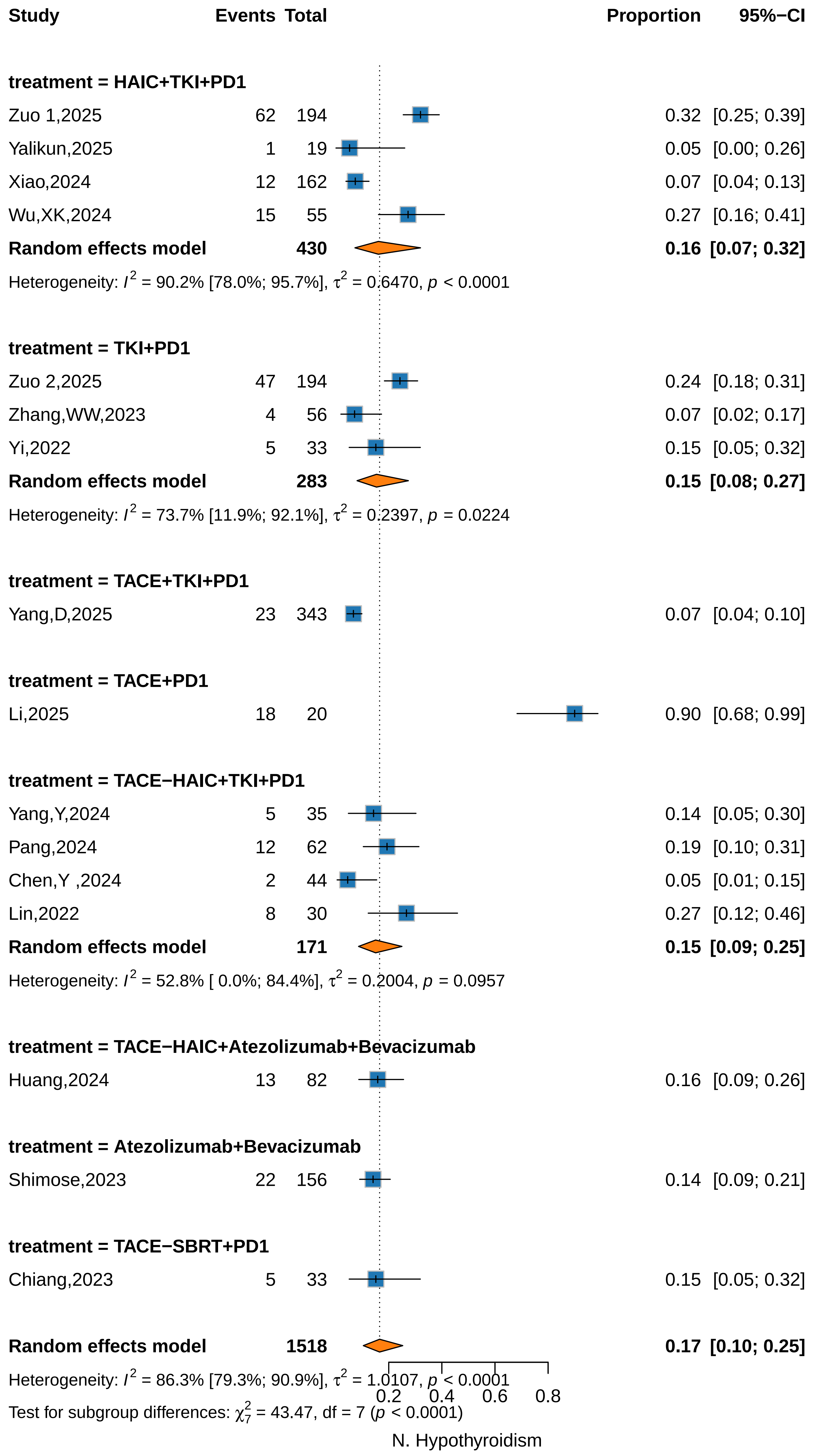


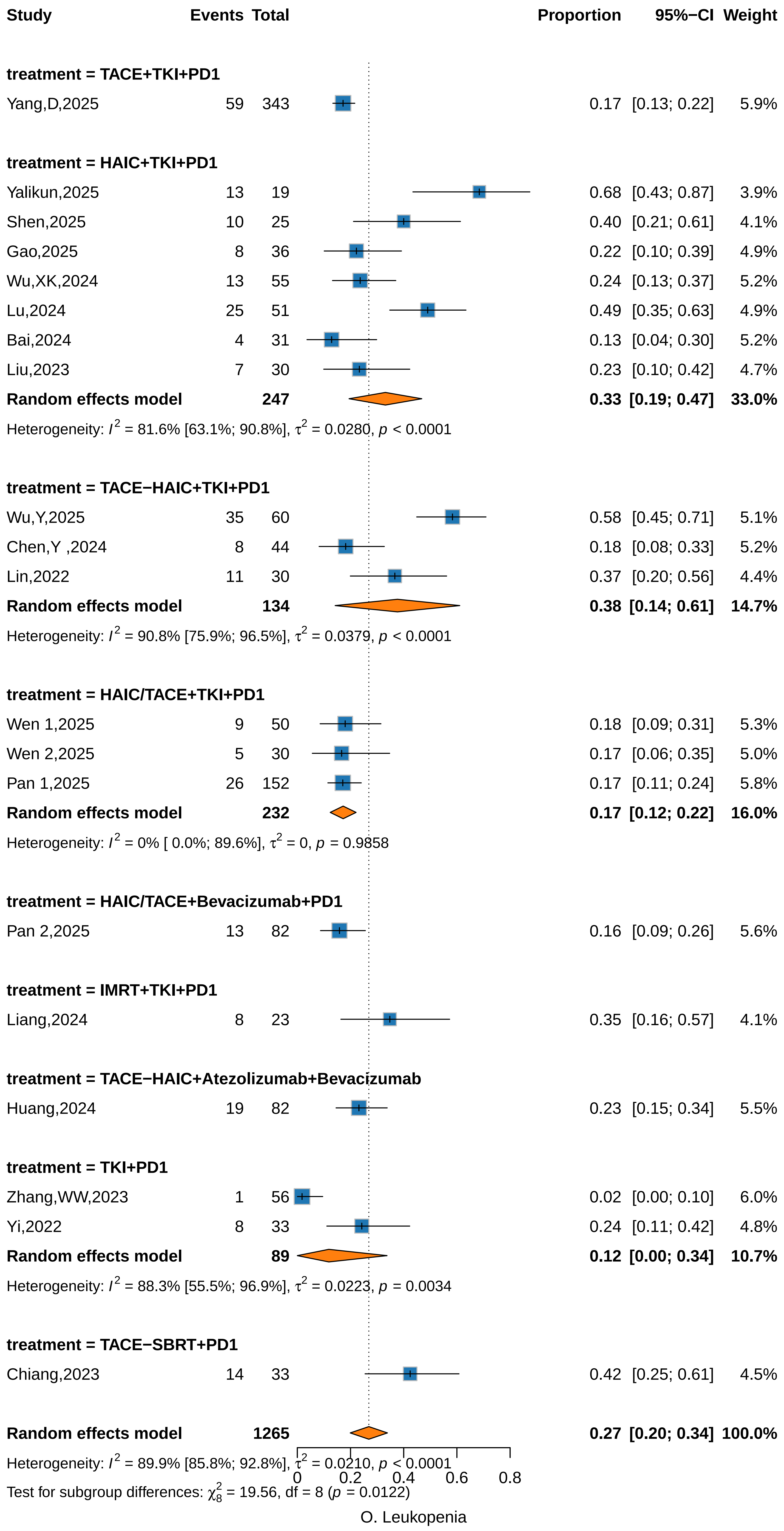
K. Hyperbilirubinemia


Study Events Total Proportion 95%−CI
treatment = HAIC+TKI+PD1
Zuo 1,2025 55 194 0.28 [0.22; 0.35]
Shen,2025 6 25 0.24 [0.09; 0.45]
Huang 1,2025 48 108 0.44 [0.35; 0.54]
Xiao,2024 29 162 0.18 [0.12; 0.25]
Wu,XK,2024 6 55 0.11 [0.04; 0.22]
Lu,2024 19 51 0.37 [0.24; 0.52]
Bai,2024 7 31 0.23 [0.10; 0.41]
Liu,2023 7 30 0.23 [0.10; 0.42]
Random effects model 656 0.25 [0.19; 0.34]
Heterogeneity: I^2 = 78.2% [57.1%; 88.9%], τ^2 = 0.2261, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 60 194 0.31 [0.25; 0.38]
Zhang,WW,2023 9 56 0.16 [0.08; 0.28]
Wang,L,2023 15 36 0.42 [0.26; 0.59]
Yi,2022 6 33 0.18 [0.07; 0.35]
Random effects model 319 0.26 [0.18; 0.37]
Heterogeneity: I^2 = 67.5% [5.4%; 88.8%], τ^2 = 0.1437, p = 0.0263
treatment = TACE+TKI+PD1
Yang,D,2025 125 343 0.36 [0.31; 0.42]
treatment = TACE−HAIC+TKI+PD1
Wu,Y,2025 35 60 0.58 [0.45; 0.71]
Zhao,2024 4 28 0.14 [0.04; 0.33]
Yang,Y,2024 10 35 0.29 [0.15; 0.46]
Pang,2024 11 62 0.18 [0.09; 0.30]
Chen,Y ,2024 18 44 0.41 [0.26; 0.57]
Lin,2022 13 30 0.43 [0.25; 0.63]
Random effects model 259 0.33 [0.21; 0.47]
Heterogeneity: I^2 = 81.7% [61.0%; 91.4%], τ^2 = 0.4323, p < 0.0001
treatment = HAIC/TACE+TKI+PD1
Wen 1,2025 13 50 0.26 [0.15; 0.40]
Wen 2,2025 4 30 0.13 [0.04; 0.31]
Han 1,2024 15 50 0.30 [0.18; 0.45]
Random effects model 130 0.25 [0.18; 0.33]
Heterogeneity: I^2 = 27.4% [0.0%; 92.4%], τ^2 = 0, p = 0.2524
treatment = HAIC+Bevacizumab+PD1
Huang 2,2025 46 108 0.43 [0.33; 0.52]
treatment = HAIC/TACE+Bevacizumab+PD1
Han 2,2024 5 28 0.18 [0.06; 0.37]
treatment = Atezolizumab+Bevacizumab
Shimose,2023 68 156 0.44 [0.36; 0.52]
Random effects model 1999 0.29 [0.24; 0.34]
Heterogeneity: I^2 = 76.4% [65.4%; 83.9%], τ^2 = 0.2731, p < 0.0001
Test for subgroup differences: χ^2_7 = 25.04, df = 7 (p = 0.0007)
0.1 0.2 0.3 0.4 0.5 0.6 0.7
L. Hypertension



M. Hypoalbuminemia

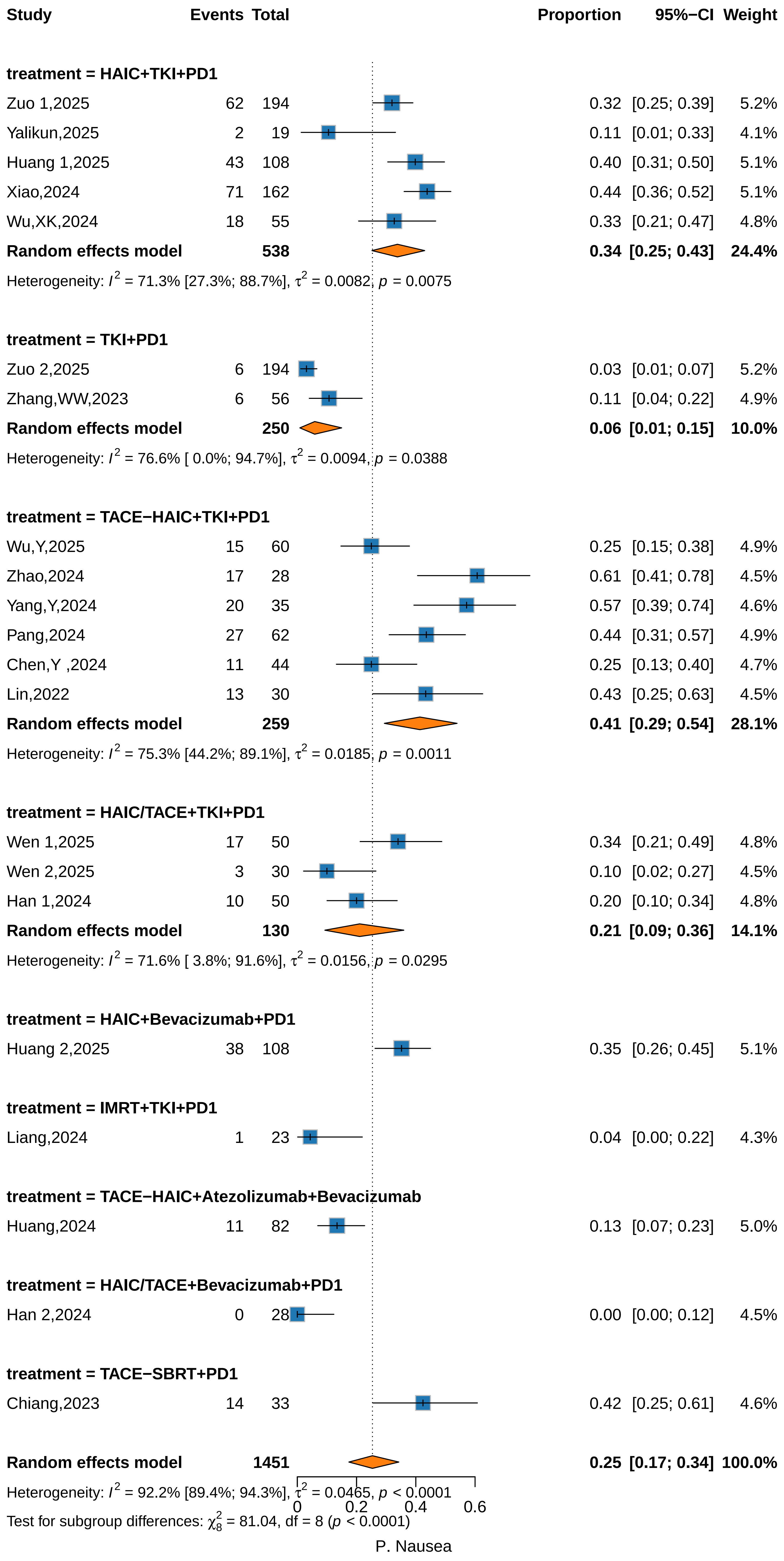

Study Events Total Proportion 95%−CI
treatment = HAIC+TKI+PD1
Zuo 1,2025 62 194 0.32 [0.25; 0.39]
Yalikun,2025 1 19 0.05 [0.00; 0.26]
Xiao,2024 12 162 0.07 [0.04; 0.13]
Wu,XK,2024 15 55 0.27 [0.16; 0.41]
Random effects model 430 0.16 [0.07; 0.32]
Heterogeneity: I^2 = 90.2% [78.0%; 95.7%], τ^2 = 0.6470, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 47 194 0.24 [0.18; 0.31]
Zhang,WW,2023 4 56 0.07 [0.02; 0.17]
Yi,2022 5 33 0.15 [0.05; 0.32]
Random effects model 283 0.15 [0.08; 0.27]
Heterogeneity: I^2 = 73.7% [11.9%; 92.1%], τ^2 = 0.2397, p = 0.0224
treatment = TACE+TKI+PD1
Yang,D,2025 23 343 0.07 [0.04; 0.10]
treatment = TACE+PD1
Li,2025 18 20 0.90 [0.68; 0.99]
treatment = TACE−HAIC+TKI+PD1
Yang,Y,2024 5 35 0.14 [0.05; 0.30]
Pang,2024 12 62 0.19 [0.10; 0.31]
Chen,Y ,2024 2 44 0.05 [0.01; 0.15]
Lin,2022 8 30 0.27 [0.12; 0.46]
Random effects model 171 0.15 [0.09; 0.25]
Heterogeneity: I^2 = 52.8% [0.0%; 84.4%], τ^2 = 0.2004, p = 0.0957
treatment = TACE−HAIC+Atezolizumab+Bevacizumab
Huang,2024 13 82 0.16 [0.09; 0.26]
treatment = Atezolizumab+Bevacizumab
Shimose,2023 22 156 0.14 [0.09; 0.21]
treatment = TACE−SBRT+PD1
Chiang,2023 5 33 0.15 [0.05; 0.32]
Random effects model 1518 0.17 [0.10; 0.25]
Heterogeneity: I^2 = 86.3% [79.3%; 90.9%], τ^2 = 1.0107, p < 0.0001
Test for subgroup differences: χ^2_7 = 43.47, df = 7 (p < 0.0001)
0.2
0.4
0.6
0.8
N. Hypothyroidism



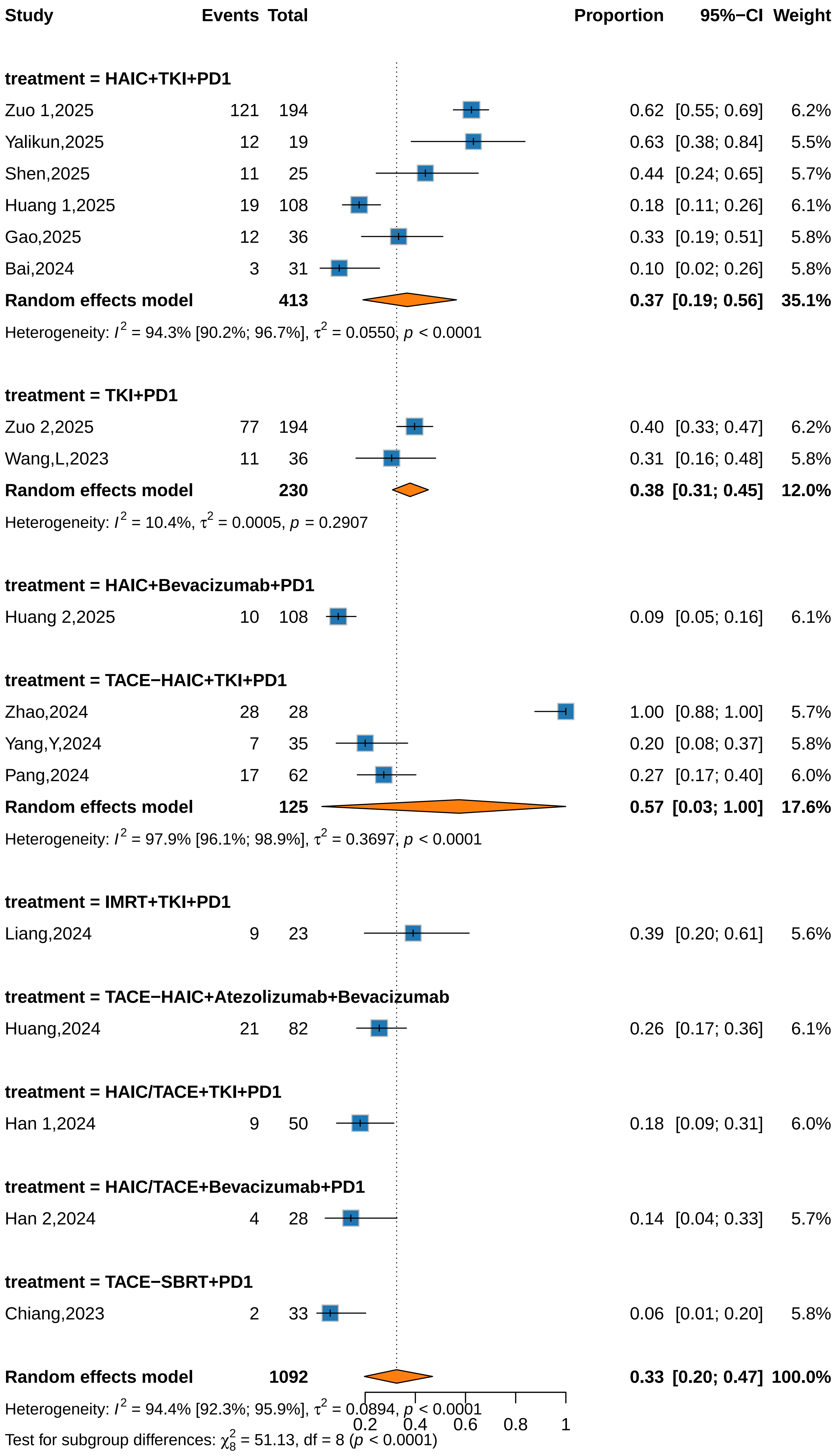
Study	Events	Total	Proportion	95%−CI	Weight
treatment = TACE+TKI+PD1					
Yang,D,2025	59	343	0.17	[0.13; 0.22]	5.9%
treatment = HAIC+TKI+PD1					
Yalikun,2025	13	19	0.68	[0.43; 0.87]	3.9%
Shen,2025	10	25	0.40	[0.21; 0.61]	4.1%
Gao,2025	8	36	0.22	[0.10; 0.39]	4.9%
Wu,XK,2024	13	55	0.24	[0.13; 0.37]	5.2%
Lu,2024	25	51	0.49	[0.35; 0.63]	4.9%
Bai,2024	4	31	0.13	[0.04; 0.30]	5.2%
Liu,2023	7	30	0.23	[0.10; 0.42]	4.7%
Random effects model		**247**	**0.33**	**[0.19; 0.47]**	**33.0%**
Heterogeneity: $I^2 = 81.6\%$ [63.1%; 90.8%], $\tau^2 = 0.0280$, $p < 0.0001$					
treatment = TACE−HAIC+TKI+PD1					
Wu,Y,2025	35	60	0.58	[0.45; 0.71]	5.1%
Chen,Y ,2024	8	44	0.18	[0.08; 0.33]	5.2%
Lin,2022	11	30	0.37	[0.20; 0.56]	4.4%
Random effects model		**134**	**0.38**	**[0.14; 0.61]**	**14.7%**
Heterogeneity: $I^2 = 90.8\%$ [75.9%; 96.5%], $\tau^2 = 0.0379$, $p < 0.0001$					
treatment = HAIC/TACE+TKI+PD1					
Wen 1,2025	9	50	0.18	[0.09; 0.31]	5.3%
Wen 2,2025	5	30	0.17	[0.06; 0.35]	5.0%
Pan 1,2025	26	152	0.17	[0.11; 0.24]	5.8%
Random effects model		**232**	**0.17**	**[0.12; 0.22]**	**16.0%**
Heterogeneity: $I^2 = 0\%$ [0.0%; 89.6%], $\tau^2 = 0$, $p = 0.9858$					
treatment = HAIC/TACE+Bevacizumab+PD1					
Pan 2,2025	13	82	0.16	[0.09; 0.26]	5.6%
treatment = IMRT+TKI+PD1					
Liang,2024	8	23	0.35	[0.16; 0.57]	4.1%
treatment = TACE−HAIC+Atezolizumab+Bevacizumab					
Huang,2024	19	82	0.23	[0.15; 0.34]	5.5%
treatment = TKI+PD1					
Zhang,WW,2023	1	56	0.02	[0.00; 0.10]	6.0%
Yi,2022	8	33	0.24	[0.11; 0.42]	4.8%
Random effects model		**89**	**0.12**	**[0.00; 0.34]**	**10.7%**
Heterogeneity: $I^2 = 88.3\%$ [55.5%; 96.9%], $\tau^2 = 0.0223$, $p = 0.0034$					
treatment = TACE−SBRT+PD1					
Chiang,2023	14	33	0.42	[0.25; 0.61]	4.5%
Random effects model		**1265**	**0.27**	**[0.20; 0.34]**	**100.0%**

Heterogeneity: $I^2 = 89.9\%$ [85.8%; 92.8%], $\tau^2 = 0.0210$, $p < 0.0001$

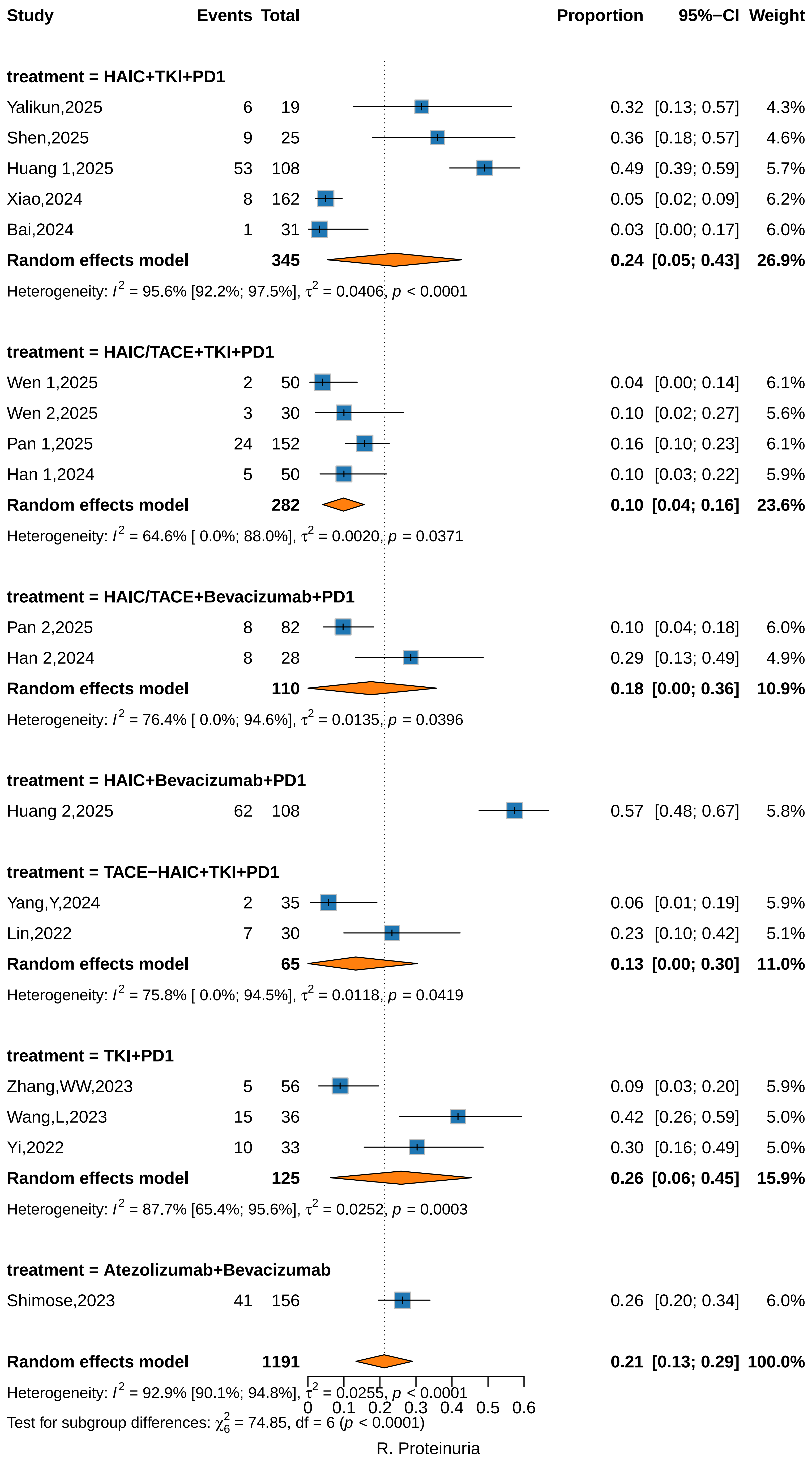
Test for subgroup differences: $\chi^2_8 = 19.56$, df = 8 ($p = 0.0122$)



Study	Events	Total	Proportion	95%−CI	Weight
treatment = HAIC+TKI+PD1					
Zuo 1,2025	62	194	0.32	[0.25; 0.39]	5.2%
Yalikun,2025	2	19	0.11	[0.01; 0.33]	4.1%
Huang 1,2025	43	108	0.40	[0.31; 0.50]	5.1%
Xiao,2024	71	162	0.44	[0.36; 0.52]	5.1%
Wu,XK,2024	18	55	0.33	[0.21; 0.47]	4.8%
Random effects model		**538**	**0.34**	**[0.25; 0.43]**	**24.4%**
Heterogeneity: I^2 = 71.3% [27.3%; 88.7%], τ^2 = 0.0082, p = 0.0075					
treatment = TKI+PD1					
Zuo 2,2025	6	194	0.03	[0.01; 0.07]	5.2%
Zhang,WW,2023	6	56	0.11	[0.04; 0.22]	4.9%
Random effects model		**250**	**0.06**	**[0.01; 0.15]**	**10.0%**
Heterogeneity: I^2 = 76.6% [0.0%; 94.7%], τ^2 = 0.0094, p = 0.0388					
treatment = TACE−HAIC+TKI+PD1					
Wu,Y,2025	15	60	0.25	[0.15; 0.38]	4.9%
Zhao,2024	17	28	0.61	[0.41; 0.78]	4.5%
Yang,Y,2024	20	35	0.57	[0.39; 0.74]	4.6%
Pang,2024	27	62	0.44	[0.31; 0.57]	4.9%
Chen,Y ,2024	11	44	0.25	[0.13; 0.40]	4.7%
Lin,2022	13	30	0.43	[0.25; 0.63]	4.5%
Random effects model		**259**	**0.41**	**[0.29; 0.54]**	**28.1%**
Heterogeneity: I^2 = 75.3% [44.2%; 89.1%], τ^2 = 0.0185, p = 0.0011					
treatment = HAIC/TACE+TKI+PD1					
Wen 1,2025	17	50	0.34	[0.21; 0.49]	4.8%
Wen 2,2025	3	30	0.10	[0.02; 0.27]	4.5%
Han 1,2024	10	50	0.20	[0.10; 0.34]	4.8%
Random effects model		**130**	**0.21**	**[0.09; 0.36]**	**14.1%**
Heterogeneity: I^2 = 71.6% [3.8%; 91.6%], τ^2 = 0.0156, p = 0.0295					
treatment = HAIC+Bevacizumab+PD1					
Huang 2,2025	38	108	0.35	[0.26; 0.45]	5.1%
treatment = IMRT+TKI+PD1					
Liang,2024	1	23	0.04	[0.00; 0.22]	4.3%
treatment = TACE−HAIC+Atezolizumab+Bevacizumab					
Huang,2024	11	82	0.13	[0.07; 0.23]	5.0%
treatment = HAIC/TACE+Bevacizumab+PD1					
Han 2,2024	0	28	0.00	[0.00; 0.12]	4.5%
treatment = TACE−SBRT+PD1					
Chiang,2023	14	33	0.42	[0.25; 0.61]	4.6%
Random effects model		**1451**	**0.25**	**[0.17; 0.34]**	**100.0%**
Heterogeneity: I^2 = 92.2% [89.4%; 94.3%], τ^2 = 0.0465, p < 0.0001					
Test for subgroup differences: χ^2_8 = 81.04, df = 8 (p < 0.0001)					



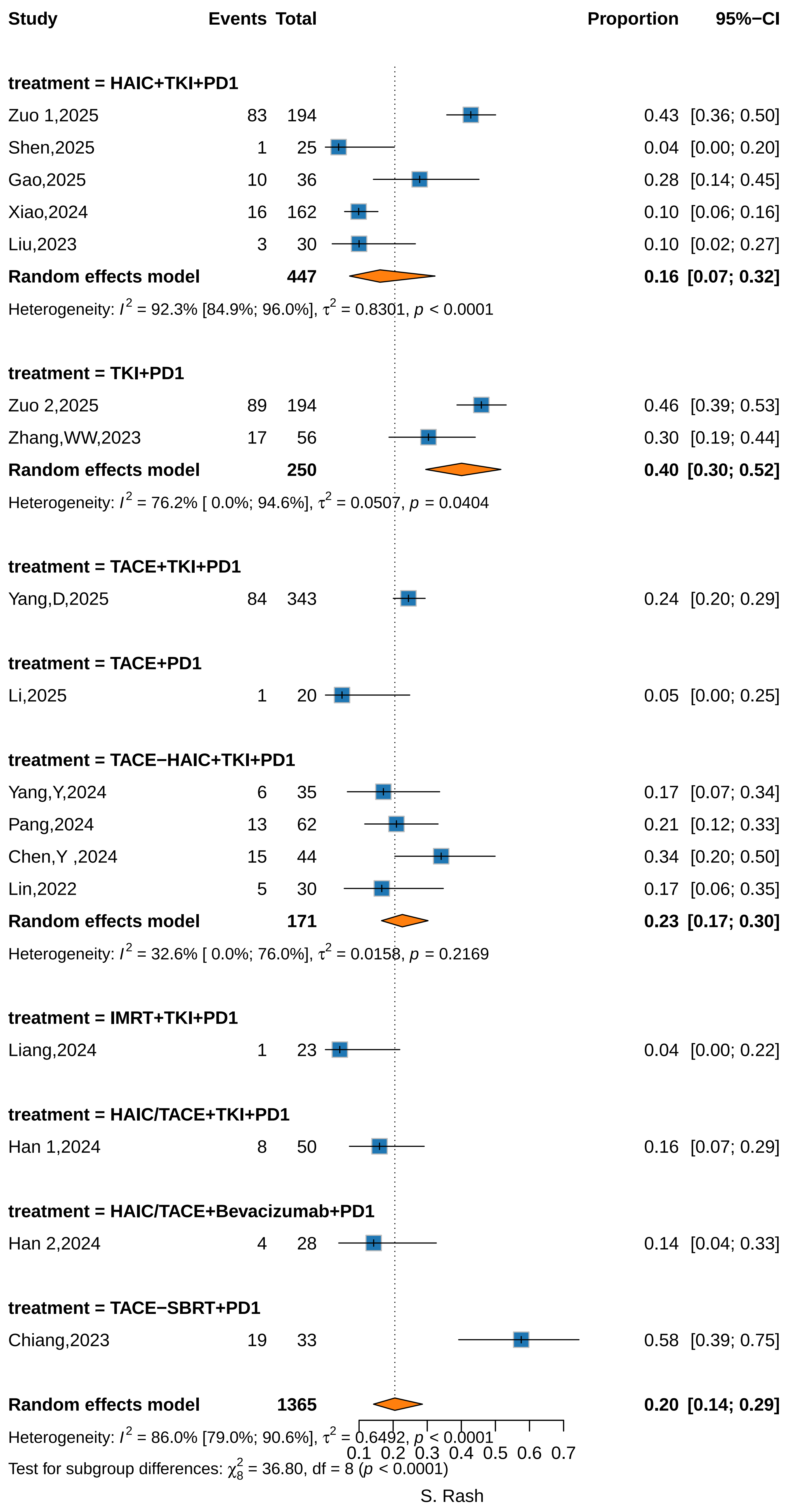
Q. Neutropenia

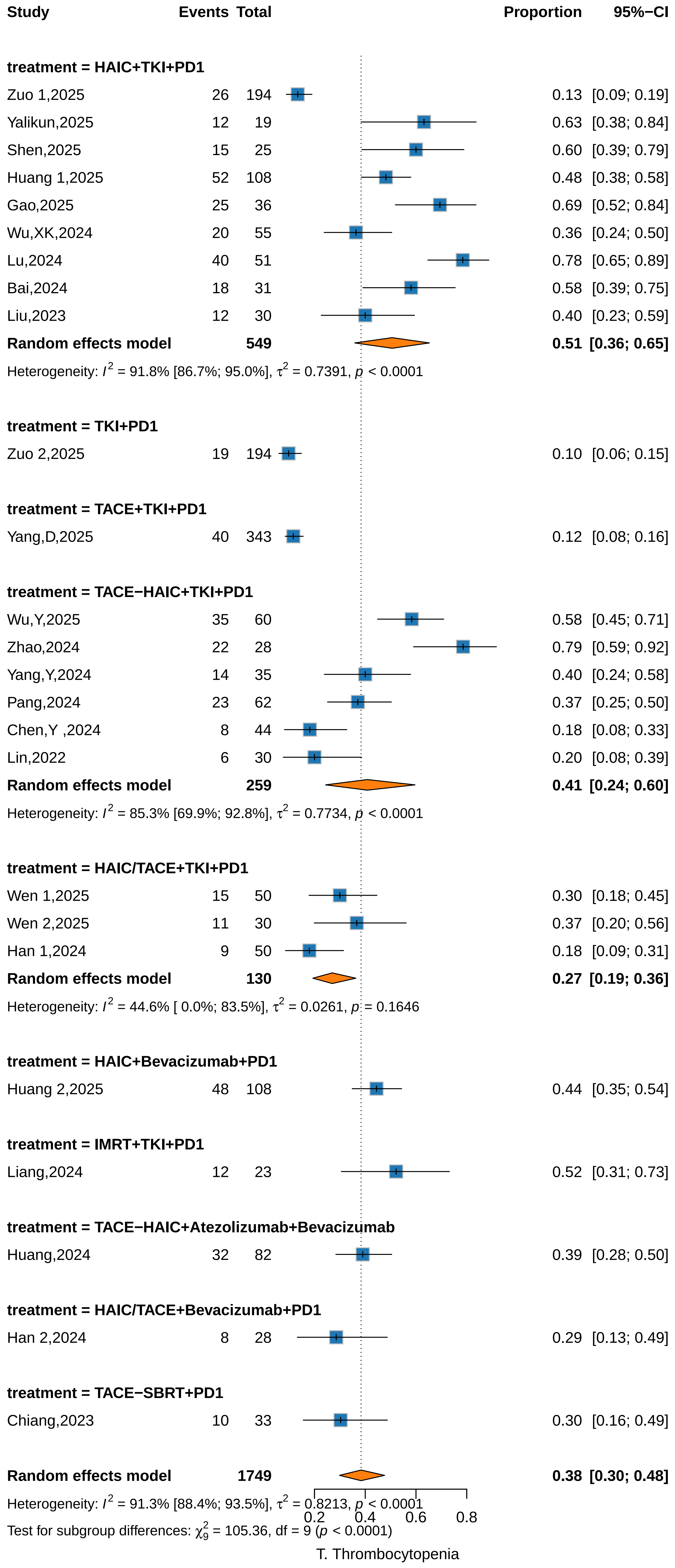


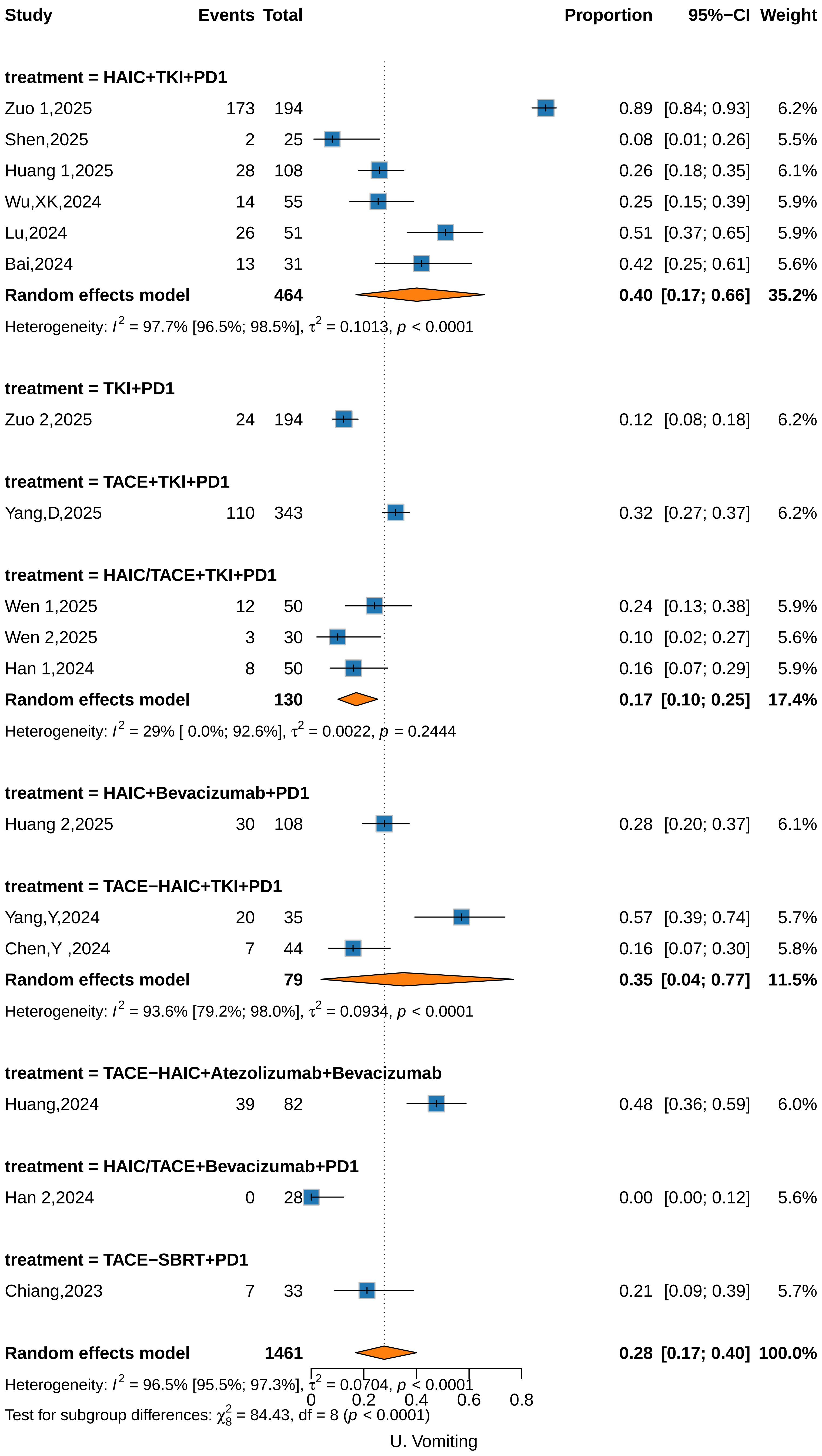
Study	Events	Total	Proportion	95%−CI	Weight
treatment = HAIC+TKI+PD1					
Yalikun,2025	6	19	0.32	[0.13; 0.57]	4.3%
Shen,2025	9	25	0.36	[0.18; 0.57]	4.6%
Huang 1,2025	53	108	0.49	[0.39; 0.59]	5.7%
Xiao,2024	8	162	0.05	[0.02; 0.09]	6.2%
Bai,2024	1	31	0.03	[0.00; 0.17]	6.0%
Random effects model		**345**	**0.24**	**[0.05; 0.43]**	**26.9%**
Heterogeneity: I^2 = 95.6% [92.2%; 97.5%], τ^2 = 0.0406, p < 0.0001					
treatment = HAIC/TACE+TKI+PD1					
Wen 1,2025	2	50	0.04	[0.00; 0.14]	6.1%
Wen 2,2025	3	30	0.10	[0.02; 0.27]	5.6%
Pan 1,2025	24	152	0.16	[0.10; 0.23]	6.1%
Han 1,2024	5	50	0.10	[0.03; 0.22]	5.9%
Random effects model		**282**	**0.10**	**[0.04; 0.16]**	**23.6%**
Heterogeneity: I^2 = 64.6% [0.0%; 88.0%], τ^2 = 0.0020, p = 0.0371					
treatment = HAIC/TACE+Bevacizumab+PD1					
Pan 2,2025	8	82	0.10	[0.04; 0.18]	6.0%
Han 2,2024	8	28	0.29	[0.13; 0.49]	4.9%
Random effects model		**110**	**0.18**	**[0.00; 0.36]**	**10.9%**
Heterogeneity: I^2 = 76.4% [0.0%; 94.6%], τ^2 = 0.0135, p = 0.0396					
treatment = HAIC+Bevacizumab+PD1					
Huang 2,2025	62	108	0.57	[0.48; 0.67]	5.8%
treatment = TACE−HAIC+TKI+PD1					
Yang,Y,2024	2	35	0.06	[0.01; 0.19]	5.9%
Lin,2022	7	30	0.23	[0.10; 0.42]	5.1%
Random effects model		**65**	**0.13**	**[0.00; 0.30]**	**11.0%**
Heterogeneity: I^2 = 75.8% [0.0%; 94.5%], τ^2 = 0.0118, p = 0.0419					
treatment = TKI+PD1					
Zhang,WW,2023	5	56	0.09	[0.03; 0.20]	5.9%
Wang,L,2023	15	36	0.42	[0.26; 0.59]	5.0%
Yi,2022	10	33	0.30	[0.16; 0.49]	5.0%
Random effects model		**125**	**0.26**	**[0.06; 0.45]**	**15.9%**
Heterogeneity: I^2 = 87.7% [65.4%; 95.6%], τ^2 = 0.0252, p = 0.0003					
treatment = Atezolizumab+Bevacizumab					
Shimose,2023	41	156	0.26	[0.20; 0.34]	6.0%
Random effects model		**1191**	**0.21**	**[0.13; 0.29]**	**100.0%**

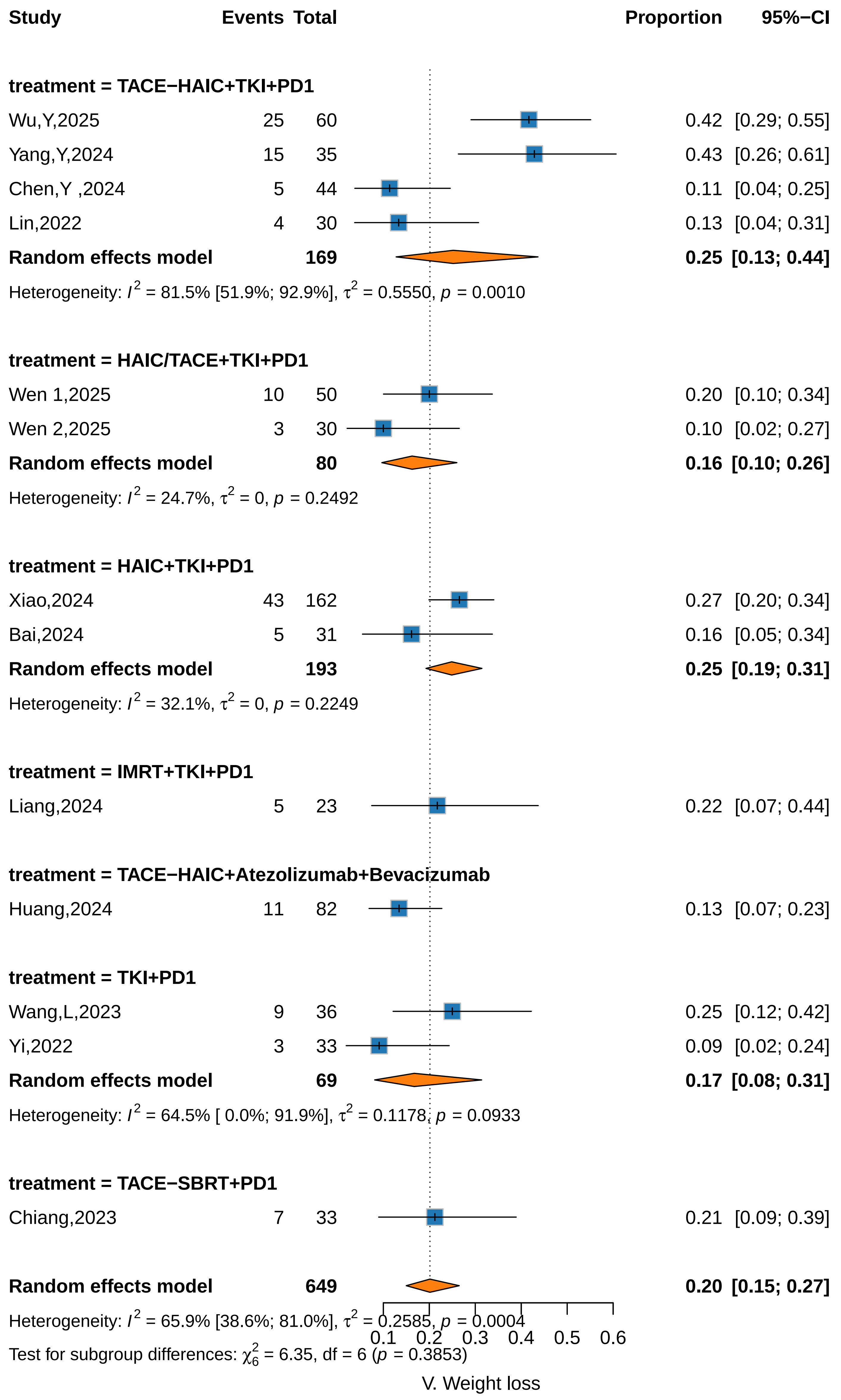
Heterogeneity: I^2 = 92.9% [90.1%; 94.8%], τ^2 = 0.0255, p < 0.0001

Test for subgroup differences: χ^2_6 = 74.85, df = 6 (p < 0.0001)


Study
Events
Total
Proportion
95%−CI
treatment = HAIC+TKI+PD1
Zuo 1,2025 83 194 0.43 [0.36; 0.50]
Shen,2025 1 25 0.04 [0.00; 0.20]
Gao,2025 10 36 0.28 [0.14; 0.45]
Xiao,2024 16 162 0.10 [0.06; 0.16]
Liu,2023 3 30 0.10 [0.02; 0.27]
Random effects model 447 0.16 [0.07; 0.32]
Heterogeneity: I^2 = 92.3% [84.9%; 96.0%], τ^2 = 0.8301, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 89 194 0.46 [0.39; 0.53]
Zhang,WW,2023 17 56 0.30 [0.19; 0.44]
Random effects model 250 0.40 [0.30; 0.52]
Heterogeneity: I^2 = 76.2% [0.0%; 94.6%], τ^2 = 0.0507, p = 0.0404
treatment = TACE+TKI+PD1
Yang,D,2025 84 343 0.24 [0.20; 0.29]
treatment = TACE+PD1
Li,2025 1 20 0.05 [0.00; 0.25]
treatment = TACE−HAIC+TKI+PD1
Yang,Y,2024 6 35 0.17 [0.07; 0.34]
Pang,2024 13 62 0.21 [0.12; 0.33]
Chen,Y ,2024 15 44 0.34 [0.20; 0.50]
Lin,2022 5 30 0.17 [0.06; 0.35]
Random effects model 171 0.23 [0.17; 0.30]
Heterogeneity: I^2 = 32.6% [0.0%; 76.0%], τ^2 = 0.0158, p = 0.2169
treatment = IMRT+TKI+PD1
Liang,2024 1 23 0.04 [0.00; 0.22]
treatment = HAIC/TACE+TKI+PD1
Han 1,2024 8 50 0.16 [0.07; 0.29]
treatment = HAIC/TACE+Bevacizumab+PD1
Han 2,2024 4 28 0.14 [0.04; 0.33]
treatment = TACE−SBRT+PD1
Chiang,2023 19 33 0.58 [0.39; 0.75]
Random effects model 1365 0.20 [0.14; 0.29]
Heterogeneity: I^2 = 86.0% [79.0%; 90.6%], τ^2 = 0.6492, p < 0.0001
Test for subgroup differences: χ^2_8 = 36.80, df = 8 (p < 0.0001)
0.1 0.2 0.3 0.4 0.5 0.6 0.7
S. Rash


Study Events Total Proportion 95%−CI
treatment = HAIC+TKI+PD1
Zuo 1,2025 26 194 0.13 [0.09; 0.19]
Yalikun,2025 12 19 0.63 [0.38; 0.84]
Shen,2025 15 25 0.60 [0.39; 0.79]
Huang 1,2025 52 108 0.48 [0.38; 0.58]
Gao,2025 25 36 0.69 [0.52; 0.84]
Wu,XK,2024 20 55 0.36 [0.24; 0.50]
Lu,2024 40 51 0.78 [0.65; 0.89]
Bai,2024 18 31 0.58 [0.39; 0.75]
Liu,2023 12 30 0.40 [0.23; 0.59]
Random effects model 549 0.51 [0.36; 0.65]
Heterogeneity: I^2 = 91.8% [86.7%; 95.0%], τ^2 = 0.7391, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 19 194 0.10 [0.06; 0.15]
treatment = TACE+TKI+PD1
Yang,D,2025 40 343 0.12 [0.08; 0.16]
treatment = TACE−HAIC+TKI+PD1
Wu,Y,2025 35 60 0.58 [0.45; 0.71]
Zhao,2024 22 28 0.79 [0.59; 0.92]
Yang,Y,2024 14 35 0.40 [0.24; 0.58]
Pang,2024 23 62 0.37 [0.25; 0.50]
Chen,Y ,2024 8 44 0.18 [0.08; 0.33]
Lin,2022 6 30 0.20 [0.08; 0.39]
Random effects model 259 0.41 [0.24; 0.60]
Heterogeneity: I^2 = 85.3% [69.9%; 92.8%], τ^2 = 0.7734, p < 0.0001
treatment = HAIC/TACE+TKI+PD1
Wen 1,2025 15 50 0.30 [0.18; 0.45]
Wen 2,2025 11 30 0.37 [0.20; 0.56]
Han 1,2024 9 50 0.18 [0.09; 0.31]
Random effects model 130 0.27 [0.19; 0.36]
Heterogeneity: I^2 = 44.6% [0.0%; 83.5%], τ^2 = 0.0261, p = 0.1646
treatment = HAIC+Bevacizumab+PD1
Huang 2,2025 48 108 0.44 [0.35; 0.54]
treatment = IMRT+TKI+PD1
Liang,2024 12 23 0.52 [0.31; 0.73]
treatment = TACE−HAIC+Atezolizumab+Bevacizumab
Huang,2024 32 82 0.39 [0.28; 0.50]
treatment = HAIC/TACE+Bevacizumab+PD1
Han 2,2024 8 28 0.29 [0.13; 0.49]
treatment = TACE−SBRT+PD1
Chiang,2023 10 33 0.30 [0.16; 0.49]
Random effects model 1749 0.38 [0.30; 0.48]
Heterogeneity: I^2 = 91.3% [88.4%; 93.5%], τ^2 = 0.8213, p < 0.0001
Test for subgroup differences: χ^2_9 = 105.36, df = 9 (p < 0.0001)
0.2
0.4
0.6
0.8
T. Thrombocytopenia


Study Events Total Proportion 95%−CI Weight
treatment = HAIC+TKI+PD1
Zuo 1,2025 173 194 0.89 [0.84; 0.93] 6.2%
Shen,2025 2 25 0.08 [0.01; 0.26] 5.5%
Huang 1,2025 28 108 0.26 [0.18; 0.35] 6.1%
Wu,XK,2024 14 55 0.25 [0.15; 0.39] 5.9%
Lu,2024 26 51 0.51 [0.37; 0.65] 5.9%
Bai,2024 13 31 0.42 [0.25; 0.61] 5.6%
Random effects model 464 0.40 [0.17; 0.66] 35.2%
Heterogeneity: I^2 = 97.7% [96.5%; 98.5%], τ^2 = 0.1013, p < 0.0001
treatment = TKI+PD1
Zuo 2,2025 24 194 0.12 [0.08; 0.18] 6.2%
treatment = TACE+TKI+PD1
Yang,D,2025 110 343 0.32 [0.27; 0.37] 6.2%
treatment = HAIC/TACE+TKI+PD1
Wen 1,2025 12 50 0.24 [0.13; 0.38] 5.9%
Wen 2,2025 3 30 0.10 [0.02; 0.27] 5.6%
Han 1,2024 8 50 0.16 [0.07; 0.29] 5.9%
Random effects model 130 0.17 [0.10; 0.25] 17.4%
Heterogeneity: I^2 = 29% [0.0%; 92.6%], τ^2 = 0.0022, p = 0.2444
treatment = HAIC+Bevacizumab+PD1
Huang 2,2025 30 108 0.28 [0.20; 0.37] 6.1%
treatment = TACE−HAIC+TKI+PD1
Yang,Y,2024 20 35 0.57 [0.39; 0.74] 5.7%
Chen,Y ,2024 7 44 0.16 [0.07; 0.30] 5.8%
Random effects model 79 0.35 [0.04; 0.77] 11.5%
Heterogeneity: I^2 = 93.6% [79.2%; 98.0%], τ^2 = 0.0934, p < 0.0001
treatment = TACE−HAIC+Atezolizumab+Bevacizumab
Huang,2024 39 82 0.48 [0.36; 0.59] 6.0%
treatment = HAIC/TACE+Bevacizumab+PD1
Han 2,2024 0 28 0.00 [0.00; 0.12] 5.6%
treatment = TACE−SBRT+PD1
Chiang,2023 7 33 0.21 [0.09; 0.39] 5.7%
Random effects model 1461 0.28 [0.17; 0.40] 100.0%
Heterogeneity: I^2 = 96.5% [95.5%; 97.3%], τ^2 = 0.0704, p < 0.0001
Test for subgroup differences: χ^2_8 = 84.43, df = 8 (p < 0.0001)
0
0.2
0.4
0.6
0.8
U. Vomiting


Study Events Total Proportion 95%−CI
treatment = TACE−HAIC+TKI+PD1
Wu,Y,2025 25 60 0.42 [0.29; 0.55]
Yang,Y,2024 15 35 0.43 [0.26; 0.61]
Chen,Y ,2024 5 44 0.11 [0.04; 0.25]
Lin,2022 4 30 0.13 [0.04; 0.31]
Random effects model 169 0.25 [0.13; 0.44]
Heterogeneity: I^2 = 81.5% [51.9%; 92.9%], τ^2 = 0.5550, p = 0.0010
treatment = HAIC/TACE+TKI+PD1
Wen 1,2025 10 50 0.20 [0.10; 0.34]
Wen 2,2025 3 30 0.10 [0.02; 0.27]
Random effects model 80 0.16 [0.10; 0.26]
Heterogeneity: I^2 = 24.7%, τ^2 = 0, p = 0.2492
treatment = HAIC+TKI+PD1
Xiao,2024 43 162 0.27 [0.20; 0.34]
Bai,2024 5 31 0.16 [0.05; 0.34]
Random effects model 193 0.25 [0.19; 0.31]
Heterogeneity: I^2 = 32.1%, τ^2 = 0, p = 0.2249
treatment = IMRT+TKI+PD1
Liang,2024 5 23 0.22 [0.07; 0.44]
treatment = TACE−HAIC+Atezolizumab+Bevacizumab
Huang,2024 11 82 0.13 [0.07; 0.23]
treatment = TKI+PD1
Wang,L,2023 9 36 0.25 [0.12; 0.42]
Yi,2022 3 33 0.09 [0.02; 0.24]
Random effects model 69 0.17 [0.08; 0.31]
Heterogeneity: I^2 = 64.5% [0.0%; 91.9%], τ^2 = 0.1178, p = 0.0933
treatment = TACE−SBRT+PD1
Chiang,2023 7 33 0.21 [0.09; 0.39]
Random effects model 649 0.20 [0.15; 0.27]
Heterogeneity: I^2 = 65.9% [38.6%; 81.0%], τ^2 = 0.2585, p = 0.0004
Test for subgroup differences: χ^2_6 = 6.35, df = 6 (p = 0.3853)
0.1 0.2 0.3 0.4 0.5 0.6
V. Weight loss