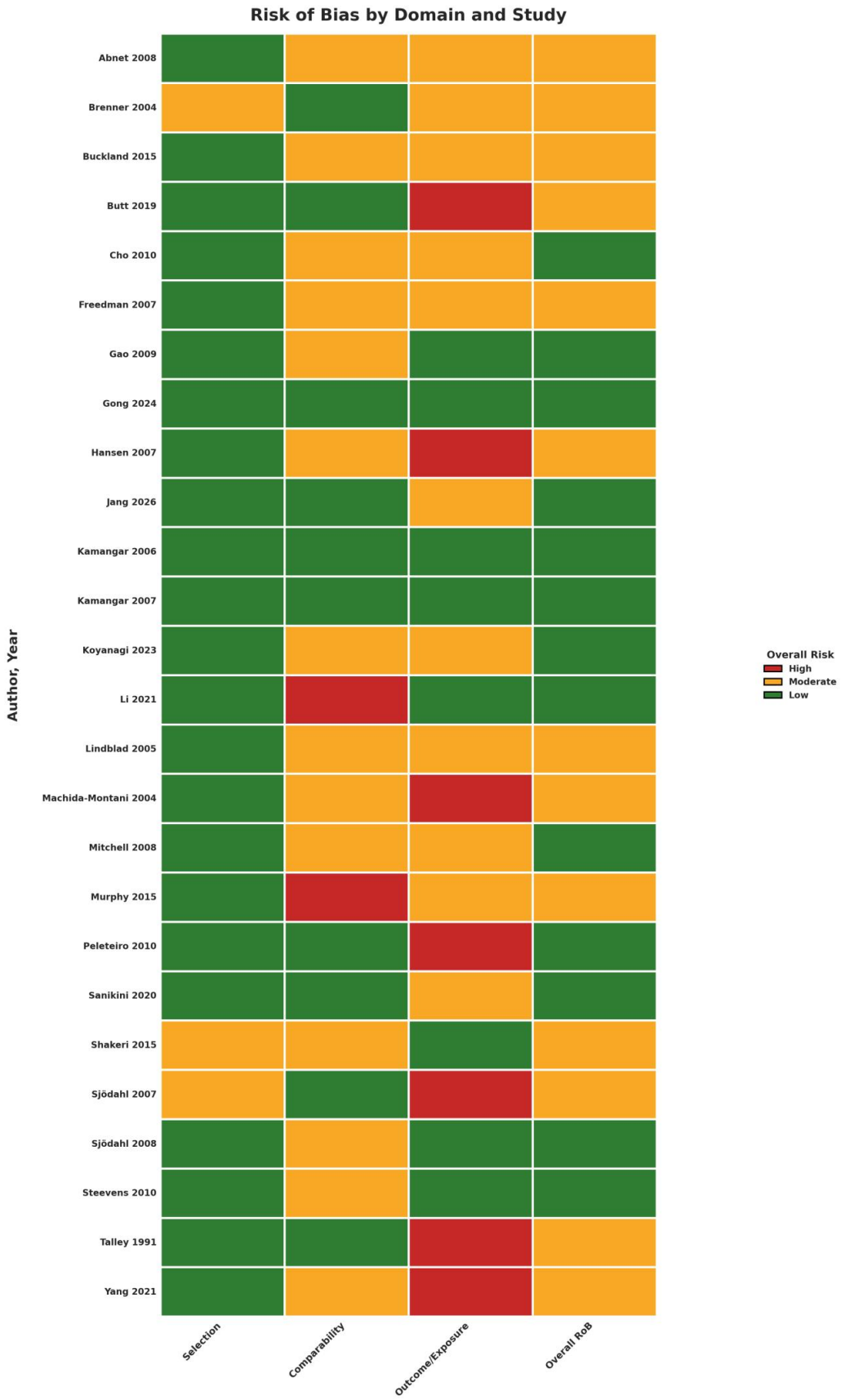
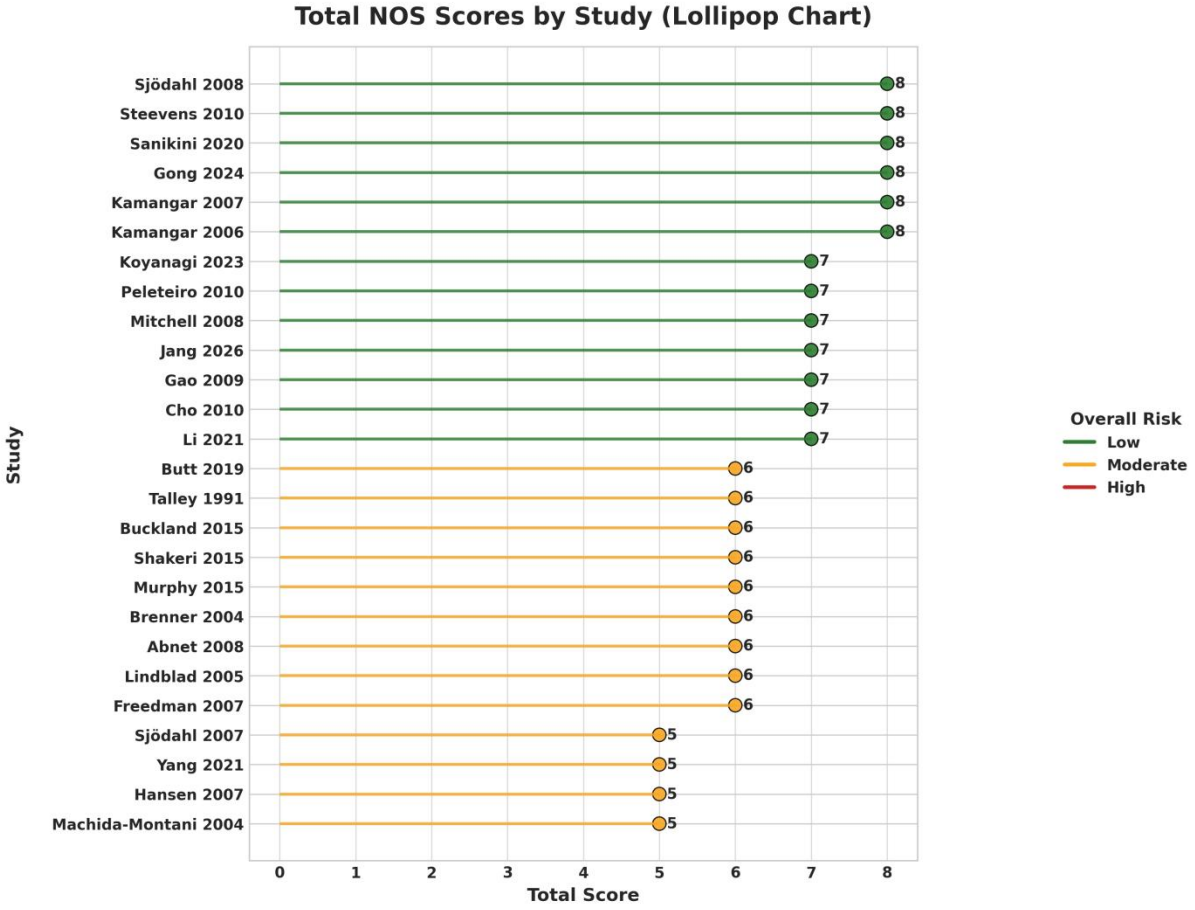


Supplementary Figure 1 Risk of Bias by Domain and Study.



Supplementary Figure 2 Total NOS Scores by Study (Lollipop Chart).

Supplementary Table 1 Database Search Query Date searched.

Database	Search Query	Date searched
MEDLINE	"gastric cancer"[tiab] OR "cardia gastric adenocarcinoma"[tiab] OR "non-cardia gastric adenocarcinoma"[tiab] OR"smoking"[MeSH] OR "smoking"[tiab] OR "tobacco"[tiab] OR "alcohol drinking"[MeSH] OR "alcohol consumption"[tiab] OR "obesity"[MeSH] OR "obesity"[tiab] OR "body mass index"[tiab] OR "Helicobacter pylori"[MeSH] OR "H. pylori"[tiab]	November 2025
Embase	("gastric cancer":tiab OR "cardia gastric adenocarcinoma":tiab OR "non-cardia gastric adenocarcinoma":tiab "smoking":tiab) and ("smoking":tiab OR "tobacco":tiab OR "alcohol consumption":tiab OR "Helicobacter pylori":tiab OR "H. pylori":tiab	November 2025
Web of Science	TS=("stomach cancer" OR "gastric cancer" OR "cardia adenocarcinoma" OR "non-cardia gastric cancer") and TS=("smoking" OR "alcohol" OR "obesity" OR "BMI" OR "Helicobacter pylori")	November 2025

Supplementary Table 2 Main exposure definitions and ranges used in the included studies

Risk Factor	Definition / Contrast Used	Main Categories / Ranges
Smoking	Never vs. Ever / Never vs. Current	Ever, Current, Never (Note: No continuous data

		[cigarettes/day or pack-years] were reported)
Alcohol	Never vs. Any drinking / Never vs. Heavy	Any, Heavy (≥45 g/day) (Note: No continuous dose data [g/day] were reported)
BMI	Normal weight vs. Overweight / Obesity	≥25.0 kg/m², ≥30.0 kg/m² (Note: No continuous) BMI data were reported)
H. pylori	Seronegative vs. Seropositive	Positive, Negative

Supplementary Table 3 GRADE certainty of evidence for primary associations.

Exposure-outcome	**No. of studies (k)**	**Design**	**Starting certainty**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Publication bias**	**Pooled effect OR (95%CI)**	**Upgrade factors**	**Final GRADE**
Smoking-CGA	6	Observational	Low	Serious	Serious (I^2=64%)	Not serious	Not serious	Not assessed (<10)	1.99 (1.52–2.61)	None	Very low
Smoking-NCGA	6	Observational	Low	Serious	Serious (I^2=68%)	Not serious	Not serious	Not assessed (<10)	1.51 (1.25–1.84)	None	Very low
Alcohol-C	6	Observati	Low	Serious	Not seriou	Not serio	Not serio	Not assess	1.26 (1.04–1.	None	Low

GA		onal			s (I^2=30 %)	us	us	ed (<10)	53)		
Alcohol-NCGA	6	Observational	Low	Serious	Very serious (I^2=82 %)	Not serious	Serious	Not assessed (<10)	1.09 (0.77–1.53)	None	Very low
BMI-CGA	6	Observational	Low	Serious	Serious (I^2=65 %)	Not serious	Serious	Not assessed (<10)	1.43 (1.03–1.98)	None	Very low
BMI-NCGA	6	Observational	Low	Serious	Not serious (I^2=34 %)	Not serious	Serious	Not assessed (<10)	1.03 (0.93–1.15)	None	low
H. pylori-CGA overall	10	Observational	Low	Serious	Very serious (I^2=88 %)	Not serious	Serious	Borderline[6]	0.99 (0.59–1.65)	None	Very low
H. pylori-NCGA	14	Observational	Low	Serious	Very serious (I^2=91 %)	Not serious	Not serious	Assessed[7]	2.49 (1.69–3.66)	Large effect (+1)	low
H.	3	Obse	Low	Seriou	Very	Not	Not	Not	2.45	Large	Very

pylori East Asian-CGA		rvational		s	serious (I²=86%)	serious	serious	assessed	(1.43–4.20)	effect (+1)	low
H. pylori European-CGA	4	Observational	Low	Serious	Not serious (I²=0%)	Not serious	Serious	Not assessed	0.46 (0.29–0.72)	Large effect (+1)	Low
H. pylori East Asian-NCGA	6	Observational	Low	Serious	Very serious (I²=83%)	Not serious	Not serious	Not assessed	3.04 (2.21–4.20)	Large effect (+1)	low
H. pylori European-NCGA	4	Observational	Low	Serious	Not serious (I²=21%)	Not serious	Not serious	Not assessed	2.97 (2.18–4.05)	Large effect (+1)	Moderate

Supplementary Table 4 Summary of excluded full-text reports by reason (n = 240)

Reason for exclusion	**n**	**Examples of exclusion criteria**	**Representative excluded studies (First author, Year)**

Reason 1: Excluded case literature	19	Case reports, case series without control groups	[Yan, 2024]
Reason 2: Interventions did not match	12	Studies evaluating exposures other than smoking, alcohol, BMI, or H. pylori	[Sheikh, 2019]
Reason 3: The trial design was not fit	25	Cross-sectional studies, reviews, or trials not reporting RR/OR	[Xie, 2020]
Reason 4: Study subjects do not fit	28	Studies not distinguishing CGA from NCGA, or on ESCC only	[Sun, 2019]
Reason 5: Useful data cannot be extracted	156	Studies not reporting subsite-specific ORs or 95% CIs	[Cai, 2017]
Total	240		

Supplementary Table 5 Leave-one-out sensitivity analysis for the association between *H. pylori* infection and CGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Brenner 2004	1.55	[1.32, 1.80]	89%
Cho 2010	1.37	[1.16, 1.62]	88%
Gao 2009	1.58	[1.35, 1.85]	88%
Hansen 2007	1.65	[1.40, 1.93]	86%

Kamangar 2006	1.64	[1.40, 1.93]	86%
Kamangar 2007	1.48	[1.22, 1.80]	89%
Mitchell 2008	1.53	[1.31, 1.79]	89%
Shakeri 2015	1.55	[1.32, 1.81]	89%
Talley 1991	1.55	[1.32, 1.81]	89%
Yang 2021	1.26	[1.07, 1.49]	84%
Overall (Original)	1.52	[1.30, 1.77]	88%

Supplementary Table 6 Leave-one-out sensitivity analysis for the association between *H. pylori* infection and NCGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Brenner 2004	2.28	[2.05, 2.52]	92%
Butt 2019	2.16	[1.93, 2.42]	92%
Cho 2010	2.19	[1.95, 2.45]	92%
Gao 2009	2.29	[2.07, 2.54]	92%
Hansen 2007	2.23	[2.01, 2.48]	92%
Kamangar 2006	2.25	[2.03, 2.49]	92%
Kamangar 2007	2.42	[2.17, 2.69]	92%
Machida-Montani 2004	2.23	[2.01, 2.47]	92%
Mitchell 2008	2.29	[2.07, 2.54]	92%
Murphy 2015	2.26	[2.03, 2.50]	92%
Peleteiro 2010	2.85	[2.55, 3.19]	66%
Shakeri 2015	2.30	[2.08, 2.55]	92%
Talley 1991	2.28	[2.06, 2.53]	92%
Yang 2021	2.16	[1.95, 2.40]	91%

Overall (Original)	2.29	[2.07, 2.54]	91%

Supplementary Table 7 Leave-one-out sensitivity analysis for the association between BMI and CGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Abnet 2008	1.16	[0.95, 1.40]	81%
Gong 2024	1.21	[1.02, 1.43]	74%
Jang 2025	1.37	[1.17, 1.60]	83%
Koyanagi 2023	1.43	[1.22, 1.67]	81%
Lindblad 2005	1.37	[1.17, 1.59]	83%
Sanikini 2020	1.59	[1.35, 1.87]	65%
Sjodahl 2008	1.37	[1.17, 1.59]	83%
Overall (Original)	1.36	[1.17, 1.57]	80%

Supplementary Table 8 Leave-one-out sensitivity analysis for the association between BMI and NCGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Abnet 2008	1.00	[0.89, 1.13]	38%
Jang 2025	1.06	[0.94, 1.20]	36%
Koyanagi 2023	1.03	[0.90, 1.18]	47%
Lindblad 2005	1.06	[0.94, 1.18]	28%
Sanikini 2020	1.04	[0.93, 1.18]	45%

Sjodahl 2008	1.00	[0.89, 1.13]	0%
Overall (Original)	1.03	[0.93, 1.15]	34%

Supplementary Table 9 Leave-one-out sensitivity analysis for the association between smoking and CGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Abnet 2008	2.10	[1.77, 2.50]	69%
Buckland 2015	2.19	[1.84, 2.60]	66%
Freedman 2007	1.83	[1.55, 2.14]	47%
Lindblad 2005	2.12	[1.80, 2.48]	65%
Sjodahl 2007	2.01	[1.74, 2.34]	71%
Steevens 2010	1.86	[1.59, 2.19]	56%
Overall (Original)	2.01	[1.74, 2.33]	64%

Supplementary Table 10 Leave-one-out sensitivity analysis for the association between smoking and NCGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Abnet 2008	1.55	[1.38,1.75]	74%
Buckland 2015	1.66	[1.46, 1.87]	66%
Freedman 2007	1.57	[1.40, 1.76]	74%
Lindblad 2005	1.54	[1.37, 1.73]	73%
Sjodahl 2007	1.63	[1.45, 1.83]	63%

Steevens 2010	1.38	[1.22, 1.57]	17%
Overall (Original)	1.56	[1.40, 1.73]	68%

Supplementary Table 11 Leave-one-out sensitivity analysis for the association between alcohol consumption and CGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Buckland 2015	1.36	[1.06, 1.73]	37%
Freedman 2007	1.36	[1.08, 1.72]	37%
Li 2021	1.20	[0.99, 1.46]	0%
Lindblad 2005	1.26	[1.03, 1.53]	43%
Sjodahl 2007	1.25	[1.03, 1.52]	39%
Steevens 2010	1.20	[0.96, 1.50]	34%
Overall (Original)	1.26	[1.04, 1.53]	30%

Supplementary Table 12 Leave-one-out sensitivity analysis for the association between alcohol consumption and NCGA

Excluded Study	**Pooled OR**	**95% CI**	**Heterogeneity (I^2)**
Buckland 2015	1.10	[0.95, 1.28]	85%
Freedman 2007	1.26	[1.09, 1.45]	80%
Li 2021	1.04	[0.91, 1.20]	71%
Lindblad 2005	1.19	[1.04, 1.35]	84%
Sjodahl 2007	1.21	[1.05, 1.38]	84%

Steevens 2010	1.17	[1.00, 1.37]	86%
Overall (Original)	1.16	[1.02, 1.32]	82%

Supplementary Table 13 E-values for unmeasured confounding in the meta-analysis of gastric cancer risk factors

Exposure	**Subsite**	**Pooled OR (95% CI)**	**P value**	**Statistical Model**	**E-value for Estimate**	**E-value for CI limit**	**k**	**Prediction interval (95%)**
Smoking	CGA	1.99 (1.52-2.61)	<0.00001	Random	3.39	2.41	6	0.87-4.56
Smoking	NCGA	1.51 (1.25-1.84)	<0.0001	Random	2.39	1.81	6	0.81-2.80
Alcohol	CGA	1.26 (1.04-1.53)	0.02	Fixed	1.83	1.24	—	NA
Alcohol	NCGA	1.09 (0.77-1.53)	0.64	Random	1.4	1	6	0.33–3.56
BMI	CGA	1.43 (1.03-1.98)	0.03	Random	2.21	1.21	7	0.48–4.30
BMI	NCGA	1.03 (0.93-1.15)	0.56	Fixed	1.21	1	—	NA
H. pylori	CGA	0.99 (0.59-1.65)	0.96	Random	1.11	1	10	0.16–6.16
H. pylori	NCGA	2.49 (1.69-3.66)	<0.00001	Random	4.42	2.77	14	0.51–12.2*

H. pylori (East Asian)	CGA	2.45 (1.43-4.20)	0.001	Random	4.33	2.21	3	0.004–1710
H. pylori (European)	CGA	0.46 (0.29-0.72)	0.0007	Fixed	3.77	2.12	—	NA
H. pylori (East Asian)	NCGA	3.04 (2.21-4.20)	<0.00001	Random	5.53	3.85	6	1.05–8.81
H. pylori (European)	NCGA	2.97 (2.18-4.05)	<0.00001	Fixed	5.39	3.78	—	NA