Supplementary Material: Risk of Malnutrition in Digestive System Cancers: a systematic review and meta-analysis

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Supplementary Document S1: Detailed protocol deviation 3
Supplementary Document S2: Individualised search key in different databases 3
Supplementary Document S3: Detailed definition of the measurement tools 4
Supplementary Document S4: Detailed strategy for the selection process 20
Supplementary Document S5: Detailed strategy for data collection 20
Supplementary Document S6: Leave-one-out analysis 20
Supplementary Document S7: Detailed strategy for overlapping population 21
Supplementary Document S8: References of the included studies 30
Supplementary Document S9: Detailed strategy for retrieval and reasons for excluding articles 74
Supplementary Document S10: Individual forest plots for population characteristics: Figure S1-S75 75
Supplementary Document S11: Individual forest plots for inflammation and other biological parameters: Figure S76-S96 127
Supplementary Document S12: Individual forest plots for tumour characteristics: Figure S97-S121 141
Supplementary Document S13: Individual forest plots for neoadjuvant therapy: Figures S122-S125 161
Supplementary Document S14: Moderator analysis: Figures S126-S172 165
Supplementary Document S15: Publication bias 210
Supplementary Document S16: Funnel plots for the publication bias and leave-one-out plots: Figures S173-S227 211
Supplementary Table S1.: PRISMA 2020 Checklist and PRISMA 2020 for Abstract Checklist 267
Supplementary Table S2.: Study characteristics table 271
Supplementary Table S3.: Summary plot of the risk of bias assessment 312

Supplementary Document S1: Detailed protocol deviation

We redo the search with a more comprehensive search key, including the following measurement tools for malnutrition: Geriatric Nutritional Risk Index (GNRI), Prognostic Nutritional Index (PNI), Controlling Nutritional Status (CONUT), Nutritional Risk Index (NRI).

Supplementary Document S2: Individualised search key in different databases

PubMed:
(("digestive system") OR ("gastrointestinal tract") OR (oesophag*) OR (esophag*) OR ("esogastric junction") OR (stomach) OR (gastric) OR (cardia) OR (antrum) OR (gut) OR (bowel) OR (duodenum) OR (ileum) OR (jejunum) OR (colon) OR (rectum) OR (appendix) OR (cecum) OR (cecal) OR (colorectal) OR (biliary) OR (gallblader) OR (cholecyst) OR (pancreas) OR (liver)) AND (("Neoplasms"[Mesh:NoExp]) OR (cancer) OR (malignancy) OR (tumor) OR (tumour) OR (carcinoma) OR (adenocarcinoma)) AND ((malnutrition) OR (malnourishment*) OR (undernutrition) OR ("fat free mass") OR ("FFM") OR ("fat mass") OR ("muscle mass") OR (cachexia) OR (cachec*) OR (non-cachectic) OR (pre-cachexia) OR ("nutritional deficiency") OR ("nutritional deficiencies") OR ("PG-SGA") OR ("skeletal muscle mass index") OR ("SMMI") OR ("Nutrition Risk Screening-2002") OR ("NRS-2002") OR ("Mini Nutritional Assessment") OR ("MNA") OR ("MNA-SF") OR ("Malnutrition Screening Tool") OR ("MST") OR ("Short Nutritional Assessment Questionnaire") OR ("SNAQ") OR ("Subjective Global Assessment") OR ("Malnutrition Universal Screening Tool") OR ("SGA") OR ("nutritional risk") OR (GLIM) OR ("geriatric nutritional risk index") OR ("gnri") OR ("prognostic nutritional index") OR ("pni") OR ("conut") OR ("controlling nutritional status") OR (nri) OR ("nutritional risk index" OR "creatinine height index"))

Embase:
('digestive system' OR 'gastrointestinal tract' OR oesophagus OR esophagus OR 'esogastric junction' OR stomach OR gastric OR cardia OR antrum OR gut OR bowel OR duodenum OR ileum OR jejunum OR colon OR rectum OR appendix OR cecum OR cecal OR colorectal OR biliary OR gallblader OR cholecyst OR pancreas OR liver) AND ('neoplasm' OR cancer OR malignancy OR tumor OR tumour OR carcinoma OR adenocarcinoma) AND (malnutrition OR malnourishment* OR undernutrition OR 'fat free mass' OR 'ffm' OR 'fat mass' OR 'muscle mass' OR cachexia OR cachec* OR 'non cachectic' OR 'pre cachexia' OR 'nutritional deficiency' OR 'nutritional deficiencies' OR 'pg-sga' OR 'skeletal muscle mass index' OR 'smmi' OR 'nutrition risk screening-2002' OR 'nrs-2002' OR 'mini nutritional assessment' OR 'mna' OR 'mna-sf' OR 'malnutrition screening tool' OR 'mst' OR 'short nutritional assessment questionnaire' OR 'snaq' OR 'subjective global assessment' OR 'sga' OR 'nutritional risk' OR 'malnutrition universal screening tool' OR 'GLIM' OR 'geriatric nutritional risk index' OR 'gnri' OR 'prognostic nutritional index' OR 'pni' OR 'conut' OR 'controlling nutritional status' OR 'nri' OR 'nutritional risk index' OR 'creatinine height index')

Central:
(('digestive system') OR ('gastrointestinal tract') OR (oesophag*) OR (esophag*) OR ('esogastric junction') OR (stomach) OR (gastric) OR (cardia) OR (antrum) OR (gut) OR (bowel) OR (duodenum) OR (ileum) OR (jejunum) OR (colon) OR (rectum) OR (appendix) OR (cecum) OR (cecal) OR (colorectal) OR (biliary) OR (gallblader) OR (cholecyst) OR (pancreas) OR (liver) AND ('Neoplasms') OR (cancer) OR (malignancy) OR (tumor) OR (tumour) OR (carcinoma) OR (adenocarcinoma)) AND ((malnutrition) OR (malnourishment*) OR (undernutrition) OR ("fat free mass") OR ("FFM") OR ("fat mass") OR ("muscle mass") OR (cachexia) OR (cachec*) OR (non-cachectic) OR (pre-cachexia) OR ("nutritional deficiency") OR ("nutritional deficiencies") OR ("PG-SGA") OR ("skeletal muscle mass index") OR ("SMMI") OR ("Nutrition Risk Screening-2002") OR ("NRS-2002") OR ("Mini Nutritional Assessment") OR ("MNA") OR ("MNA-SF") OR ("Malnutrition Screening Tool") OR ("MST") OR ("Short Nutritional Assessment Questionnaire") OR ("SNAQ") OR ("Subjective Global Assessment") OR ("SGA") OR ("Malnutrition Universal Screening Tool") OR ("nutritional risk") OR ("GLIM") OR ("geriatric nutritional risk index") OR ("gnri") OR ("prognostic nutritional index") OR ("pni") OR ("conut") ("controlling nutritional status") OR (nri) OR ("nutritional risk index") OR ("creatinine height index"))

Supplementary Document S3: Detailed definition of the measurement tools

I. Malnutrition Universal Screening Tool – MUST

BMI (kg/m^2)	Unintentional weight loss in the past 3–6 months	Acute illness with reduced food intake (estimated) for ≥5 days	
≥20 -0	≤5% -0	No = 0	Yes = 2
18.5–20.0 -1	5–10% -1		
≤18.5 -2	≥10% -2		
Overall Risk for Malnutrition			
0	Low		
1	Medium		
≥2	High		

II. Nutritional Risk Screening – NRS-2002

Impaired nutritional status		Severity of disease	
Absent Score 0	normal nutritional status	Absent Score 0	normal nutritional requirement
Mild Score 1	weight loss >5% in 3 months OR Food intake below 50-70% of normal requirement in preceding week	Mild Score 1	Hip fracture Chronic patients, in particular with acute complications; cirrhosis; COPD; chronic hemodialysis, diabetes, oncology
Moderate Score 2	weight loss >5% in 2 months OR BMI 18,5-20,5 kg/m^2 + impaired general condition OR Food intake 25-50% of normal requirement in preceding week	Moderate Score 2	Major abdominal surgery; stroke; severe pneumonia; hematologic malignancy
Severe Score 3	weight loss >5% in 1 months OR BMI 18,5 kg/m^2 + impaired general condition OR Food intake 0-25% of normal requirement in preceding week	Severe Score 3	Head injury; bone marrow transplantation; intensive care patients
Total score:			
If age ≥70 years add 1 to total score:			
Score ≥3:	the patient is nutritionally at risk and a nutritional care plan is initiated		
Score <3:	weekly rescreening of the patient. If the patient e.g is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.		

III. Mini Nutritional Assessment - MNA

Screening	
Has food intake declined over the past 3 months due to loss of appetite, digestive problems, or chewing or swallowing difficulties?	0 = severe decrease in food intake
	1 = moderate decrease in food intake
	2 = no decrease in food intake
Weight loss during the last 3 months	0 = weight loss greater than 3 kg
	1 = does not know
	2 = weight loss between 1 and 3 kg
	3 = no weight loss
Mobility	0 = bedridden or chair bound
	1 = able to get out of bed/chair but does not go out
	2 = goes out
Has the patient suffered psychological stress or acute disease in the past 3 months?	0 = yes
	2 = no
Neuropsychological problems	0 = severe dementia or depression
	1 = mild dementia
	2 = no psychological problems
Body mass index (BMI)	0 = BMI less than 19
	1 = BMI 19 to less than 21
	2 = BMI 21 to less than 23
	3 = BMI 23 or greater
Screening Score	
12–14 points	Normal nutritional status
8–11 points	At risk of malnutrition
0–7 points	Malnourished
Assessment	
Lives independently (not in nursing home or hospital)	0 = yes
	1 = no
Takes more than 3 prescription drugs per day	0 = yes
	1 = no
Pressure sores or skin ulcers	0 = yes
	1 = no
How many full meals does the patient eat daily?	0 = 1 meal
	1 = 2 meals
	2 = 3 meals
Selected consumption markers for protein intake	0.0 = if 0 or 1 yes
	0.5 = if 2 yes
	1.0 = if 3 yes
• Meat, fish or poultry every day Yes/No • ≥1 serving of dairy products (milk, cheese, yoghurt) per day Yes/No • ≥2 servings of legumes or eggs per week Yes/No	
Consumes ≥2 servings of fruit or vegetables per day?	0 = yes
	1 = no
How much fluid (water, juice, coffee, tea, milk...) is consumed per day?	0.0 = less than 3 cups
	1.0 = more than 5 cups
	0 = unable to eat without assistance
Mode of feeding	1 = self-fed with some difficulty
	2 = self-fed without any problem
Self-view of nutritional status	0 = views self as being malnourished
	1 = is uncertain of nutritional status
	2 = views self as having no nutritional problem

In comparison with other people of the same age, how does the patient consider his/her health status?	0.0 = not as good
	0.5 = does not know
	1.0 = as good
	2.0 = better
Mid-arm circumference (MAC) in cm	0.0 = MAC less than 21
	0.5 = MAC 21 to 22
	1.0 = MAC greater than 22
Calf circumference (CC) in cm	0 = CC less than 3
	1 = CC 31 or greater
Malnutrition Indicator Score	
24–30 points	Normal nutritional status
17–23.5 points	At risk of malnutrition
<17 points	Malnourished

IV. Mini Nutritional Assessment Short-Form - MNA-SFA

Has food intake declined over the past 3 months due to loss of appetite, digestive problems, or chewing or swallowing difficulties?	0 = severe decrease in food intake
	1 = moderate decrease in food intake
	2 = no decrease in food intake
Weight loss during the last 3 months	0 = weight loss greater than 3 kg
	1 = does not know
	2 = weight loss between 1 and 3 kg
	3 = no weight loss
Mobility	0 = bedridden or chair bound
	1 = able to get out of bed/chair but does not go out
	2 = goes out
Has the patient suffered psychological stress or acute disease in the past 3 months?	0 = yes
	2 = no
Neuropsychological problems	0 = severe dementia or depression
	1 = mild dementia
	2 = no psychological problems
Body mass index (BMI)	0 = BMI less than 19
	1 = BMI 19 to less than 21
	2 = BMI 21 to less than 23
	3 = BMI 23 or greater
If BMI is not available, replace with the following question	
Calf circumference (CC) in cm	0 = CC less than 31
	3 = CC 31 or greater
Screening Score	
12–14 points	Normal nutritional status
8–11 points	At risk of malnutrition
0–7 points	Malnourished

V. Malnutrition Screening Tool - MST

Have you lost weight recently without trying?	
No	0
Unsure	2
If yes, how much weight (kg) have you lost?	
1-2	1
6-10	2
11-15	3
>15	4
Have you been eating poorly because of a decreased appetite?	

No	0
Yes	1
Total score:	
Score 0-1	low risk of malnutrition
Score 2	moderate risk of malnutrition
Score 3-5	high risk of malnutrition

VI. Simplified Nutritional Appetite Questionnaire - SNAQ

Did you lose weight unintentionally?	
More than 6 kg in the last 6 month	3
More than 3 kg in the last month	2
Did you experience a decreased appetite over the last months?	1
Did you use supplemental drinks or tube feeding over last month?	1
Total scores:	
1 – no intervention	
2 – moderately malnourished, nutritional intervention	
3 – severely malnourished, nutritional intervention and treatment dietician	

VII. Subjective Global Assessment - SGA

		Ratings		
Weight loss	Ratings	7, 6	5,4,3	2,1
0%	7			
<3%	6			
3<5%	5			
5<7%	4			
7<10%	3			
10<15%	2			
>=15%	1			
If weight trend, add 1 point, if weight trend within 1-month, minus point				
Dietary intake	Ratings	Ratings		
Good (full share of usual meal)	7	7, 6	5,4,3	2,1
Good (>3/4 -<1 share of usual meal)	6			
Borderline (1/2-3/4 share usual meal)	5			
Boderline (1/2-3/4 share of usual meal, but increasing)	4			
Poor (<1/2 share of usual meal, but increasing)	3			
Poor (<1/2 share of usual meal, no increasing or decreasing)	2			
Starvation (<1/4 of usual meal)	1			
Gastrointestinal symptoms (that persisted for >2 weeks [nausea; vomiting; diarrhea]	Ratings	Ratings		
No symptoms	7	7, 6	5,4,3	2,1
Very few intermittent symptoms (1x per day)	6			
Some symptoms (2-3x per day) – improving	5			
Some symptoms (2-3x per day) – no change	4			
Some symptoms (2-3x per day) – getting worse	3			
Some or all symptoms 8>3x per day)	1-2			

Functional status (nutrition related)	Ratings	Ratings		
Full functional capacity	6-7	7, 6	5,4,3	2,1
Mild or moderate loss of stamina	3-5			
Severe loss of functional ability (bedridden)	1-2			
Muscle wastage		Ratings		
No deletion in all areas	6-7	7, 6	5,4,3	2,1
Mild or moderate depletion	3-5			
Severe depletion	1-2			
Fat stores		Ratings		
No depletion in all areas	6-7	7, 6	5,4,3	2,1
Mild to moderate depletion	3-5			
Severe depletion	1-2			
Edema (nutrition related)		Ratings		
No edema	6-7	7, 6	5,4,3	2,1
Mild to moderate edema	3-5			
Severe edema	1-2			
Overall SGA rating		7, 6	5,4,3	2,1
Nutritional status		well-nourished	mildly to moderately malnourished	severely malnourished

VIII. Patients Generated Subjective Global Assessment - PG-SGA

1 - 4 are designed to be completed by the patient	
1. Weight	2. Food intake:
In summary of my current and recent weight: I currently weigh about _____ pounds I am about _____ feet _____ inches tall One month ago, I weighed about _____ pounds Six months ago, I weighed about _____ pounds During the past two weeks my weight has: • decreased (1) • not changed (0) • increased (0)	As compared to my normal intake, I would rate my food intake during the past month as • unchanged (0) • more than usual (0) • less than usual (1) I am now taking normal food but less than • normal amount (1) • little solid food (2) • only liquids (3) • only nutritional supplements (3) • very little of anything (4) • only tube feedings or only nutrition by vein (0)
3. Symptoms	4. Activities and Functions

I have had the following problems that have kept me from eating enough during the past two weeks (check all that apply) • no problems eating (0) • no appetite, just did not feel like eating (3) • vomiting (3) • nausea (1) • diarrhea (3) • constipation (1) • dry mouth (1) • mouth sores (2) • smells bother me (1) • things taste funny or have no taste (1) • feel full quickly (1) • problems swallowing (2) • fatigue (1) • pain; where? (3) _____ • other (1)** _____ **Examples: depression, money, or dental problems	Over the past month, I would generally rate my activity as: • normal with no limitations (0) • not my normal self, but able to be up and about with fairly normal activities (1) • not feeling up to most things, but in bed or chair less than half the day (2) • able to do little activity and spend most of the day in bed or chair (3) • pretty much bed ridden, rarely out of bed (3)
Additive Score of Boxes 1-4	

Worksheet 1 – Scoring Weight Loss

Weight loss in 1 month	Points	Weight loss in 6 months
10% or greater	4	20% or greater
5-9.9%	3	10- 19.9%
3-4.9%	2	6- 9.9%
2-2.9%	1	2- 5.9%
0-1.9%	0	0- 1.9%
		Numerical score from Worksheet 1

Worksheet 2 – Disease and its relation to nutritional requirements:
Score is derived by adding 1 point for each of the following conditions:

- Cancer
- Presence of decubitus, open wound or fistula
- AIDS
- Presence of trauma
- Pulmonary or cardiac cachexia
- Age greater than 65
- Chronic renal insufficiency

Other relevant diagnoses (specify) _____
Primary disease staging (circle if known or appropriate) I II III IV Other

Numerical score from Worksheet 2

Worksheet 3 – Metabolic Demand
Score for metabolic stress is determined by a number of variables known to increase protein & caloric needs. Note: Score fever intensity or duration, whichever is greater. The score is additive so that a patient who has a fever of 38.8 °C (3 points) for < 72 hrs (1 point) and who is on 10 mg of prednisone chronically (2 points) would have an additive score for this section of 5 points.

Stress	none	low	moderate	high
Fever °F	no fever	> 99 and < 101	≥ 101 and < 102	≥ 102
Fever duration	no fever	< 72 hours	72 hours	> 72 hours
Corticosteroids	no corticosteroids	low dose (< 10 mg prednisone equivalents/day)	moderate dose (≥ 10 and < 30 mg prednisone equivalents/day)	high dose (≥ 30 mg prednisone equivalents/day)

Numerical score from Worksheet 3

Worksheet 4 – Physical Exam
Exam includes a subjective evaluation of 3 aspects of body composition: fat, muscle, & fluid. Since this is subjective, each aspect of the exam is rated for degree. Muscle deficit/loss impacts point score more than fat deficit/loss. Definition of categories: 0 = no abnormality, 1+ = mild, 2+ = moderate, 3+ = severe. Rating in these categories is not additive but are used to clinically assess the degree of deficit (or presence of excess fluid).

Muscle Status	Fat Stores	Fluid status
temples (temporalis muscle)	orbital fat pads	ankle edema
clavicles (pectoralis & deltoids)	triceps skin fold	sacral edema
shoulders (deltoids)	fat overlying lower ribs	ascites
interosseous muscles		
scapula (latissimus dorsi, trapezius, deltoids)		
thigh (quadriceps)		
calf (gastrocnemius)		
Point score for the physical exam is determined by the overall subjective rating of the total body deficit		
No deficit	score = 0 points	
Mild deficit	score = 1 point	
Moderate deficit	score = 2 points	
Severe deficit	score = 3 points	
		Numerical score from Worksheet 3

Worksheet 5 – PG-SGA Global Assessment Categories

	Stage A	**Stage B**	**Stage C**
Category	**well-nourished**	**moderate/suspected malnourished**	**severely malnourished**
Weight	No weight loss OR recent non-fluid wt gain	≤ 5% loss in 1 month (≤10% in 6 months) OR Progressive weight loss	> 5% loss in 1 month (>10% in 6 months) OR Progressive weight loss
Nutrient Intake	No deficit OR Significant recent improvement	Definite decrease in intake	Severe deficit in intake

Nutrition Impact Symptoms	None OR significant recent improvement allowing adequate intake	Presence of NIS (Box 3 of PG-SGA)	Presence of NIS (Box 3 of PG-SGA)
Functioning	No deficit OR Significant recent improvement	Moderate functional deficit OR Recent deterioration	Severe functional deficit OR Recent significant deterioration
Physical Exam	No deficit OR chronic deficit but with recent clinical improvement	Evidence of mild to moderate loss of muscle mass &/or muscle tone on palpation &/or loss of SQ fat	Obvious signs of malnutrition (e.g., severe loss of muscle, fat, possible edema)

Triage based on PG-SGA point score:	
0-1	No intervention required at this time. Re-assessment on routine and regular basis during treatment
2-3	Patient & family education by dietitian, nurse, or other clinician with pharmacologic intervention as indicated by symptom survey (Box 3) and lab values as appropriate
4-8	Requires intervention by dietitian, in conjunction with nurse or physician as indicated by symptoms (Box 3)
≥9	Indicates a critical need for improved symptom management and/or nutrient intervention options

IX. Global Leadership Initiative on Malnutrition criteria -GLIM criteria

Risk screening	**At risk for malnutrition** • Use validated screening tools
Diagnostic Assessment	**Assessment criteria** • Phenotypic ○ non-volitional weight loss ○ low body mass index ○ reduced muscle mass • Etiologic ○ reduced food intake or assimilation ○ disease burden/inflammatory condition
Diagnosis	**Meets criteria for malnutrition** • requires at least 1 phenotypic criterion and 1 etiologic criterion
Severity Grading	**Determine severity of malnutrition** • Severity determined based on phenotypic criterion

X. Geriatric Nutritional Risk Index (GNRI)

GNRI = (1.489 × serum albumin, g/l) + (41.7 × current/ideal body weight)

XI. Prognostic Nutritional Index (PNI)

PNI = serum albumin (g/L) + 5 × total lymphocyte count (10^9/L)

XII. Controlling Nutritional Status (CONUT)

CONUT = 10^* serum albumin (g/dL) + 0.005^* total lymphocyte count (number/mm^3)

XIII. Nutritional Risk Index (NRI)

NRI = (1.519 × serum albumin (g/L) +41.7× (present weight/usual weight)

XIV. Cachexia:

Defintion		Article
low cachexia index	SMI (cm2/m2) × serum albumin (g/dL)/NLR	M. Akaoka, 2022
Evans, 2008	Weight loss of at least 5%* in 12 months or less in the presence of underlying illness**, PLUS THREE of the following criteria • Decreased muscle strength (lowest tertile) • Fatigue • Anorexia • Low fat-free mass index • Low fat-free mass index • Abnormal biochemistry o increased inflammatory markers CRP (>5.0 mg/l), IL-6 >4.0 pg/ml) o Anemia (<12 g/dl) o Low serum albumin (<3.2 g/dl)	M. J. Alves, 2017
	unintended loss of more than 10% of the pre-illness stable weight prior to the diagnosis of the disease	J. Bachmann, 2013
	cases of unintended weight loss greater than 10% of the pre-illness stable body weight.	J. Bachmann, 2008
	lost 10% or more of his stable pre-illness weight	J. Bachmann, 2009

Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	M. L. Batista, 2016
	unintentional weight loss of >5% of the habitual weight during the last 3 months or >10% weight loss during the last 6 months.	M. L. Batista, 2013
	had lost >10% of their pre-illness stable weight within 6 months,	S. Bo, 2010
	an unintentional 10% decrease in body weight occurring during the 6 months before surgery.	D. R. Brown, 2001
low cachexia index	SMI (cm2/m2) × serum albumin (g/dL)/NLR	L.R. Brown, 2024
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	L. R. Brown, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	X. Chen, 2019
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	L. E. Daly, 2018
Evans, 2008	Weight loss of at least 5%* in 12 months or less in the presence of underlying illness**, PLUS THREE of the following criteria • Decreased muscle strength (lowest tertile) • Fatigue • Anorexia • Low fat-free mass index • Low fat-free mass index • Abnormal biochemistry o increased inflammatory markers CRP (>5.0 mg/l), IL-6 >4.0 pg/ml) o Anemia (<12 g/dl) o Low serum albumin (<3.2 g/dl)	G. S. de Castro, 2021
	reported involuntary weight loss exceeding 5% of former body weight during three months period	D. Diakowska, 2010
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	W. P. M. Dijksterhuis, 2021
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	T. G. Dolin, 2022
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	Y. Du, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	H. Fujii, 2020
	Eastern Cooperative Oncology Group performance status (ECOG PS) 1 to 4, grade 1 to 4 anorexia, and weight loss greater than 10% over the past 6 months	Y. Fujiwara, 2014
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current	A. Fukuta, 2019

	bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	
	weight lose ≥5% if BMI ≥ 20 kg/m2 or unintentional ≥2% weight loss if BMI < 20 kg/m2	L. A. Gilmore, 2022
	skeletal muscle index x serum albumin)/neutrophil-to-lymphocyte ratio	M. J. Goh, 2022
low cachexia index	SMI (cm2/m2) × serum albumin (g/dL)/NLR	C. Gong, 2022
low cachexia index	SMI (cm2/m2) × serum albumin (g/dL)/NLR	M.C. Gül, 2025
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	R. Hamura, 2022
	weight loss >5% in the recent 6 months	J. Han, 2021
	weight loss > 5% and 5 kg during radiotherapy	Y. He, 2023
	weight loss greater than 5% over the 6 months of evaluation, or weight loss greater than 2% in individuals already showing depletion according to current body weight and height (BMI <20 kg/m2 or sarcopenia)	A. E. Hendifar, 2018
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	Y. Huang, 2025
cancer cachexia	weight loss > 10% of preillness stable weight within 6 months and serum CRP > 10 mg/L	Y. Jiang, 2014
cancer cachexia	- cancer cachexia defined as weight loss more than 5% - cancer cachexia defined as weight loss more than 10% - cancer cachexia defined as low muscularity (measured by CT) - cancer cachexia defined as weight loss more than 2% + low muscularity	N. Johns, 2014
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	T. Kamada
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	A. E. J. Latenstein, 2020
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	H. Li, 2024
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	X.-X. Li, 2024
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	W. Ch. Liao, 2020
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	T. Matsunaga, 2024
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	J. Miller, 2020
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	A. Molfino, 2021
	unintentional weight loss >=5% during the previous 6 months	T. Mracek, 2011
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	K. Nakashima, 2022
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	A. Narasimhan, 2018
	weight loss >5% in the past 6 months or any degree of weight	N. I. P. Neto, 2018

	loss >2% in the last 6 months plus BMI <20 kg/m2	
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	T. Nishhiyama, 2025
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	T. Ohara, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	S. Olaechea, 2021
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	S. Olaechea, 2023
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	J. Ose, 2019
	weight loss >5 kg in the 6 months before diagnosis	M. Piciucchi, 2013
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	Y. Qin, 2024
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	N. E. Rich, 2022
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	G.-T. Ruan, 2023
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	K. Sakashita, 2025
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	T. Shimagaki, 2025
	at least 5% of involuntary weight loss in the previous 6months or BMI<20kg/m^2 and three out of five of the following criteria: decreased muscle strength, fatigue, anorexia, low fat-free mass index or abnormal biochemistry characterised by increased inflammatory biomarkers (PCR>5mg/L; IL-6>4pg/ mL), anaemia (Hb<12 g/dL) or hypoalbuminemia (< 3.2 g/dL)	E. Simoes, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	J. D. P. Soares, 2020
	met all 3 factors of the multifactor cachexia profile: weight loss (≥10% of their pre-illness stable weight within 6 months), low food intake (≤1500 kcal/d), systemic inflammation (CRP ≥10 mg/L)	B. Song, 2009
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	N. A. Stephens, 2015
	weight loss >5% in the past 6 months or any degree of weight loss >2% in the last 6 months plus BMI <20 kg/m2	N. I. P. Stephens, 2018
	body weight loss of more than 5% within 6 months; (2) body mass index (BMI) is less than 20kg/m^2, body weight loss of more than 2% within 6 months; (3) combined with sarcopenia, Body weight decreased by more than 2% within 6 months.	Y. Sun, 2014
	>5% weight loss in the past six months or body mass index (BMI) <20 or >2% weight loss in the past six months with sarcopenia.	D. Sun, 2024
	weight loss was >10% of their pre-illness stable weight within 6 months and if their serum CRP level was >10 mg/L	F. Sun, 2010
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current	H. Suzuki, 2021

	bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	Y. Takano, 2023
	weight loss > 5 % or > 2% with either a BMI of less than 20 kg/m2 or the presence of sarcopenia	T. Takeda, 2021
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	E. E. Talbert, 2018
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	F. Tambaro, 2024
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	H. Tanda, 2025
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	Y. Tanji, 2022
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	Z. Tao, 2024
Asian Working Group for Cachexia (AWGC) criteria	body mass index (BMI) < 21 kg/m^2 or a weight loss >2% in the past 3-6 months as mandatory, combined with one or more of the following: anorexia, decreased grip strength (<28 kg for men and <18 kg for women), or C-reactive protein (CRP) > 0.5 mg/dl	S. Unome, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	A. van der Werf, 2018
low cachexia index	SMI (cm^2/m^2) × serum albumin (g/dL)/NLR	Q. Wan, 2022
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	S. Yasui-Yamada, 2020
	weight loss >10% plus CRP >10 mg/dl	D. Zhang, 2008
	weight loss >10 %;	D. Zhang, 2007
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	X. Zhang, 2025
Fearon, 2011	weight loss greater than 5%, or weight loss greater than 2% in individuals already showing depletion according to current bodyweight and height (body-mass index [BMI] <20 kg/m^2) or skeletal muscle mass (sarcopenia)	C. L. Zhuang, 2022

XV. Guidelines

Name of the guideline		Articles
current guidelines of the French health authority (HAS)	Classify malnutrition as absent, moderate, or severe based on body weight variations within the last 6 month or body mass index (BMI) or serum albumin levels	A. Attar, 2012
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either	J. Cao, 2021

	○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	
ESPEN 2006	Presence of at least one of the following criteria: weight loss >10-15% within 6 months, BMI<18.5 kg/m^2, Subjective Global Assessment Grade C, serum albumin <30 g/l (with no evidence of hepatic or renal dysfunction)	Y. Fukuda, 2015
Chang's protocol	Nutritional assessments were based on the following five parameters: percentage ideal body weight, triceps skin fold thickness (TSF), arm muscle circumference (AMC), serum albumin and lymphocyte count	J. M. Gallardo-Valverd 2005
Chonnam National University Hwasun Hospital-Nutritional Risk Screening Tool (CNUHH-NRST)	consisted of the following data: body mass index (BMI), weight loss, recent food intake, metabolic stress, and age;	S. Y. Lee, 2020
Chonnam National University Hwasun Hospital-Nutritional Risk Screening Tool (CNUHH-NRST)	consisted of the following data: body mass index (BMI), weight loss, recent food intake, metabolic stress, and age;	S. Y. Lee, 2018
Chonnam National University Hwasun Hospital-Nutritional Risk Screening Tool (CNUHH-NRST)	consisted of the following data: body mass index (BMI), weight loss, recent food intake, metabolic stress, and age;	S. Y. Lee, 2019
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	J. H. Park, 2021
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	P. Y. Wang, 2021
ASPEN 2012	Malnutrition was defined as having any of the following characteristics: • body mass index (BMI) <18.5 kg/m^2 • weight loss >10% during previous 6-month, preoperative albumin level of <3.5 mg/dL	J. H. Wolf, 2020
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	X. J. Ye, 2018
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	L. Yin, 2021

ASPEN 2012	Malnutrition was defined as having any of the following characteristics: • body mass index (BMI) <18.5 kg/m^2 • weight loss >10% during previous 6-month, • preoperative albumin level of <3.5 mg/dL	Y. X. Zhang, 2022
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	X. Zhao, 2022
ESPEN 2015	• Alternative 1: BMI <18,5 kg/m^2 • Alternative 2: Weight loss (unintentional) >10% indefinite of time, or >5% over the last 3 months combined with either ○ BMI <20 kg/m^2 if <70 years of age, or <22 kg/m^2 if ≥70 years of age or ○ FFMI <15 and 17 kg/m^2 in women and men, respectively.	X. H. Hua, 2022

Supplementary Document S4: Detailed strategy for the selection process

The selection of full-text content was performed by three groups which included two independent reviewers (B.Cs.B. with G.C., L.F. with P.M., and H.N. with D.D). Cohen's kappa coefficient was calculated after every selection step to assess the agreement. In the case of two groups (L.F. with P.M., and H.N. with D.D.) B.Cs.B as a third person solved the disagreements, while in the group which included B.Cs.B and G.C., P.M. as a third person solved the disagreements.

Supplementary Document S5: Detailed strategy for data collection

The extracted data on the standardized collection sheet included: information about the study – first author, year of publication, country of origin, and study design; demographic data – sample size, sex, and age distribution; population characteristics – cancer type and cancer stage; cut-off values of the reported risk factors (exposure); and outcome-related information – definition of impaired nutritional status e.g.: malnutrition risk, malnutrition diagnosis, (including cut-off values), and moment of measurement. For the meta-analyses, the number of patients with malnutrition and the total number of patients in the exposed (e.g., male gender, age ≥ 65 years) and comparator group (e.g., female gender, age < 65 years) were extracted from each article. In the case, if the mentioned count data is not available, we did not use that article in the meta-analysis. The data extraction process was done independently by reviewers (G.C., P.M., L.F., D.D., and B.Cs.B.) in each article manually and crosschecked each other's data pool.

Supplementary Document S6: Leave-one-out analysis

We did leave-one-out analysis to assess the possible influence of articles on the overall results. Cases that are considered as possibly influential with respect to any of the shown measures are marked with a 'star' in column 'Influential.' Note that the chosen cut-offs are (somewhat) arbitrary based on dmetar package.

The provided column names are: 'Influental', 'effect size', '95% CI', 'I2', 'Std residual', 'Dffits', 'Cook's dist.', 'Covariance ratio', 'Hat value'. Effect size is the pooled effect size without the given study. The 95% confidence interval of the pooled effect size without the given study. I^2 means the Higgins&Thomson I^2 heterogeneity value without the given study. Std residual is the studentized residuals. It shows the deleted residual divided by its estimated standard deviation. Dffits is the difference in fits. It quantifies the number of standard deviations that the fitted value changes without the given study. (Typical threshold is $3*\sqrt{\frac{P}{k-P}}$). Cook's dist means Cook's distance. It depends on both the residual and leverage of the omitted study. (Typical threshold value is 2). Covariance ratio is the covariance ratio. It shows the

change in the determinant of the covariance matrix of the effect size. (Typical threshold value is 1) Hat value means the value of the hat matrix without the given study. (Typical threshold is $3*\frac{P}{k}$)

Based on the leave-one--out analyses (LOO) we found relevant change in the effect (> 1 range in OR) or relevant change in the decision on the null-hypothesis in the following cases (**see figures in Supplementary Documents S10):**

In cases of "Association between malnutrition-related complication risk and sex in esophageal cancer" (Fig. 16.1); "Association between malnutrition-related complication risk and macrovascular involvement in colorectal cancer" (Fig. 54.1); "Association between malnutrition-related complication risk and etiology in hepatocellular carcinoma" (Fig.51.1); and "Association between malnutrition-related complication risk and age ≥65 in esophageal cancer" (Fig.31.1) we found an article, that leaving out would change the decision on the null-hypothesis:

- In the case of "Association between malnutrition-related complication risk and sex in esophageal cancer" (Fig. 16.1), if we omit F.K. Xiao, 2021, the OR would be 1.20 (95%Cl 1.07-1.34). In this case, the overall results would be statistically significant, meaning a statistically significant higher odds for males, compared to females.
- In the case of "Association between malnutrition-related complication risk and macrovascular involvement in colorectal cancer" (Fig. 54.1), if we omit C. Akgul, 2024, the OR would be 1.12 (95%Cl 0.99-1.26). In this case, the overall results would not be statistically significant, meaning not a statistically significant higher odds for macrovascular involvement.
- In the case of "Association between malnutrition-related complication risk and etiology in hepatocellular carcinoma" (Fig. 51.1), if we omit A. Hiraoka, 2023 the OR would be 1.24 (95%Cl 1.10-1.39). In this case, the overall results would be statistically significant, meaning a statistically significant higher odds for viral etiology, compared to non-viral.
- In the case of "Association between malnutrition-related complication risk and age ≥65 in esophageal cancer" (Fig.31.1), if we omit Y. Sun, 2025, the OR would be 1.24 (95%Cl 0.99-1.55). In this case, the overall results would not be statistically significant, meaning not a statistically significant higher odds for age ≥65 in esophageal.

Although there were additional influential studies in some cases, but their effect was not relevant.

Supplementary Document S7: Detailed strategy for overlapping population

In the case of more than one article reported on the same population across the eligible articles, those reporting on the higher sample size were analyzed. When different screening tools were used to measure the same risk factor in one article, the data for each screening tool were retrieved. However, we always preferred the screening tool that was used by more articles for this risk factor, as well as the screening tool that had more criteria to assess malnutrition. Therefore, we have no overlapping populations nor multiple uses of the same article in meta-analyses. Data collected prior to anticancer treatment (e.g., neoadjuvant therapy or surgery) were included in the analysis when post-treatment data were also provided to avoid an unintentional influence of therapy on malnutrition, which would distort the objective effect of the risk factor.

Author	DOI	Risk factor	Strategy
A. Fujio, 2022	10.1620/tjem.256.43	sex	use the whole population data, not the subgroups according age groups
A. Daniele, 2017	10.21873/anticanres.11447	sex	use the data in group MNA <17
A. S. Senger, 2022	NA	CA19-9	exclude, because normal CA19-9 level was not reported
A. van der Werf, 2018	10.1080/01635581.2018.1504092	sex	use the data where cachexia was defined according Fearon criteria, not clinical assessment
B. Akagunduz, 2022	10.1007/s12029-021-00664-4	N stage	exclude from the analysis, because patients got treatment
D. D. Huang, 2022	10.1038/s41430-022-01109-2	sex ASA performance status	overlapping population with Huang, 2022 (10.1016/j.ejso.2021.02.032), chose the bigger population number
D. Huang, 2022	10.1016/j.ejso.2021.02.032		
D. Huang, 2022	10.1016/j.ejso.2021.02.032	sex ASA performance status	by GLIM assessment, chose the data with sceletal muscle mass, not handgrip strength
E. Paillaud, 2014	10.1016/j.clnu.2013.05.014	sex	use the data in group MNA <17
F. Sun, 2010	NA	sex	overlapping population, chose F. Sun, 2010 (NA), because of bigger population number
F. Sun, 2010	10.1007/bf03256358		
F. Terasaki, 2021	10.1007/s13304-020-00792-9	CA19-9	exclude from the analysis, because cut off value 200 (only one with this cut off)
H. Jin, 2021	10.5230/jgc.2021.21.e14	T stage N stage	exclude from the analysis, because the population got preoperative treatment, in other articles only surgery
H. Xie, 2022	10.3389/fnut.2022.902080	tumour site N stage T stage sex	overlapping population, chose H. Xie, 2022 (10.3389/fnut.2022.794489), because of the bigger population
H. Xie, 2020	10.7150/JCA.49383		
H. Xie, 2022	10.3389/fnut.2022.794489		

J. Bachmann, 2008	10.1007/s11605-008-0505-z	sex	overlapping population, chose J. Bachmann, 2008 (10.1007/s11605-008-0505-z)
J. Bachmann, 2009	10.1186/1471-2407-9-255		
J. Bachmann, 2008	10.1007/s11605-008-0505-z	sex	use the whole population, not only the resectable cases
J. Bachmann, 2013	10.1080/01635581.2013.804580	diabetes mellitus	overlapping population, chose J. Bachmann, 2013 (10.1080/01635581.2013.804580)
J. Bachmann, 2008	10.1007/s11605-008-0505-z		
J. Cao, 2021	10.1016/j.currproblcancer.2020.100638	sex	chose the data measured by NRS-2002
J. Kang, 2022	10.1155/2022/3889588	sex tumour site	cohort and testing group analyzed together
J. Ose, 2019	10.3390/metabo9090178	sex	analyzed data about cachexia, not pre-cachexia
J. Sun, 2016	10.1016/j.jss.2016.09.050	T stage	exclude from the analysis, because the data was about T0
J. F. Feng, 2013	10.2147/tcrm.s56159	alcohol active smoking T stage N stage tumour site	analyzed the PNI <42 and PNI 42-52 together
K. Fujiya, 2018	10.1245/s10434-018-6342-8	sex T stage comorbidities	used the preoperative data
K. Sugawara, 2020	10.1016/j.jgo.2020.02.007	sex ASA performance status tumour site	used the preoperative data
K. Sugawara, 2020	10.1016/j.jgo.2020.02.007	sex tumour site	overlapping population, chose K. Sugawara, 2020 (10.1016/j.jgo.2020.02.007) because of the used measurement was PNI, instead of GNRI
K. Sugawara, 2021	10.1002/jpen.1978		
K. Takao, 2020	10.21873/invivo.12184	sex	used the pretreatment data
K. Fu, 2017	NA	tumour site	medium and high-risk malnutrition (NRS 2002 3-5 and NRS 2022 >5) analyzed together
K. Ge, 2021	10.1080/01635581.2020.1841252	T stage	cancer type is an esophageal junction, we included in the analysis of gastric cancer
K. Kouzu, 2020	10.1007/s10388-020-00795-w	T stage	chose the data about pathological T stage, not clinical
K. Mimatsu, 2017	10.21873/anticanres.11812	Ca19-9 CEA level sex	analyzed the data measured by CONUT, not PNI

		T stage	
K. Sakurai, 2015	10.1245/s10434-015-4814-7	CVD sex T stage chronic kidney disease neoadjuvant chemotherapy	overlapping population, chose K. Sakurai, 2015, because of the bigger population
K. Sakurai, 2016	10.1245/s10434-016-5272-6		
K. Sakurai, 2015	10.1245/s10434-015-4814-7	CVD	put the ischaemic heart disease into the analysis and not the cerebrovascular heart disease
K. Takao, 2020	10.21873/invivo.12184	sex N stage	used the pre-treatment data
K. Tanaka, 2021	10.1016/j.clnesp.2020.11.009	sex	use the data in group MNA <17 analyzed the data measured by CONUT, not GNRI
L. B. Xu, 2022	10.3389/fonc.2022.851091	sex	overlapping population, chose L.B. Xu,2022 (10.3389/fonc.2022.851091) because of the bigger population
L. B. Xu, 2022	10.1002/jpen.2127		
L. B. Xu, 2022	10.3389/fonc.2022.851091	sex	chose the weight loss criteria for the definition of malnutrition by the GLIM criteria
L. P. Zhou, 2021	10.1016/j.nut.2020.111044	ASA performance status	by GLIM assessment, chose the data with sceletal muscle mass, not handgrip strength
M. Shibutani, 2015	10.1186/s12885-015-1537-x	sex	analyzed the preoperative data
M. Tamai, 2021	NA	sex	analyzed the preoperative data
M. F. Chen, 2021	10.3390/nu13092997	neoadjuvant therapy	analyzed the pretreatment data
M. L. Batista, 2016	10.1002/jcsm.12037	sex	overlapping population, chose the L. M. Batista, 2013 (10.1016/j.cyto.2012.10.023) because of the bigger population
M. L. Batista, 2013	10.1016/j.cyto.2012.10.023		
M. Piciucchi, 2013	NA	sex	excluded from the analysis, because of the study type (abstract)
M. Sasaki, 2020	10.1038/s41598-020-67285-y	sex CEA tumour site	overlapping population, chose M. Sasaki, 2019 (10.23922/jarc.2018-041), because of the used measurement was PNI, instead of GNRI
M. Sasaki, 2019	10.23922/jarc.2018-041		

M. Shibutani, 2015	10.1186/s12885-015-1537-x	sex CA19-9 CEA tumour site T stage	analyzed the whole population's preoperative data (surgery in 2005 and 2006-2011)
M. Tamai, 2021	NA	sex CA19-9 CEA tumour site T stage	analyzed the pretreatment data
M. Wobith, 2022	10.1016/j.clnesp.2022.06.004	sex ASA performance status	by GLIM assessment, chose the data with skeletal muscle mass measured by CT, not BIA
N. Kubo, 2018	10.1007/s10388-018-0644-6	sex	overlapping population, chose N. Kubo, 2017 (10.1007/s10388-016-0548-2), because of the used measurement was PNI, instead of GNRI
N. Kubo, 2017	10.1007/s10388-016-0548-2		
N. E. Rich, 2022	10.1016/j.cgh.2021.09.022	sex	analyzed data about cachexia, not pre-cachexia
N. Harimoto, 2018	10.1245/s10434-018-6672-6	sex Child-Pugh class	overlapping population, chose N. Harimoto, 2018, because of the bigger population
N. Harimoto, 2017	10.1007/s00268-017-4097-1		
N. Hirahara, 2020	10.18632/oncotarget.27670	sex T stage tumour site	overlapping population, chose N. Hirahara, 2018 (10.1097/MJT.0000000000000414) because of the used measurement was CONUT
N. Hirahara, 2018	10.1097/MJT.0000000000000414		
N. Hirahara, 2018	10.18632/oncotarget.27635		
N. Hirahara, 2020	10.18632/oncotarget.27670	ASA performance status	chose the GNRI <94,8 (calculated for overall survival), instead of 90,9 (calculated for cancer specific survival)
N. Johns, 2014	10.1371/journal.pone.0083618	sex	four different cachectic groups were created, we analyzed data measured by weight loss more 5%
R. Sato, 2020	10.1007/s00595-020-02007-5	sex CA19-9 CEA T stage	overlapping population, chose the L. R.Sato, 2021 (10.1007/s00595-020-02066-8) because of the bigger population
R. Sato, 2021	10.1007/s00595-020-02066-8		

R. Tokunaga, 2015	10.1097/dcr.0000000000000458	CA19-9 neoadjuvant chemotherapy	overlapping population, chose the L. Tokunaga, 2015 (10.1007/s00384-016-2668-5) because of the bigger population
R. Tokunaga, 2016	10.1007/s00384-016-2668-5		
R. Tokunaga, 2015	10.1097/dcr.0000000000000458	sex CEA tumour site	overlapping population, choose the L. Tokunaga,2016(10.1097/dcr.0000000000000458) analyzed the data measured by CONUT, not PNI
R. Tokunaga, 2016	10.1007/s00384-016-2668-5		
S. B. Chen, 2021	10.3389/fsurg.2021.752792	sex T stage tumour site	analyzed the data measured by PNI, not GNRI
S. Ide, 2021	10.1186/s12957-021-02139-z	N stage	exclude from the analysis, because the population got preoperative treatment and metastasis
S. Y. Lee, 2020	10.1016/j.amjsurg.2020.02.015	ASA performance status	overlapping population, chose the L. Lee, 2018 (10.1038/s41430-018-0112-3) because of the bigger population
S. Y. Lee, 2018	10.1038/s41430-018-0112-3		
T. Mracek, 2011	10.1038/s41430-018-0112-3	sex	analyzed the two cohorts together
T. Hatanaka, 2019	10.2169/internalmedicine.1594-18	BCLC stage	excluded because the population is not well-described
T. Hayama, 2022	10.1038/s41598-022-07540-6	sex	overlapping population, chose T. Hayama, 2020 (10.1038/s41598-020-70252-2) because the used measurement was CONUT
T. Hayama, 2020	10.1038/s41598-020-70252-2		
T. Matsunaga, 2022	10.1186/s12885-022-09638-6	sex diabetes CVD T stage ASA performance status	chose the GNRI <95,8 (calculated for overall survival), instead of 97 (calculated for cancer specific survival)
T. Tominaga, 2019	10.1007/s00595-019-01910-w	sex	overlapping population, chose the L. Tominaga, 2020 (10.1007/s00595-020-02050-2) because of the bigger population
T. Tominaga, 2020	10.1007/s00595-020-02050-2		
T. Tominaga, 2019	10.1007/s00595-019-01910-w	comorbidities ASA performance status	use the whole population data, not the subgroups according age groups
W. Peng, 2021	10.1186/s12893-021-01334-18	alfa-fetoprotein	analyzed the data before propensity score matching
X. H. Hua, 2022	10.1371/journal.pone.0083618	sex	analyzed the data measured by NRS-2002

		diabetes mellitus chronic kidney disease neoadjuvant therapy	
X. Wang, 2020	10.1007/s10147-020-01743-5	anemia	analyzed together the mild and moderate anemia
X. Zhang, 2021	10.2147/cmar.s316437	CVD	analyzed the coronary artery disease, instead of cerebrovascular
Y. Bo, 2015	10.6133/apjcn.2015.24.4.26	alfa fetoprotein	analyzed NRI 83,5-97,5 and <83,5 together
Y. Chen, 2020	10.1007/s00270-020-02519-0	aspartate aminotransferase alfa fetoprotein	overlapping population, chose the Y. Chen, 2020 (10.1007/s00270-020-02519-0) because of the bigger population
Y. Chen, 2022	10.1017/s000711452100492x		
Y. Geng, 2015	10.1016/j.ejso.2015.07.022	sex CA19-9 tumour site	analyzed together validation and test group together
Y. Iseki, 2015	10.1371/journal.pone.0132488	sex T stage tumour site	analyzed the data measured by CONUT, not PNI
Y. S. Mao, 2020	10.1017/S0007114520002299	sex	analyzed the data measured by CONUT, not PNI
Y. Saito, 2017	10.1016/j.jamcollsurg.2017.07.865.	sex	overlapping population, chose the Y. Saito, 2017 (10.1016/j.jamcollsurg.2017.07.865.) because population did not get treatment
Y. Saito, 2021	10.3892/ol.2020.12414		
Y. Takamizawa, 2020	10.1186/s12885-020-07560-3	sex CEA tumour site age	analyzed the data measured by CONUT, not PNI
Y. X. Zhang, 2022	10.1007/s13304-022-01293-7	CVD	analyzed the data of arrhythmia, not the history of stroke, because of the bigger patient's number
Y. Zhao, 2022	10.1080/01635581.2021.1982997	tumour site	analyzed the data before propensity score matching
F. Akad, 2024	10.3390/nu16101485	sex	analyzed together PG-SGA B+C
P. Fang, 2024	10.21037/jtd-24-187	age sex tumor site	analyzed the article with doi:10.3389/fnut.2022.983039, because of bigger population
P. Fang, 2002	10.3389/fnut.2022.983039		
Zuo, 2024	10.1016/j.nut.2024.112363	sex	choose the article with doi: 10.1016/j.nut.2024.112363, because bigger population
Zuo, 2023	10.1016/j.clnesp.2023.12.004		
Feng, 2022	10.3389/fimmu.2022.1015366	sex alcohol hypertension tumor site macrovascular invasion	choose article with doi: 10.3389/fimmu.2022.1015366
Feng, 2024	10.1016/j.ejso.2024.108323		
Fujiwara, 2021	10.1159/000513961	sex	choose article with doi: 10.1159/000513961

Fujiwara, 2022	10.1007/s10388-022-00961-16	N-stage T-stage tumor site	
X. Ma, 2025	10.1186/s12876-025-03766-6	sex	choose article with doi: 10.20960/nh.05079, and analyze data measured by PNI, not CONUT
X. Ma, 2024	10.20960/nh.05079		
Tekin, 2023	10.37047/jos.2023-96450	sex comorbidities CVD hypertension serum CEA tumor site	analyzed data measured by PNI, not GNRI
Matsunaga, 2022	10.1186/s12885-022-09638-6	sex ASA performance status T-stage macrovascular invasion	choose article with doi: 10.1186/s12885-022-09638-6
Matsunaga, 2024	10.1007/s00595-024-02850-w		
Takashi, 2020	10.1007/s13304-020-00745-2	sex ASA performance status tumor site	choose article with doi: 10.1007/s13304-020-00745-2
Takashi, 2024	NA		
Zhang, 2023	10.4240/wjgs.v15.i2.211	sex	analyzed data measured by PNI, not others
L.J. Wang, 2025	10.5306/wjco.v16.i4.102294	sex anaemia serum CA19-9 serum CEA	analyzed data measured by PNI, not others
Shibutani, 2023	10.21873/invivo.13265	sex serum CEA T-stage tumor site	analyzed data measured by PNI, not others
Nakamaru, 2023	10.1002/jso.27488	sex serum CEA	choose article with doi: 10.1016/j.clnesp.2022.03.011
Nakamaru, 2025	10.7759/cureus.86268		
Nakamaru, 2022	10.1016/j.clnesp.2022.03.011		
Sato, 2022	10.23922/jarc.2022-053	sex	choose article with doi: 10.1007/s00595-020-02066-8
Sato, 2021	10.1007/s00595-020-02066-8		
Hiraoka, 2023	10.1111/hepr.13934	sex ECOG status BCLC stage Child-Pugh class etiology of HCC	analyzed GNRI data together, as GNRI <98
Ch. K. Yang, 2024	10.1016/j.clnesp.2023.12.148	sex BCLC stage Child-Pugh class	analyzed data measured by PNI, not others
Chen, 2024	10.5582/bst.2024.01108	sex	analyzed data measured by PNI, not others
Tsukagoshi, 2024	10.3390/nu16070940	sex Child-Pugh class etiology of HCC macrovascular invasion	analyzed data measured by PNI, not others

N. Funamizzu, 2025	10.3390/cancers17091448	sex	choose article with doi: 10.3390/cancers17091448
N. Funamizu, 2022	10.1038/s41598-022-18077-z		
Takano, 2023	10.1007/s00423-023-02883-8	sex	moderate and severe cachexia
D.D. Huang, 2022	10.1038/s41430-022-01109-2	sex ASA performance status	choose article with doi: 10.1038/s41430-022-01109-2
D. D. Huang, 2021	10.1016/j.clnu.2021.01.038		
T. Wu, 2022	10.3390/nu14235166	sex	moderate and severe malnutrition (according GLIM) analyzed together
L. Chang, 2022	10.1097/CJI.0000000000000438	sex smoking	choose article with doi: 10.1097/CJI.0000000000000438
L. Chang, 2023	10.21037/tcr-23-1193		
Ma, 2025	10.1186/s12876-025-03766-6	smoking alcohol hypertension chronic respiratory diseases serum CA19-9 serum CEA tumor site macrovascular invasion	choose article, with doi: 10.1186/s12876-025-03766-6
Ma, 2024	10.20960/nh.05079		
Ch. K. Yang	10.1016/j.clnesp.2023.12.148	smoking alcohol serum alanine aminotransferase serum alfa-fetoprotein etiology of HCC	analyzed data measured by PNI, not others
Yoshida, 2017	10.1007/s00423-017-1553-1	sex chronic respiratory diseases ASA performance status neoadjuvant chemotherapy	mild and moderate malnutrition analyzed together
Nakmaru, 2023	10.1002/jso.27488	ASA performance status N-stage tumor site	choose article, with doi: 10.1002/jso.27488
Nakamaru, 2025	10.7759/cureus.86268		
R. Sato, 2022	10.23922/jarc.2022-053	serum CA19-9 serum CEA T-stage	choose article, with doi: 10.1007/s00595-020-02066-8
R. Sato, 2021	10.1007/s00595-020-02066-8		
T. Kosuga, 2019	10.21873/anticanres.13901	N-stage	choose clinical N-stage, instead of the pathological N-stage
Hashimoto, 2024	10.21873/invivo.13514	T-stage	choose clinical T-stage, instead of pathological N stage
M. Yamamoto, 2025	10.1002/ags3.70057	T-stage	choose clinical T-stage, instead of pathological N stage
Sakurai, 2015	10.1245/s10434-015-4814-7	neoadjuvant therapy	choose article, with doi: 10.1245/s10434-015-4814-7
Sakurai 2016	10.1245/s10434-016-5272-6		

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Supplementary Document S9: Detailed strategy for retrieval and reasons for excluding articles

Strategy for retrieval: We have emailed the corresponding authors.
Reasons for excluding articles: During the full-text selection, we excluded 1305 articles because of the following reasons: 248 - outcome of interest is not reported, 382 not only gastrointestinal cancer patients, 472 – prevalence of malnutrition is not reported, 93 - ineligible study type, and 110 – the definition of malnutrition is not provided.
During the manual data retrieval, if odds (OR) with the corresponding 95% confidence interval (Cl) were not reported, the available raw data were used (which is the number of patients in each group of interest-exposed patients experiencing the outcome, exposed patients not experiencing the outcome, non-exposed patients experiencing the outcomes, and non-exposed patients not experiencing the outcome, respectively)

Supplementary Document S10: Individual forest plots for population characteristics: Figure S1-S75.

Figure S1.: Association between malnutrition-related complication risk and age (cut off 65) in gastrointestinal cancer (Biological composite scores)

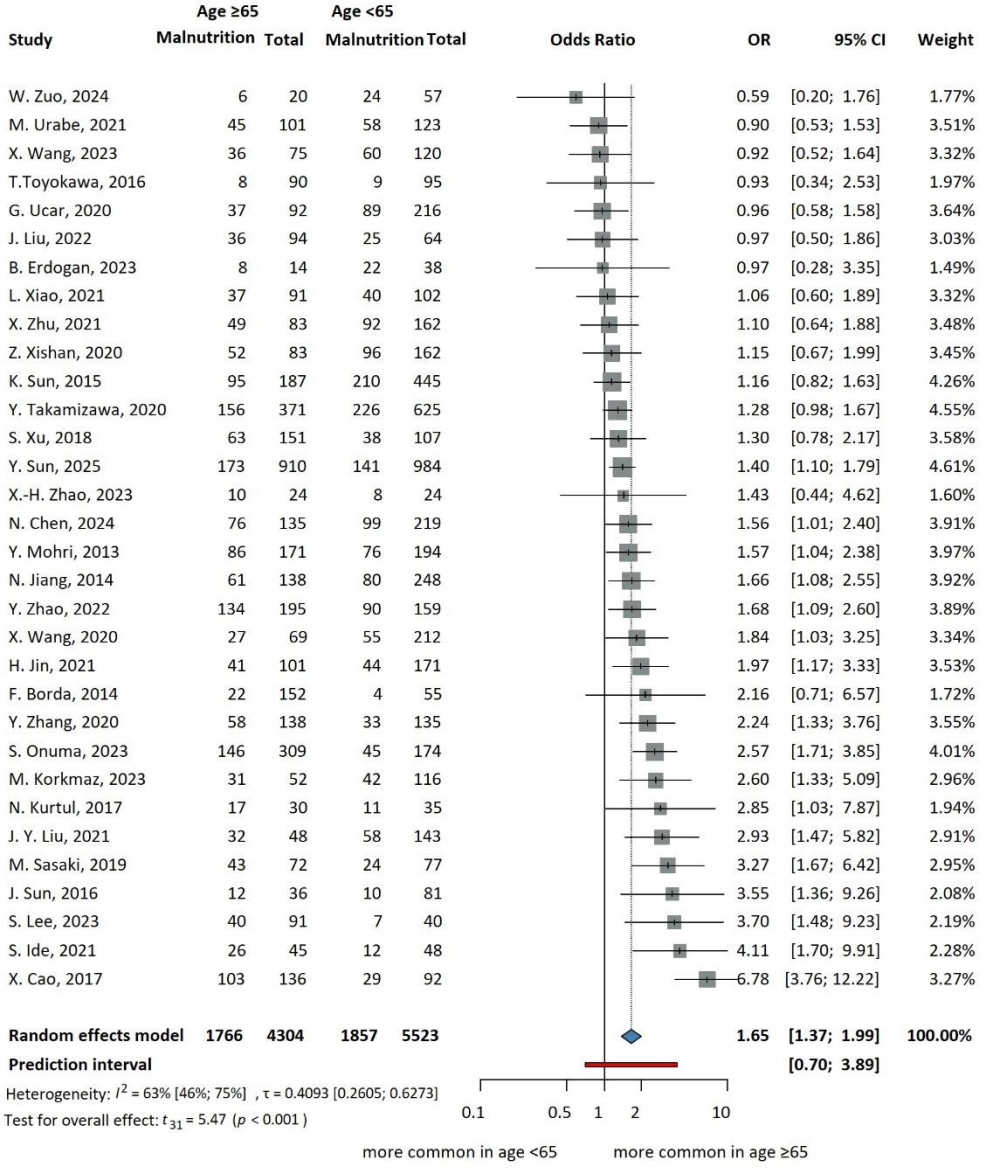
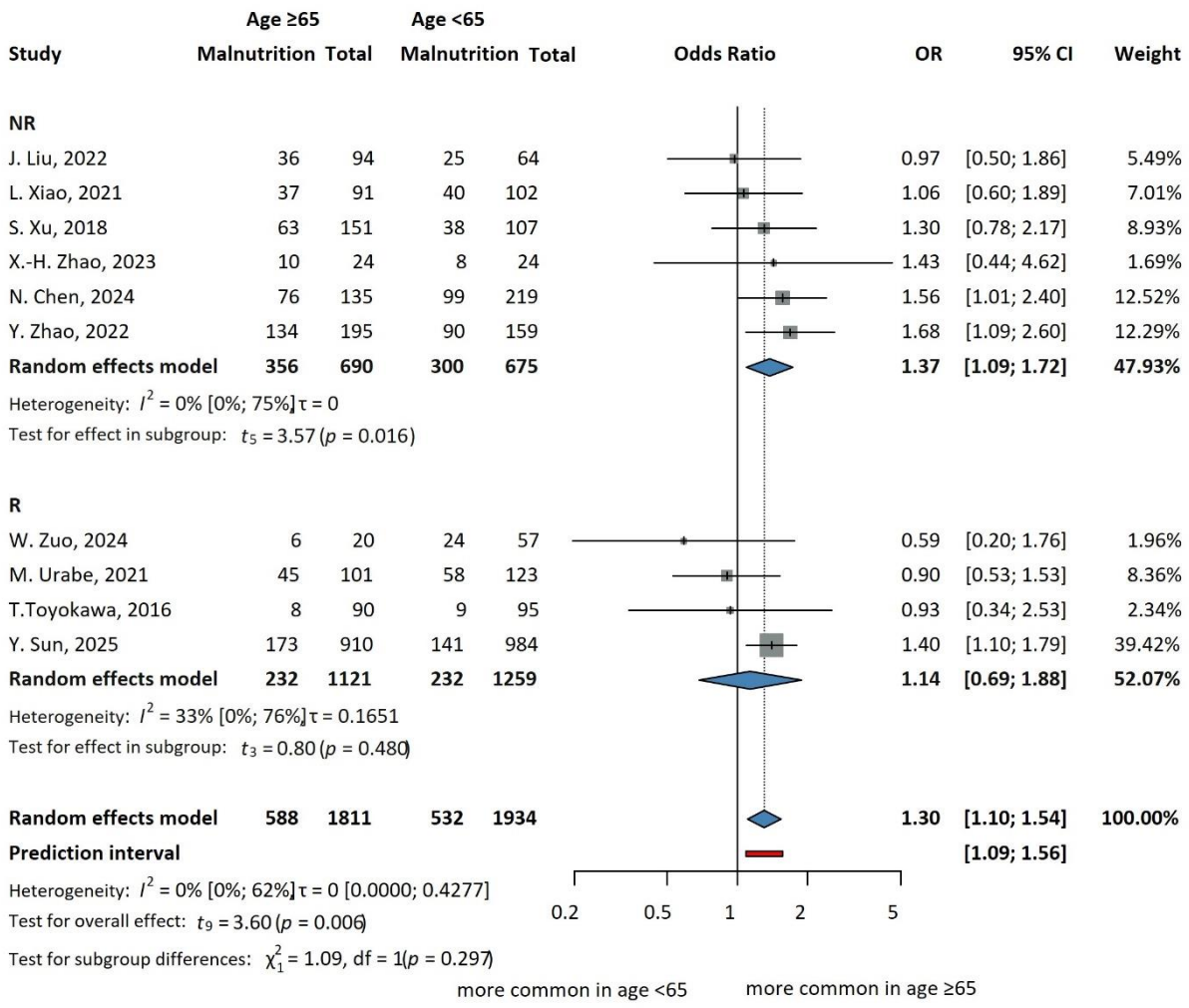
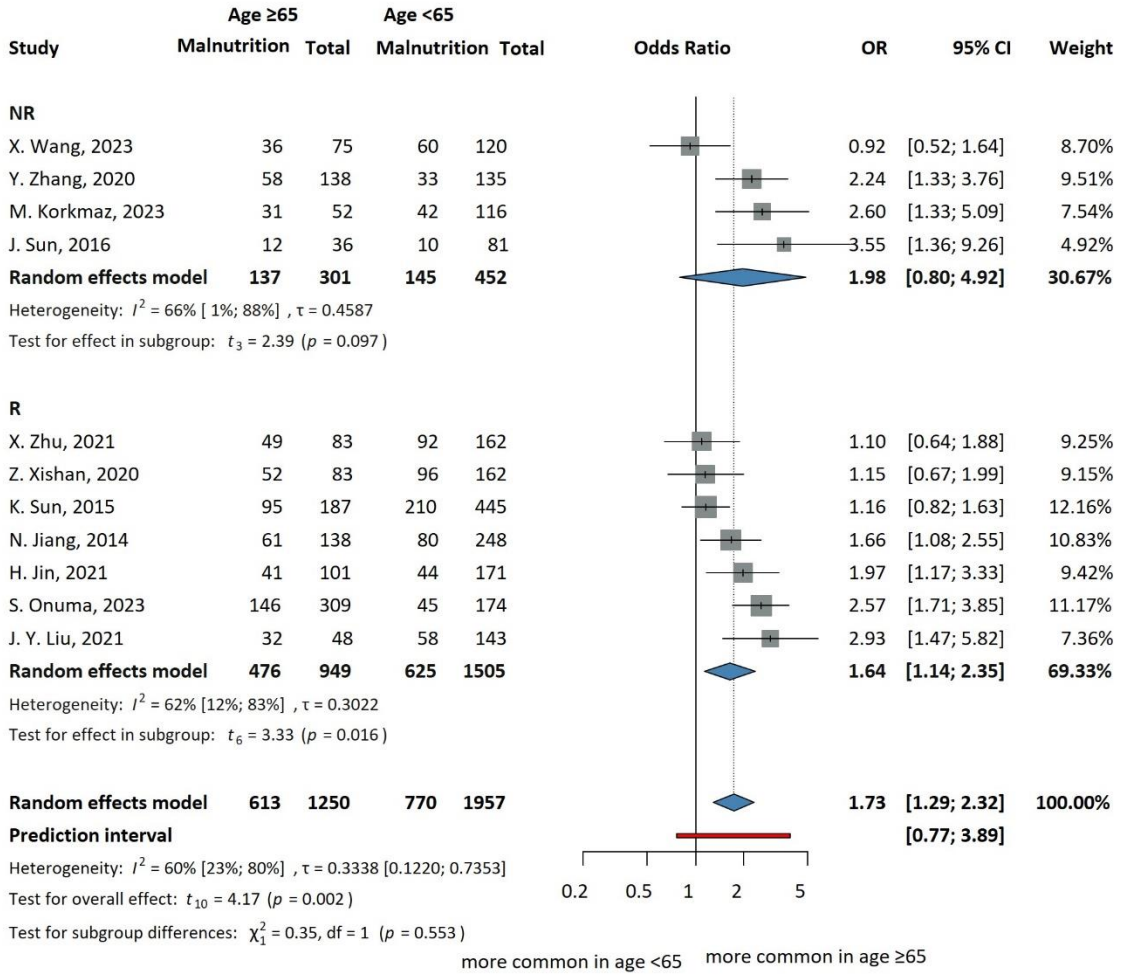


Figure S2.: Association between malnutrition-related complication risk and age (cut off 65) in esophageal cancer (Biological composite scores)



Abbreviation: R=secetable; NR= non-resectable

Figure S3.: Association between malnutrition-related complication risk and age (cut off 65) in gastric cancer (Biological composite scores)



Abbreviation: R=secetable; NR= non-resectable

Figure S4.: Association between malnutrition-related complication risk and age (cut off 65) in colorectal cancer (Biological composite scores)

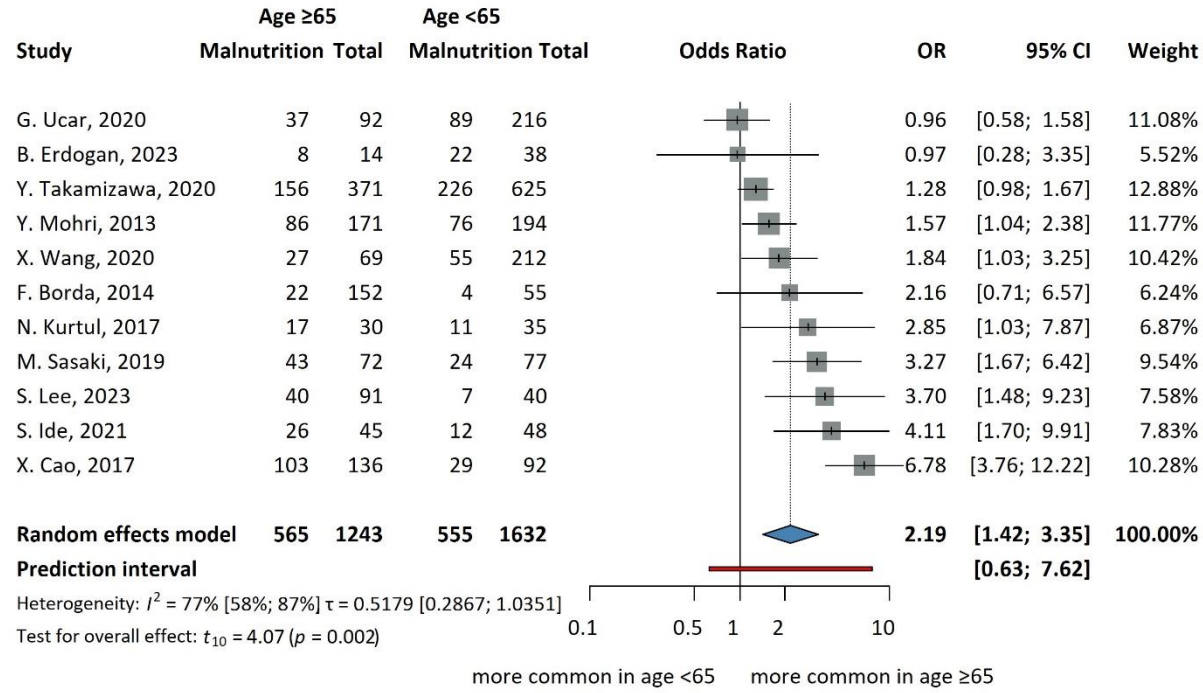


Figure 5: Association between malnutrition-related complication risk and age (cut off 65) in hepato-biliopancreatic cancer (Biological composite scores)

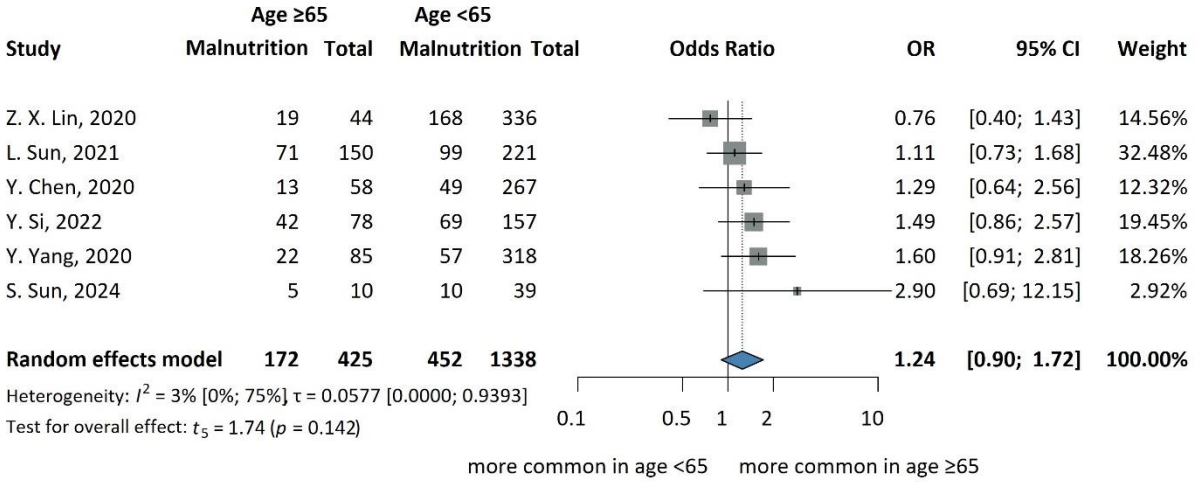


Figure S6.: Association between malnutrition-related complication risk and age (cut off 60) in esophageal cancer (Biological composite scores)

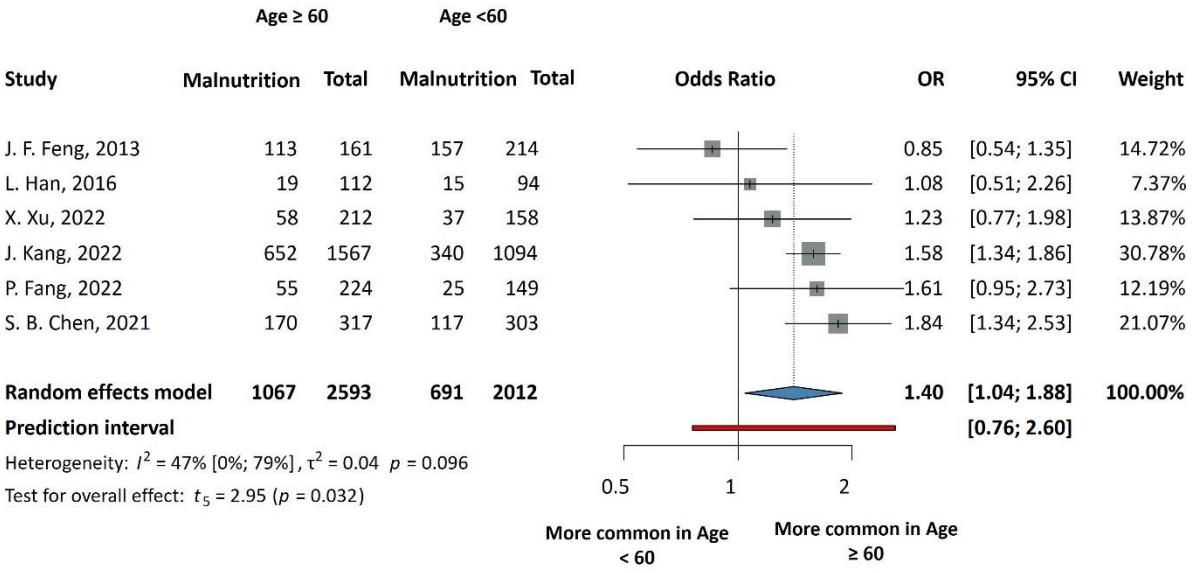


Figure S7.: Association between malnutrition-related complication risk and age (cut off 60) in gastric cancer (Biological composite scores)

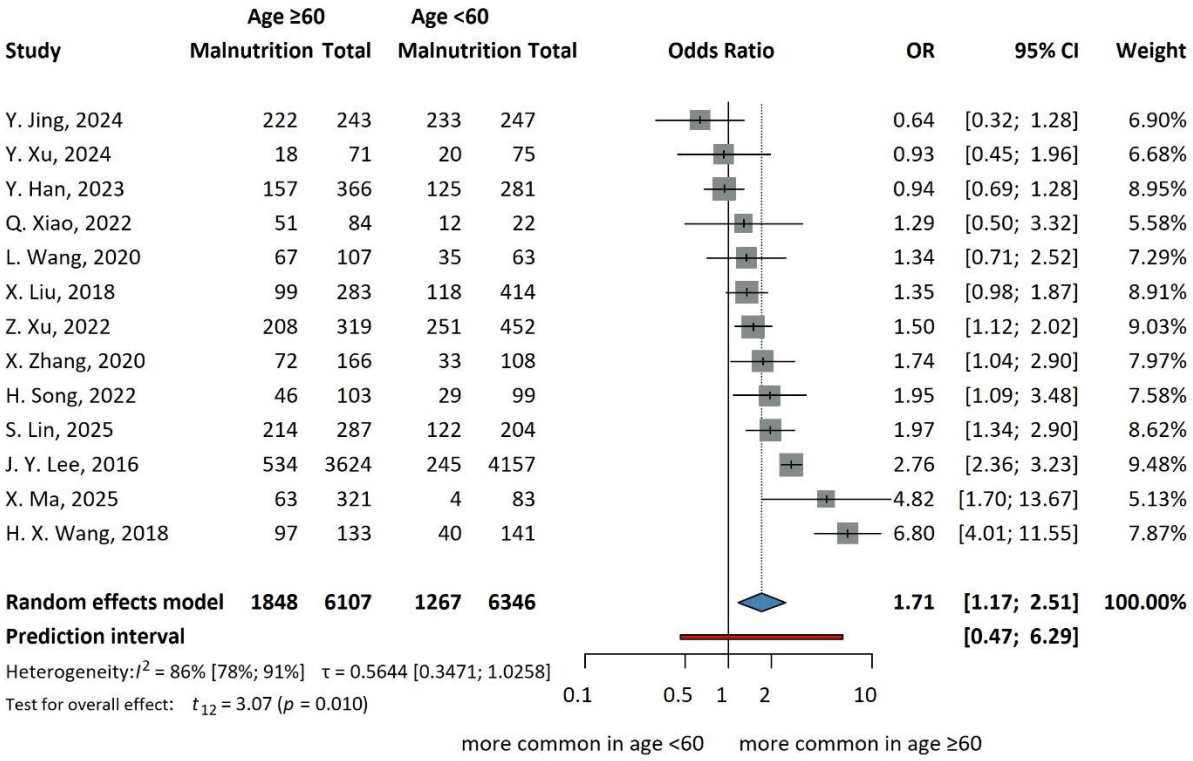


Figure S8.: Association between malnutrition-related complication risk and age (cut off 60) in colorectal cancer (Biological composite scores)

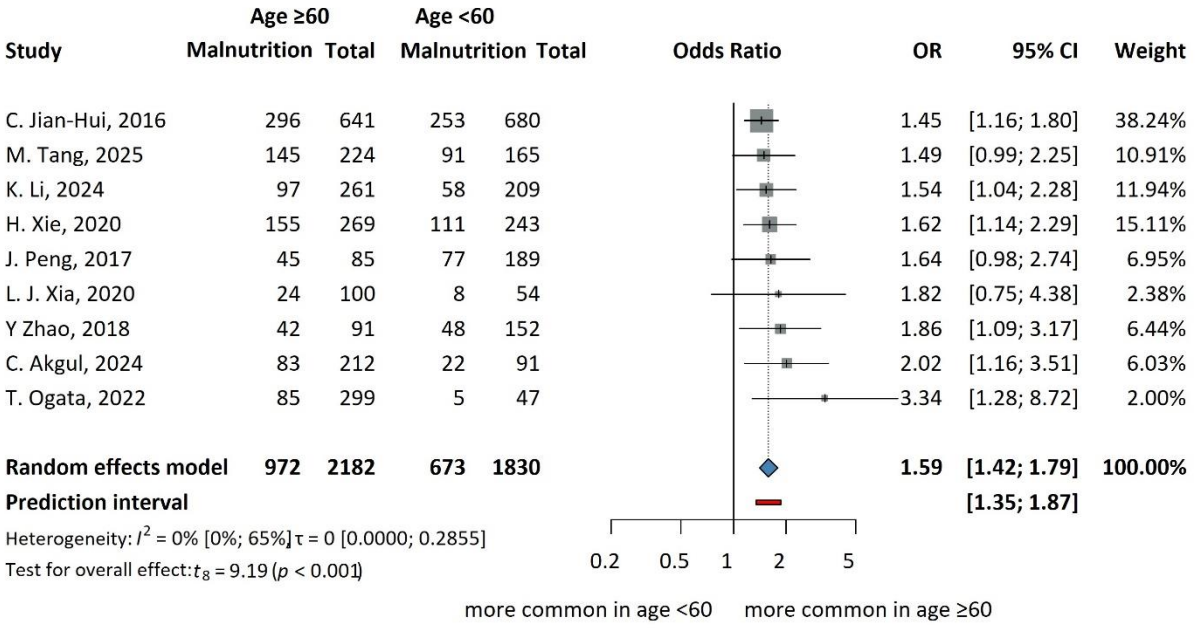


Figure S9.: Association between malnutrition risk and sex in esophageal cancer (Symptom-based risk assessment tools)

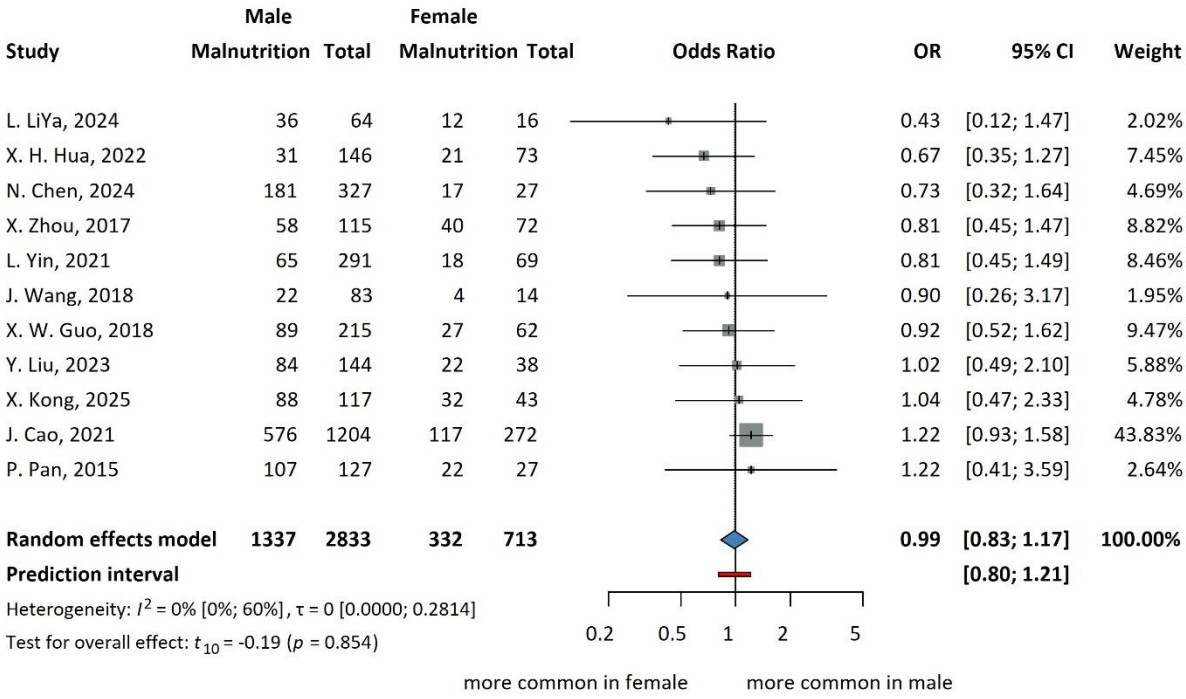


Figure S10.: Association between malnutrition risk and sex in gastric cancer (Symptom-based risk assessment tools)

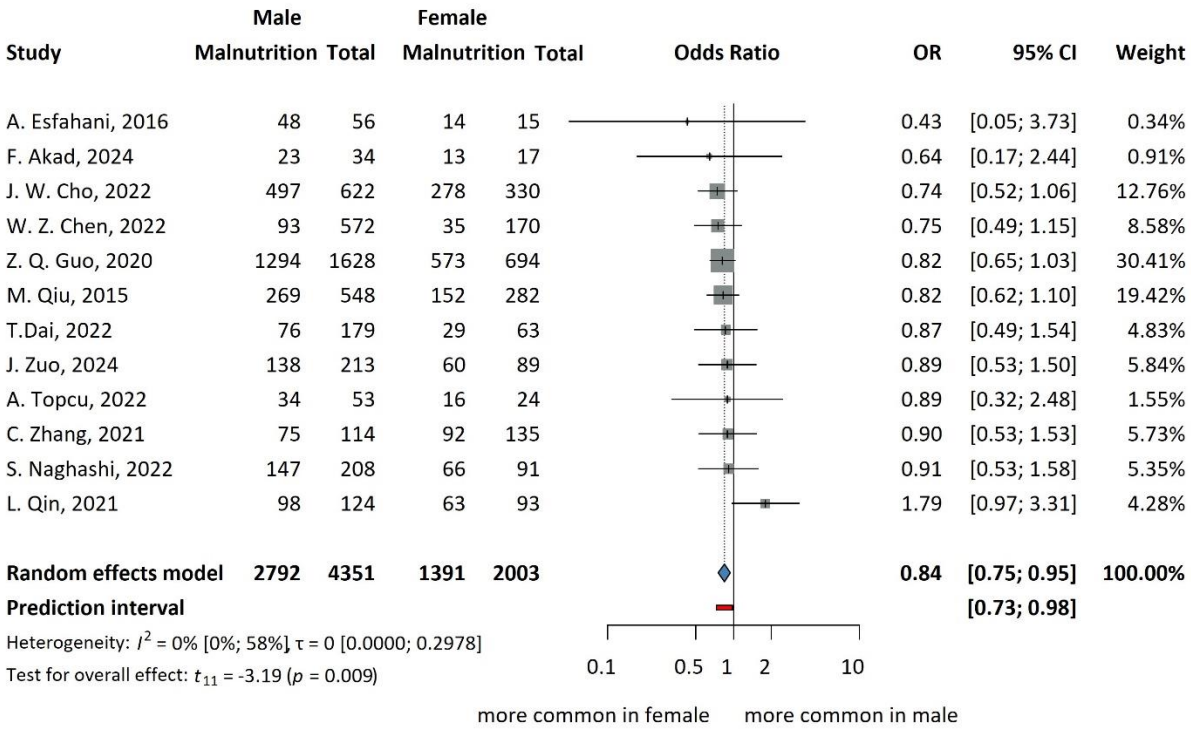
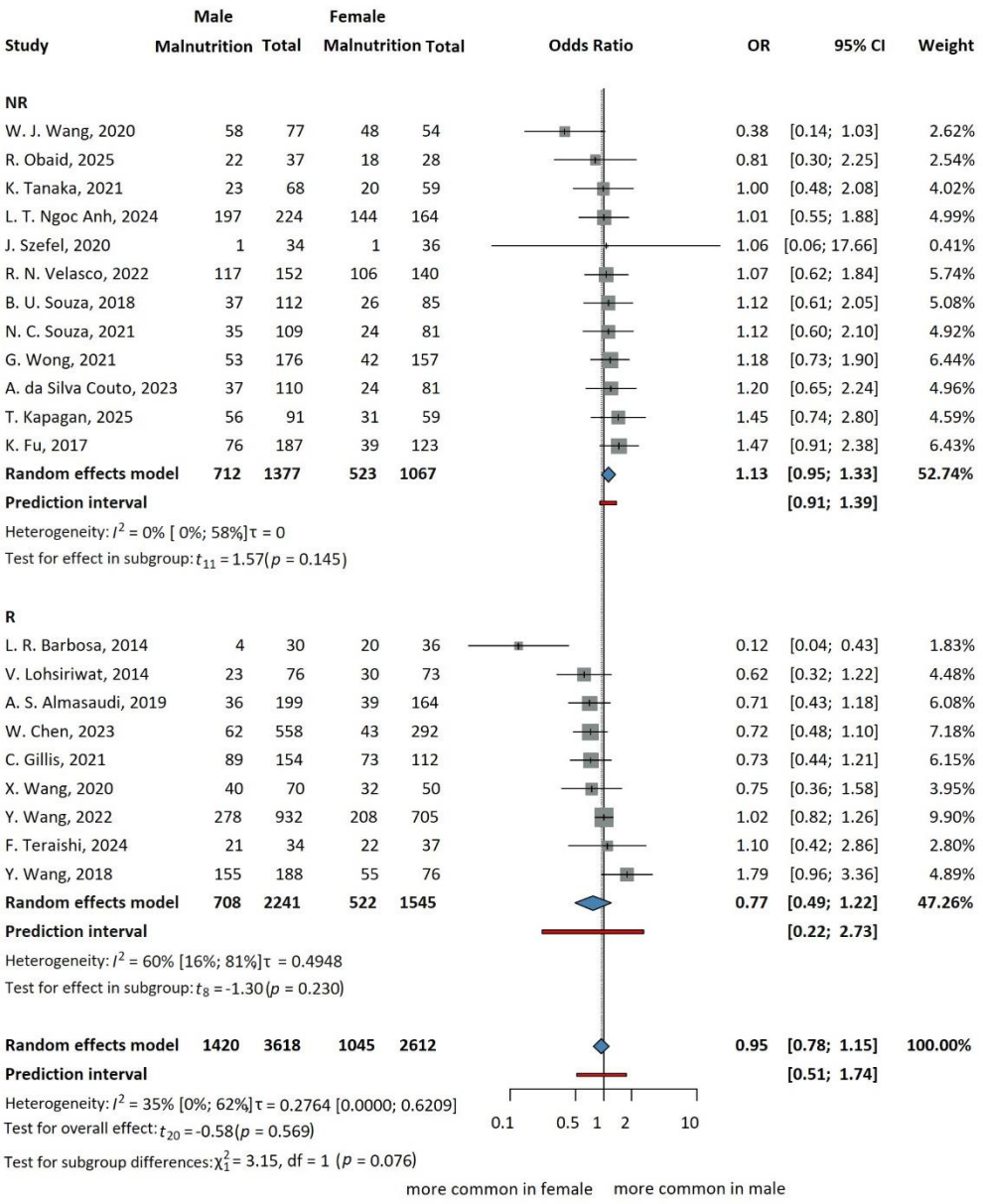


Figure S11.: Association between malnutrition risk and sex in colorectal cancer (Symptom-based risk assessment tools)



Abbreviation: R= resectable; NR=non-resectable

Figure S12.: Association between malnutrition risk and sex in hepatocellular carcinoma cancer (Symptom-based risk assessment tools)

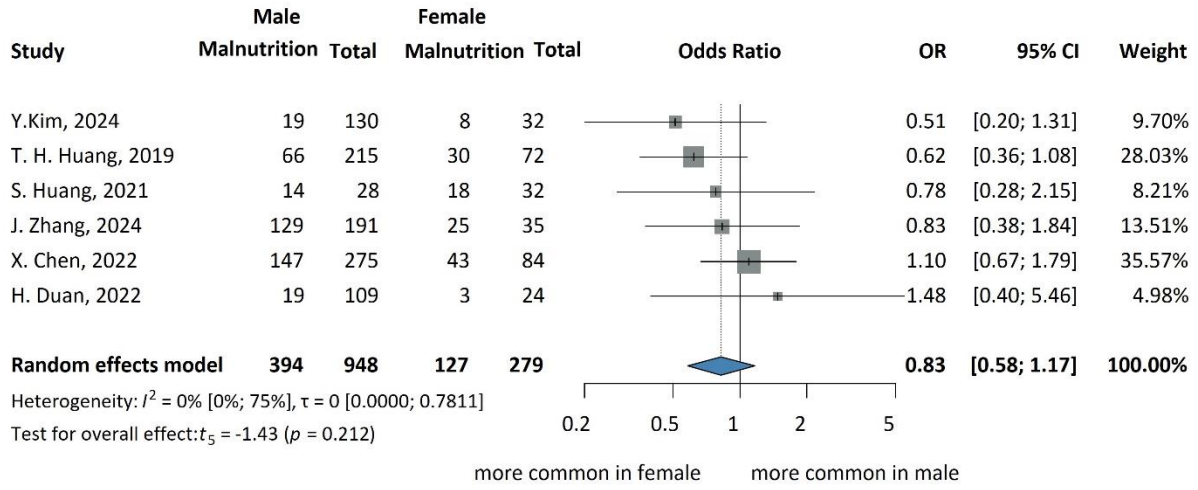


Figure S13.: Association between malnutrition risk and sex in pancreatic ductal adenocarcinoma (Symptom-based risk assessment tools)

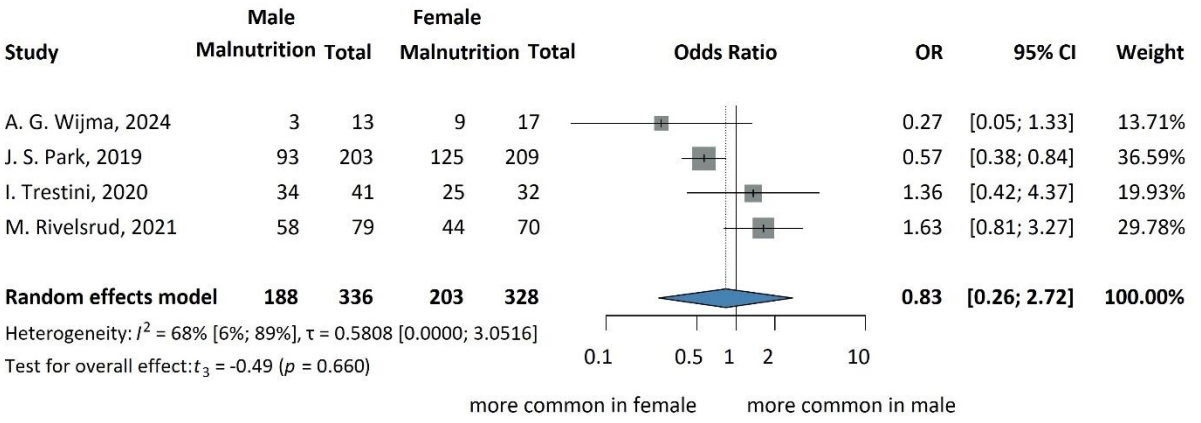


Figure S14.: Association between malnutrition diagnosis and sex in resectable gastrointestinal cancer (GLIM criteria)

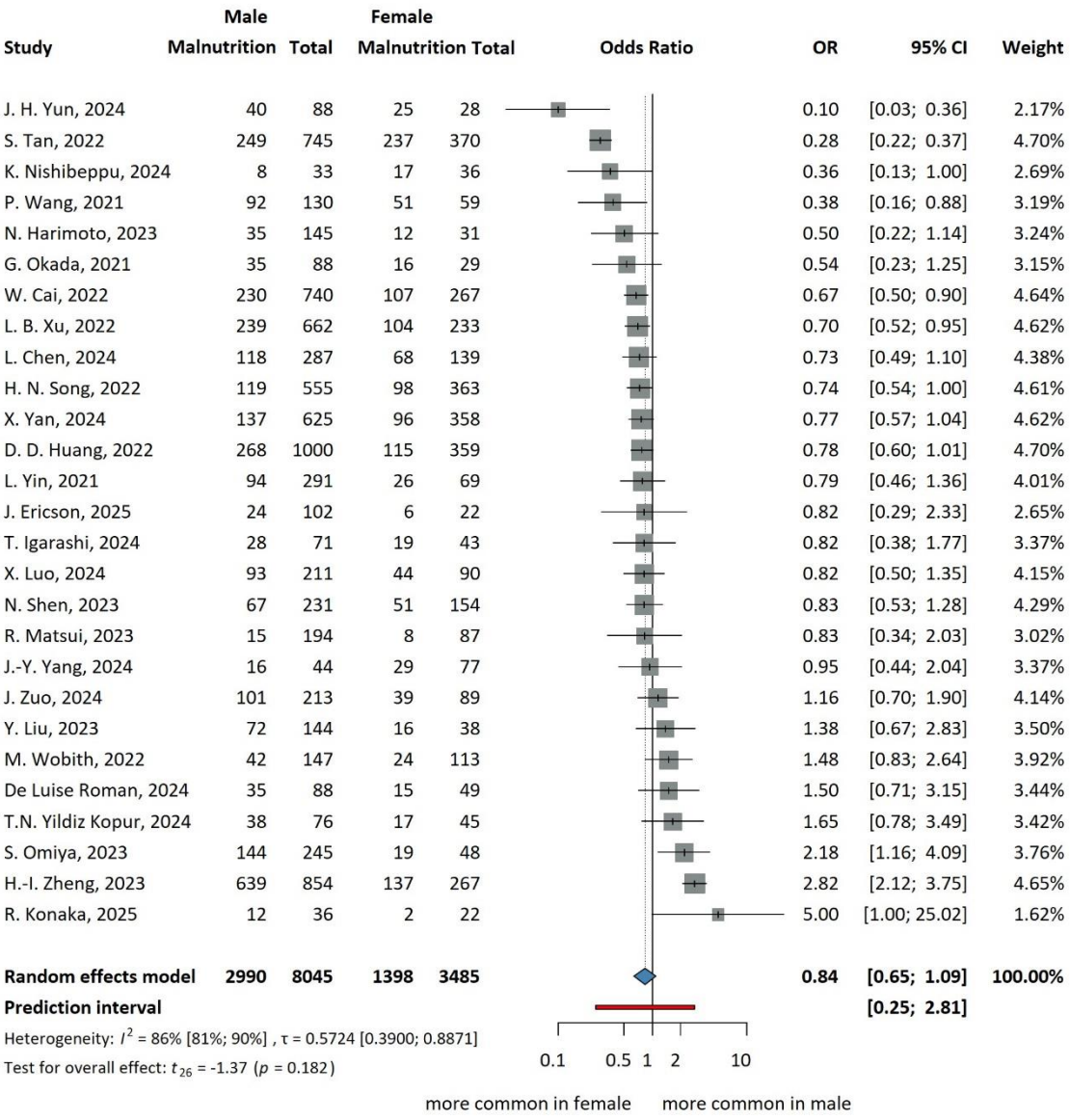


Figure S15.: Association between malnutrition diagnosis and sex in esophageal cancer (GLIM criteria)

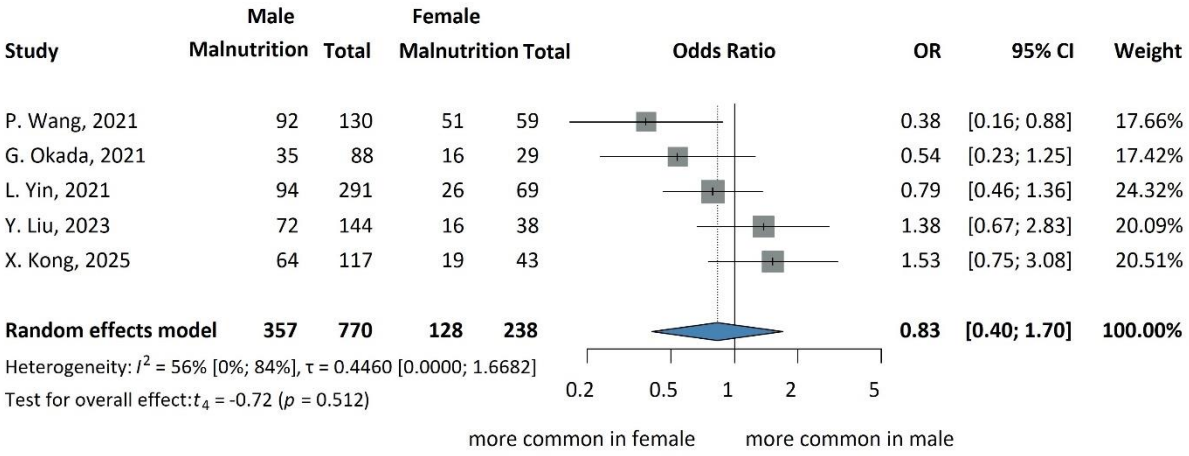
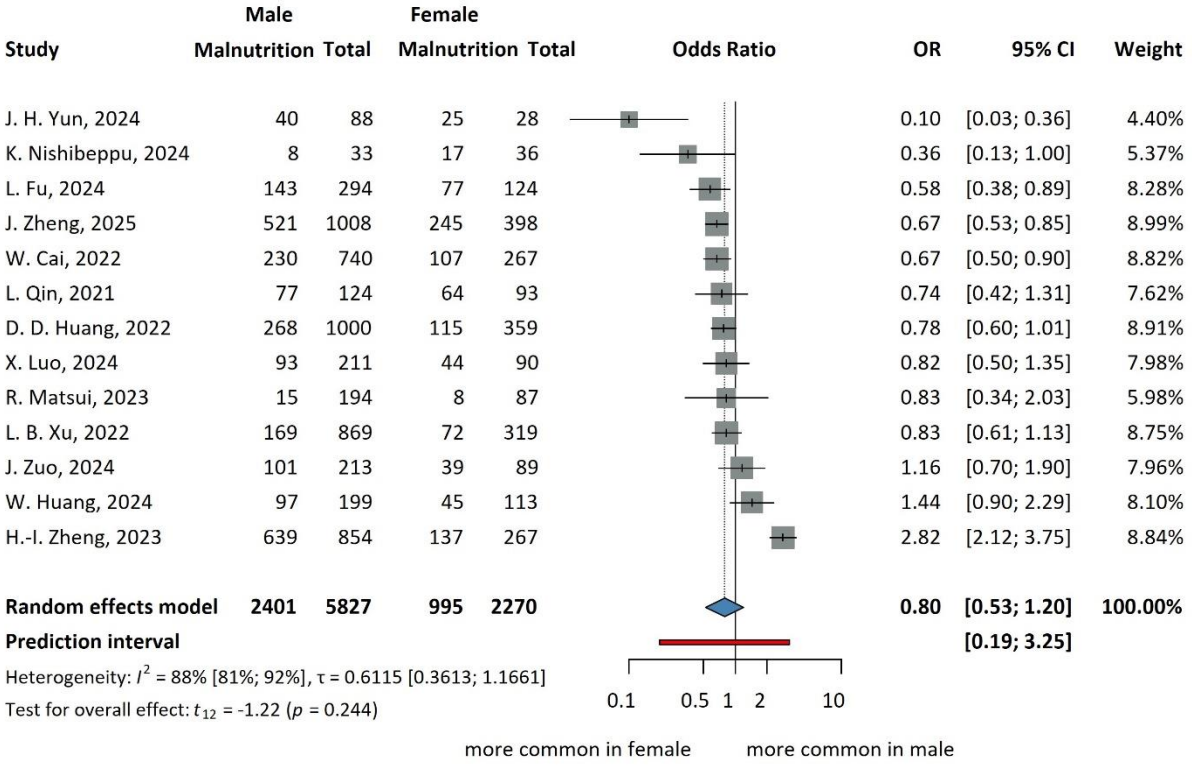
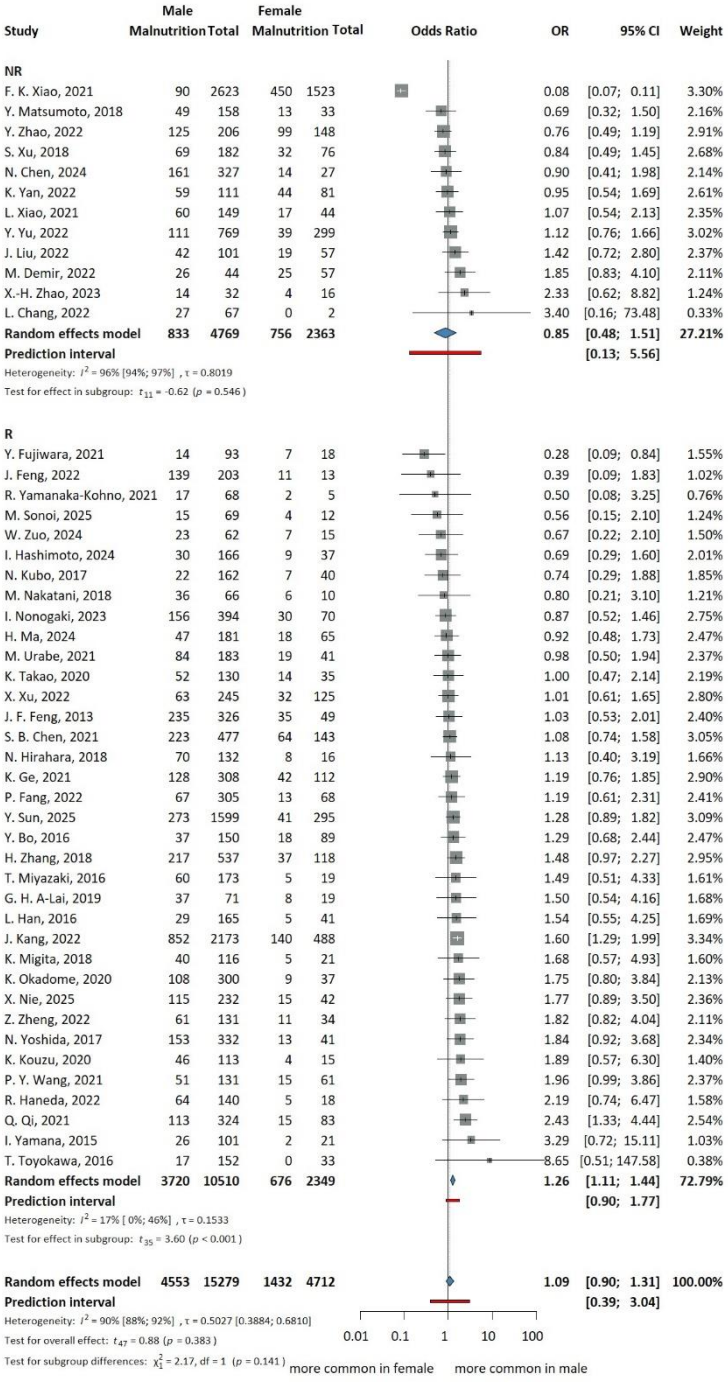


Figure S16.: Association between malnutrition diagnosis and sex in gastric cancer (GLIM criteria)



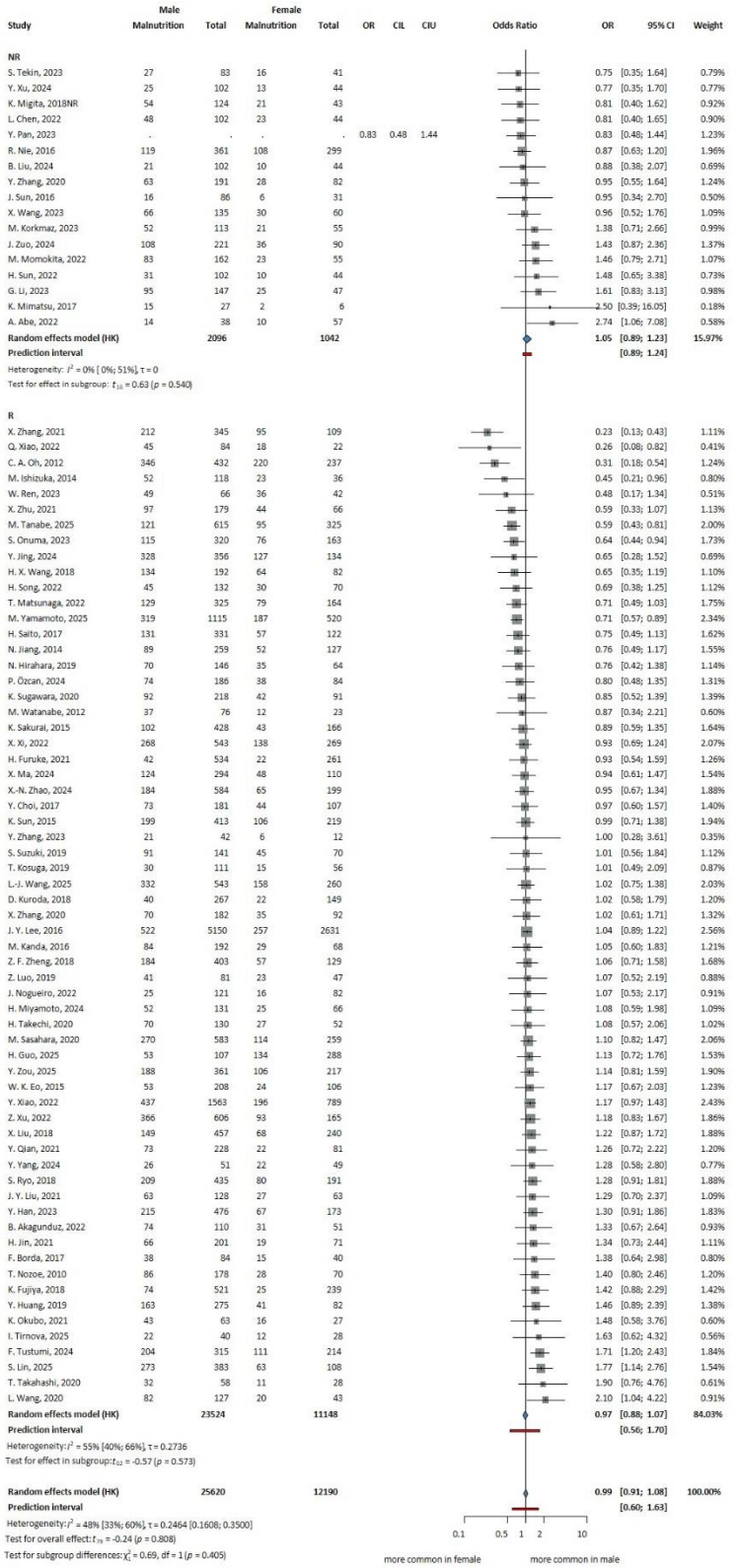
Abbreviation: R= resectable; NR= non-resectable

Figure S17.: Association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



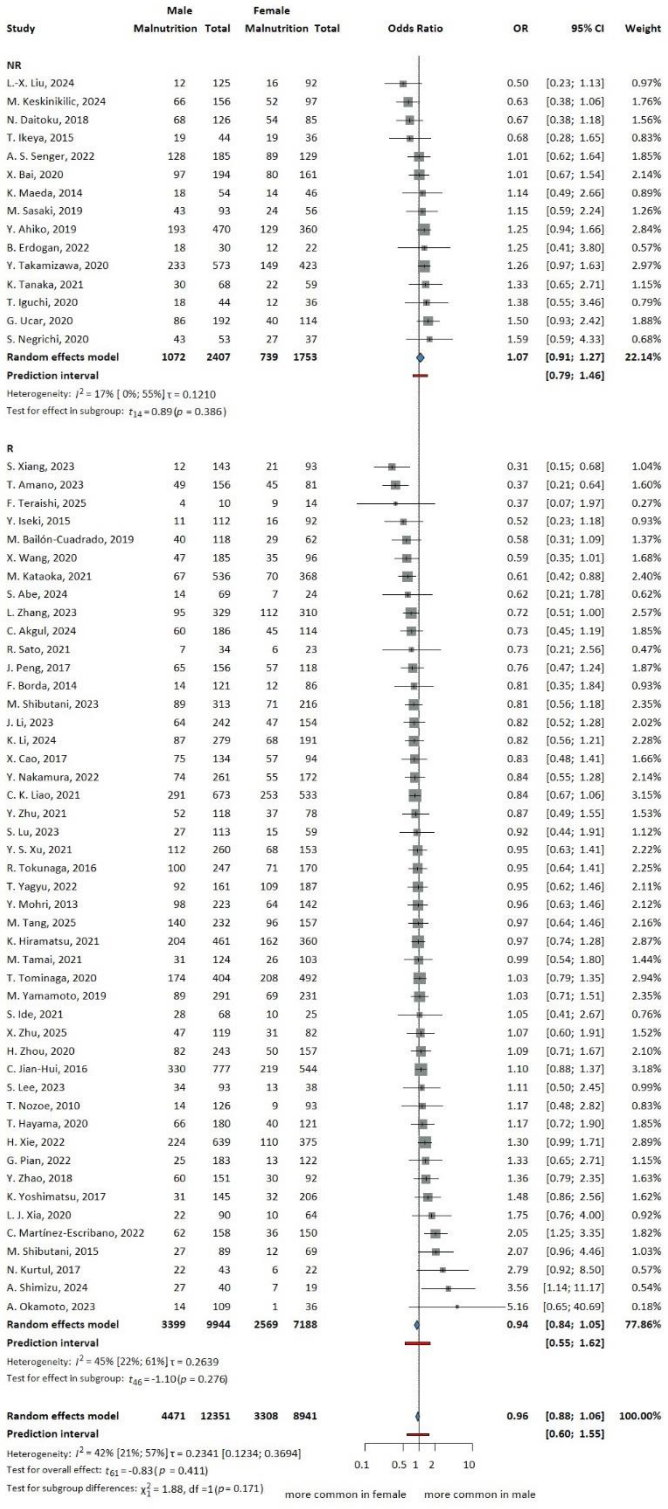
Abbreviation: R= resectable; NR= non-resectable

Figure S18.: Association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S19.: Association between malnutrition-related complication risk and sex in colorectal cancer (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S20.: Association between malnutrition-related complication risk and sex in biliary tract cancer (Biological composite scores)

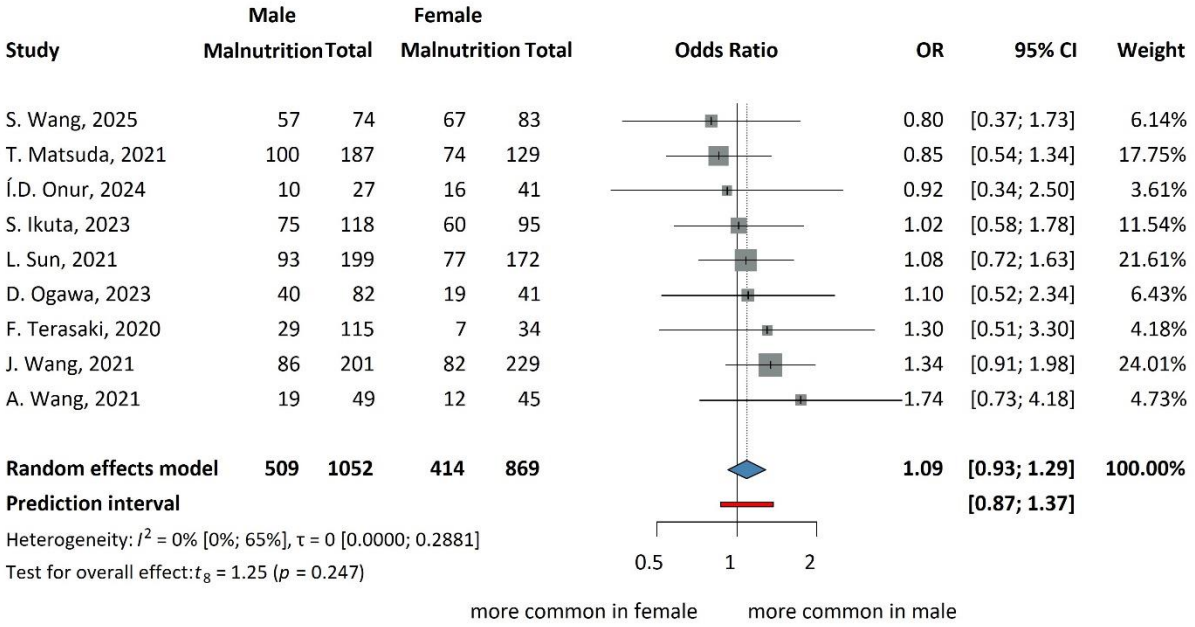
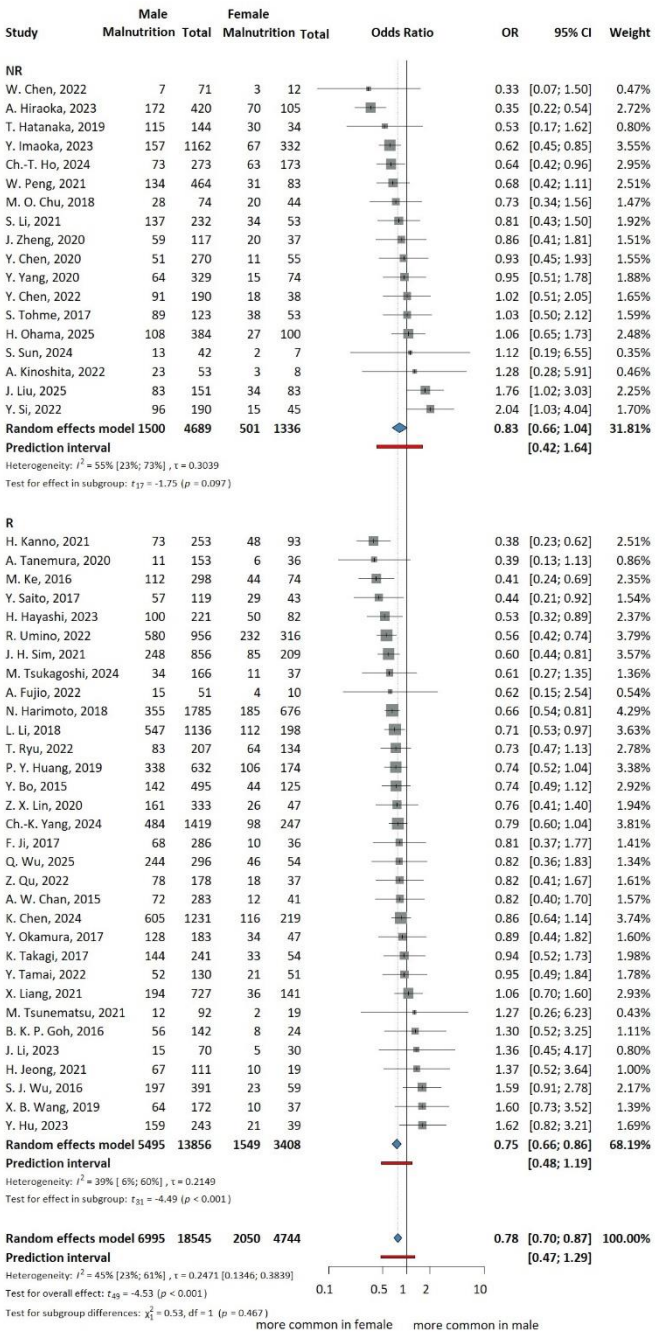


Figure S21.: Association between malnutrition-related complication risk and sex in hepatocellular carcinoma (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S22.: Association between malnutrition-related complication risk and sex in Vater papilla cancer (Biological composite scores)

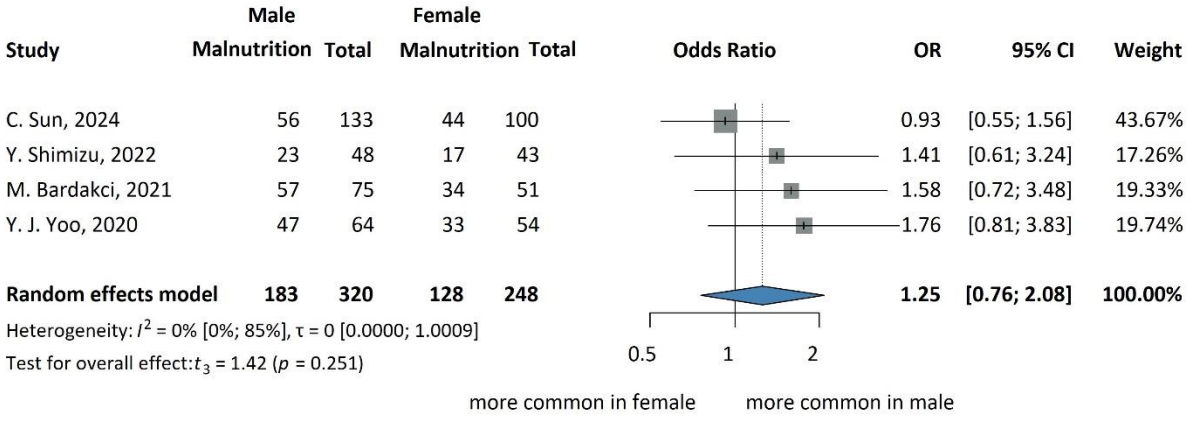
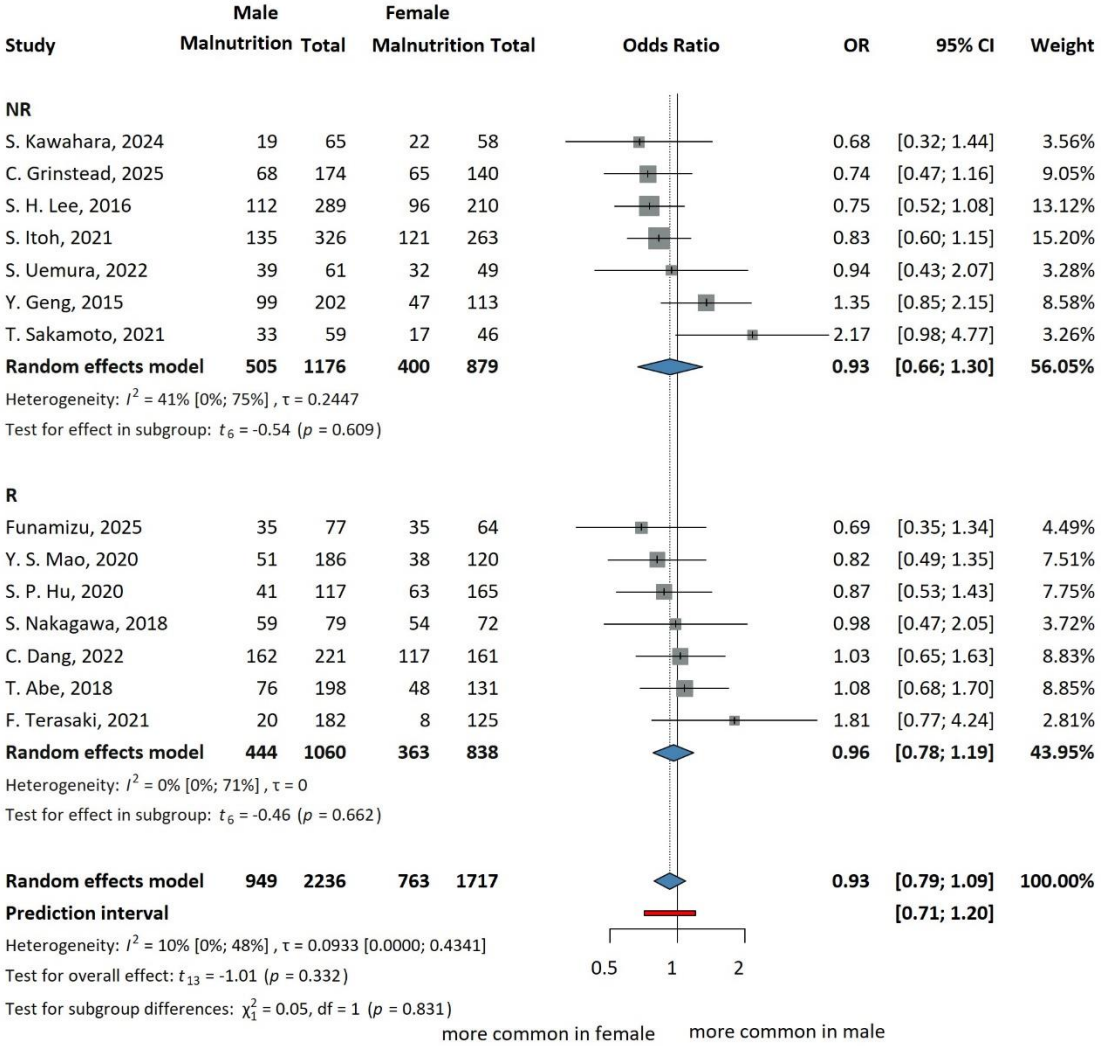


Figure S23.: Association between malnutrition-related complication risk and sex in pancreatic ductal adenocarcinoma (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S24.: Association between malnutrition diagnosis and sex in esophageal cancer (guidelines)

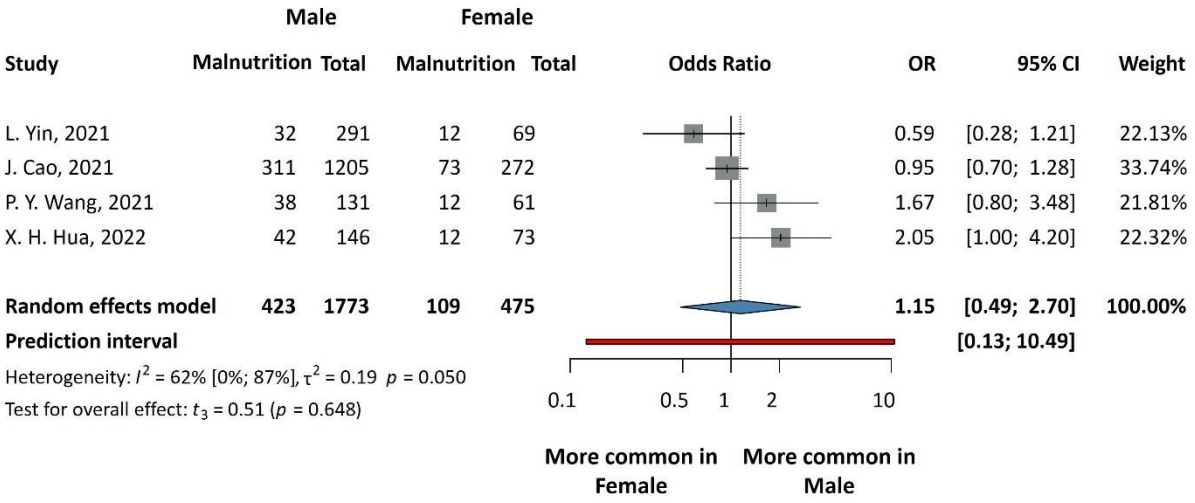


Figure S25.: Association between malnutrition diagnosis and sex in gastric cancer (guidelines)

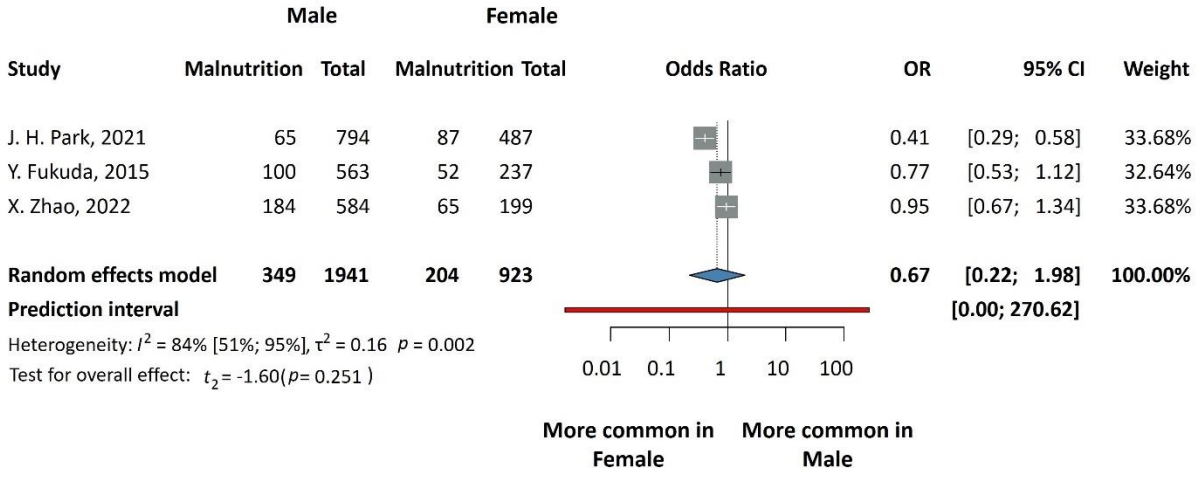


Figure S26.: Association between cachexia and sex in resectable gastrointestinal cancer

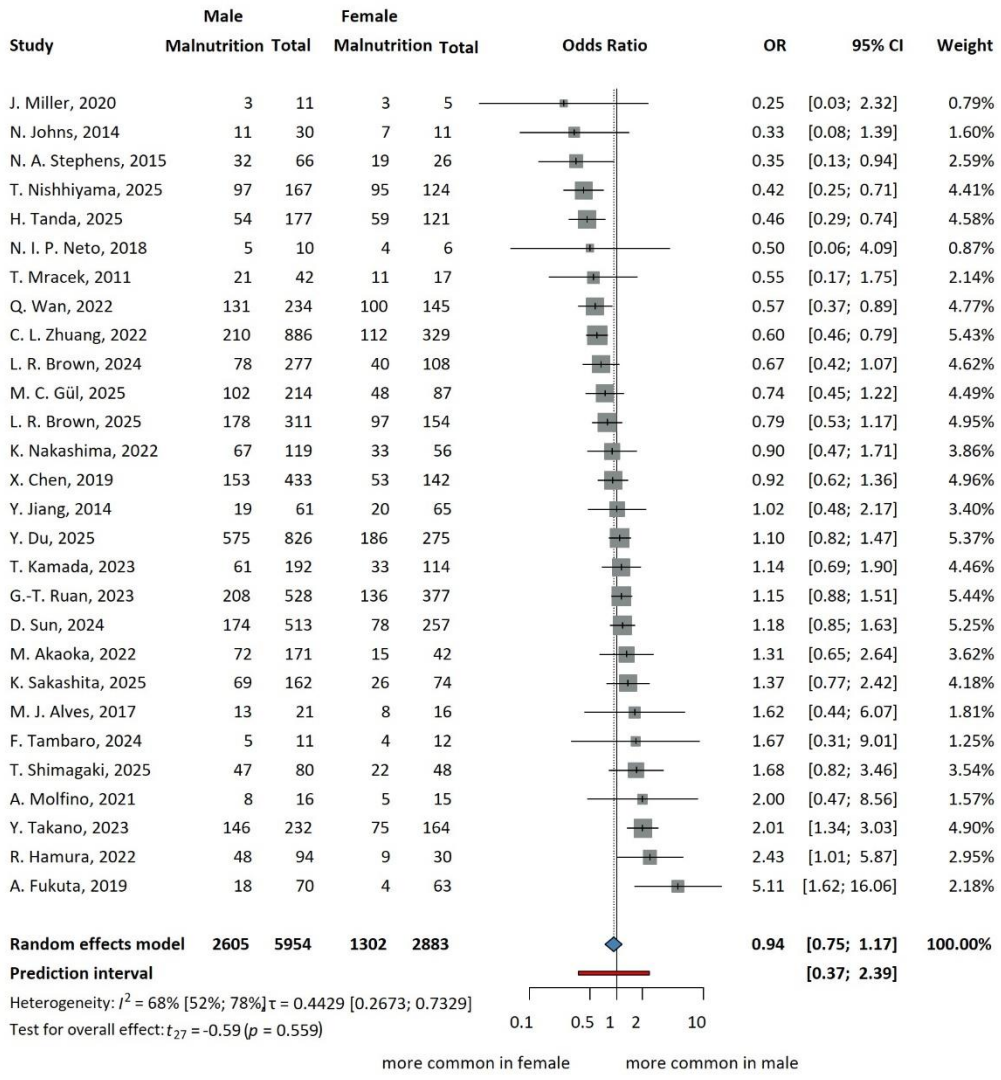


Figure S27.: Association between cachexia and sex in gastric cancer

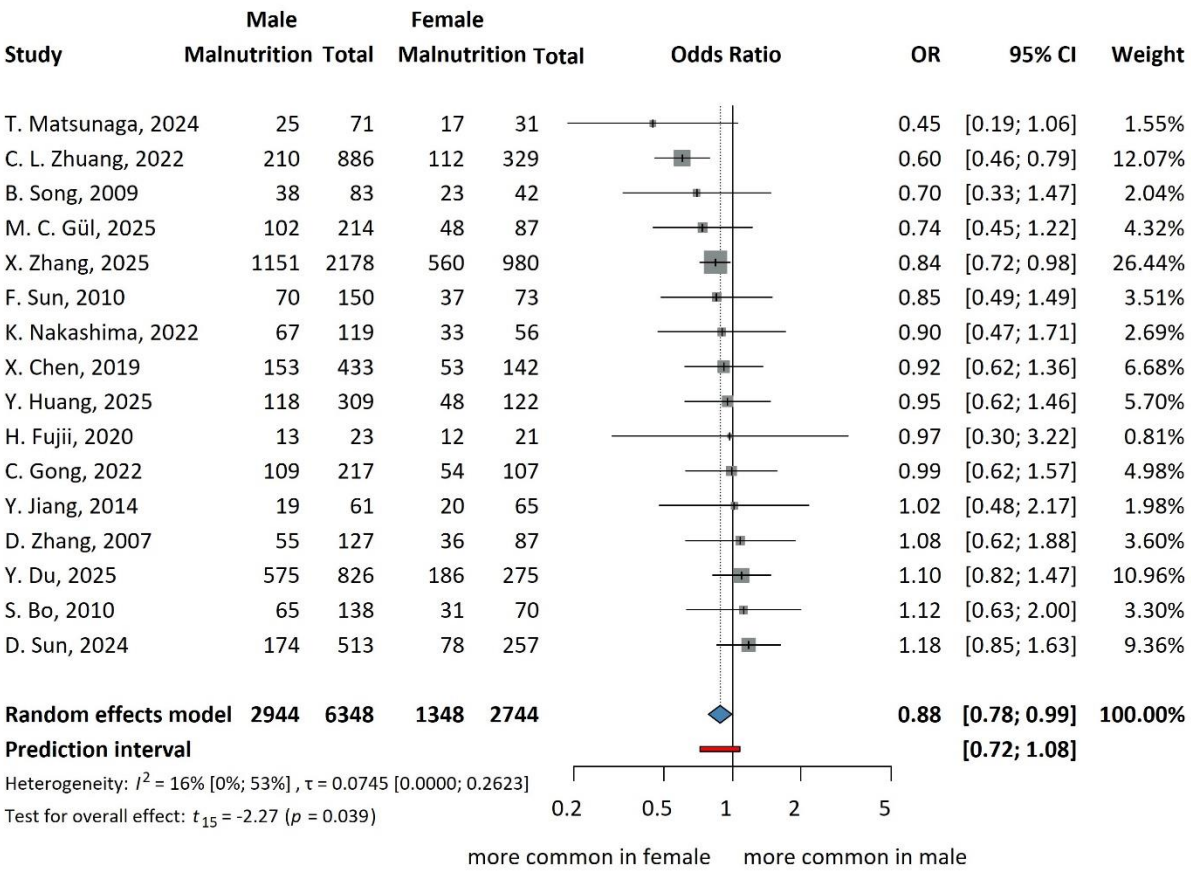


Figure S28.: Association between cachexia and sex in colorectal cancer

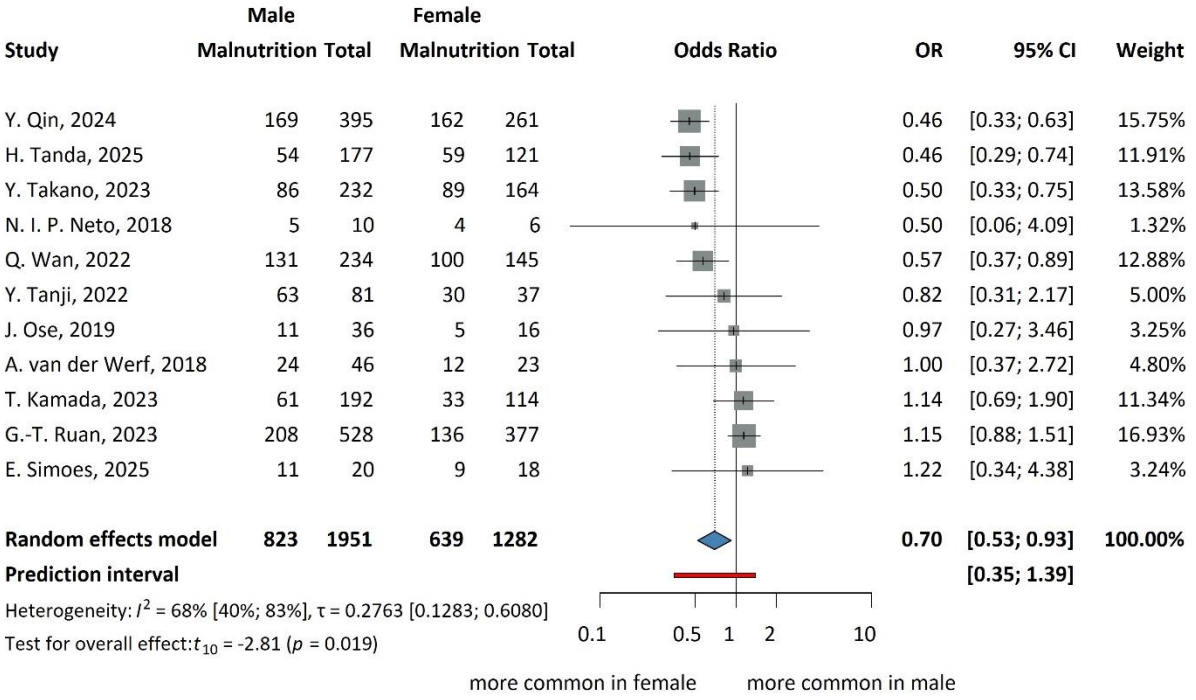


Figure S29.: Association between cachexia and sex in pancreatic ductal adenocarcinoma

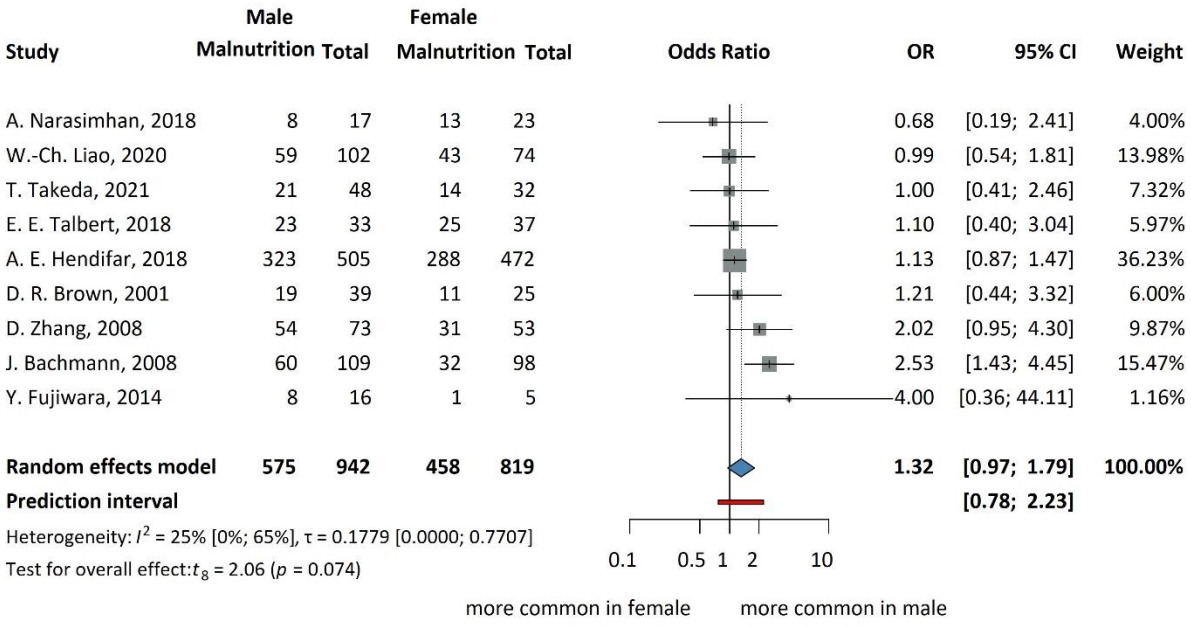


Figure S30.: Association between malnutrition risk and active smoking in gastrointestinal cancer (Symptom-based risk assessment tools)

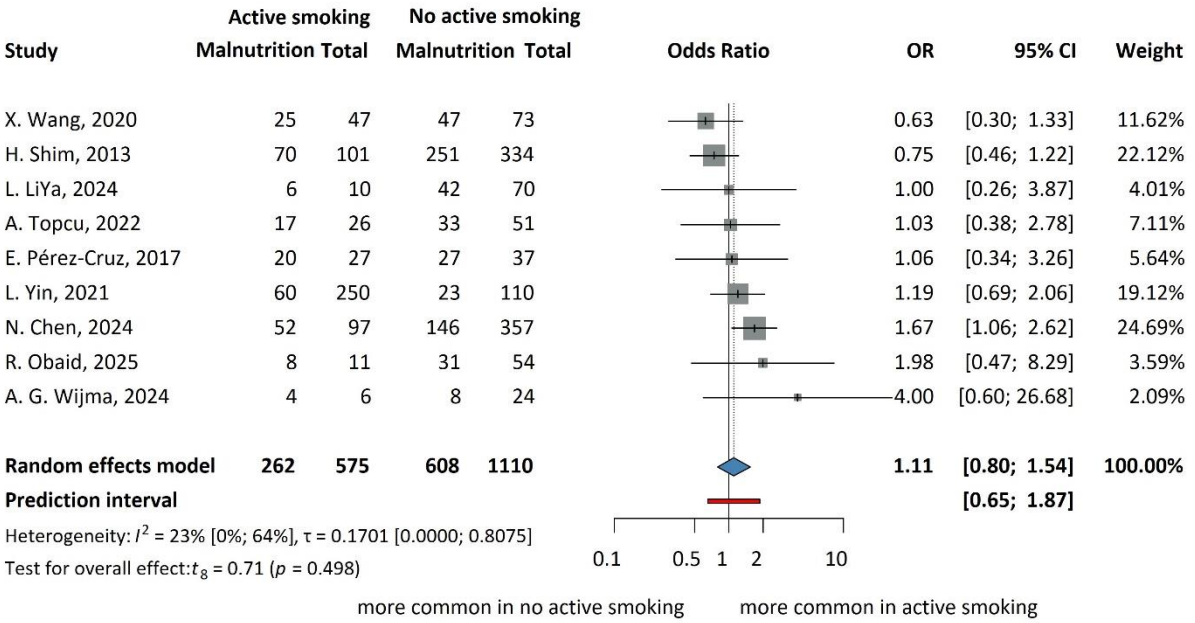


Figure S31.: Association between malnutrition-related complication risk and active smoking in esophageal cancer (Biological composite scores)

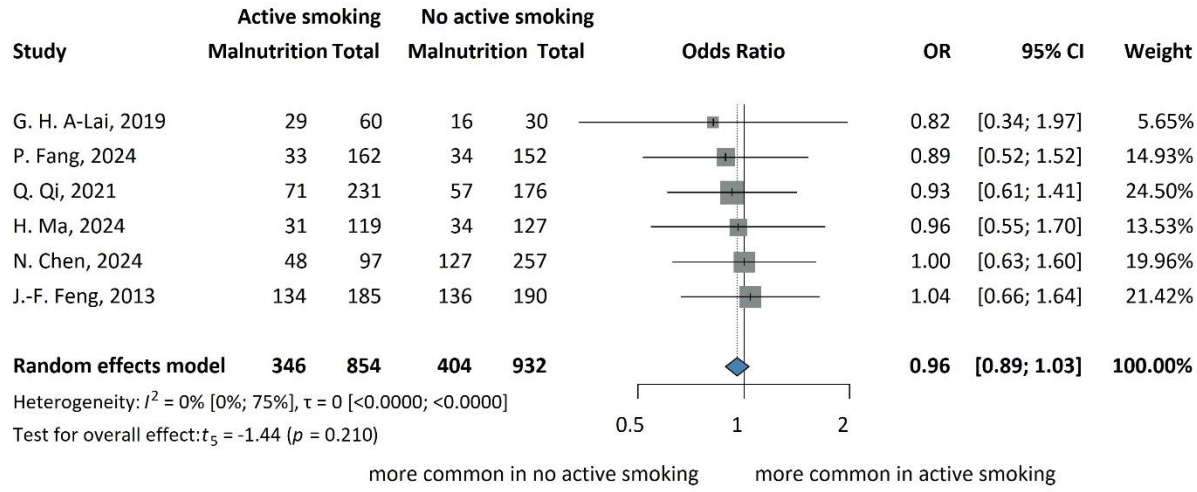


Figure S32.: Association between malnutrition-related complication risk and active smoking in gastric cancer (Biological composite scores)

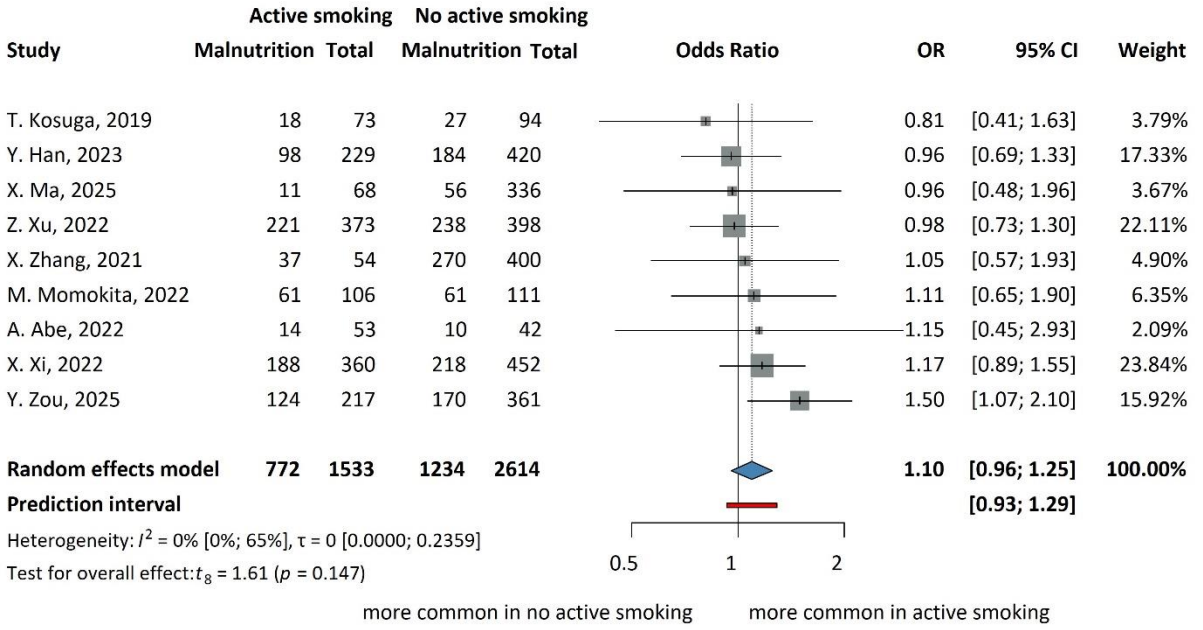
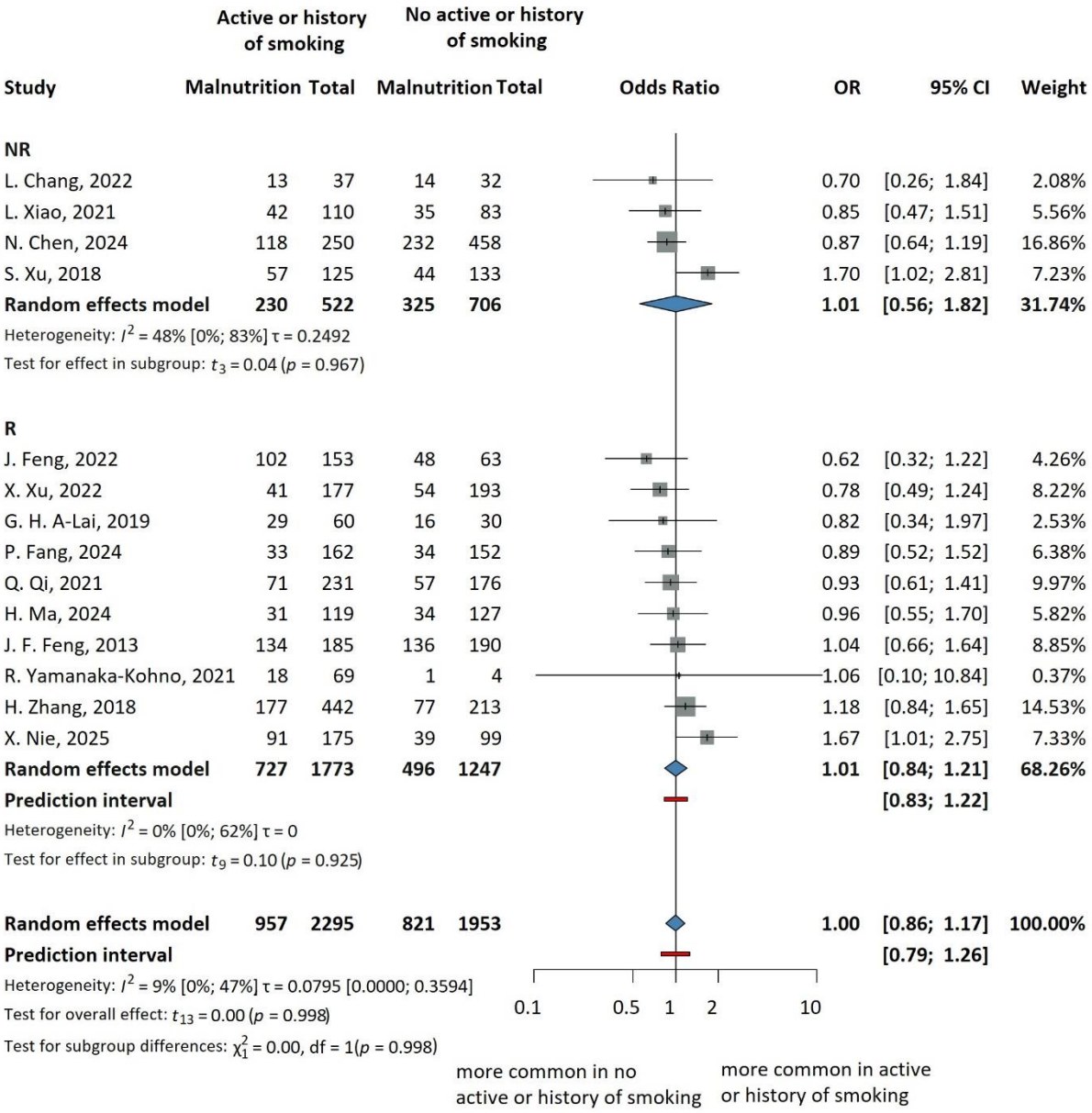


Figure S33.: Association between malnutrition-related complication risk and smoking (active or history) in esophageal cancer (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S34.: Association between malnutrition-related complication risk and smoking (active or history) in colorectal cancer (Biological composite scores)

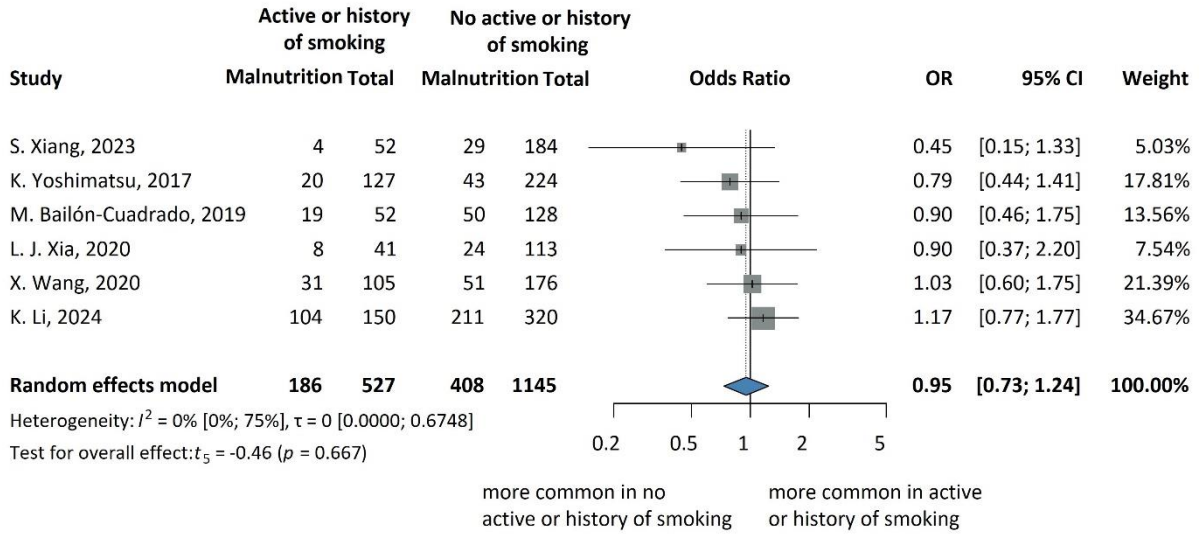


Figure S35.: Association between malnutrition-related complication risk and smoking (active or history) in hepato-biliopancreatic cancer (Biological composite scores)

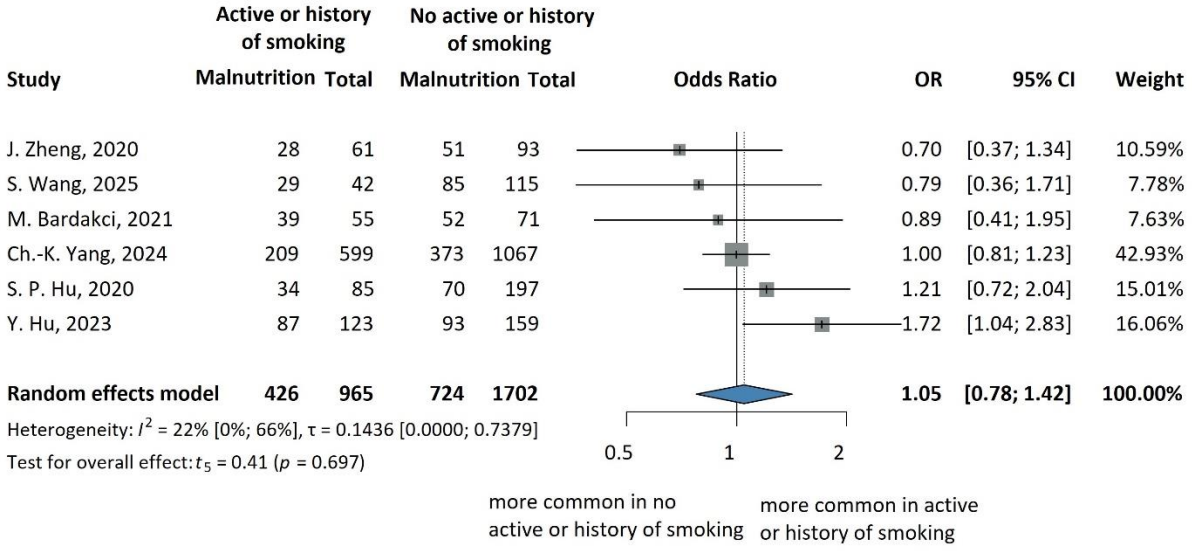


Figure S36.: Association between malnutrition diagnosis and smoking (active or history) in gastrointestinal cancer (guideline)

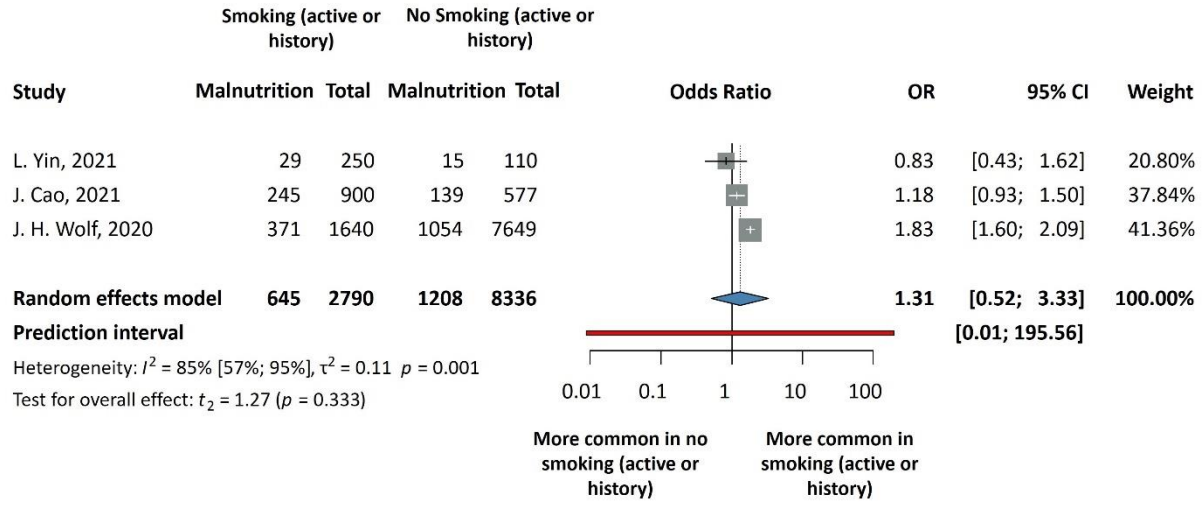


Figure S37.: Association between malnutrition-related complication risk and smoking history in esophageal and colorectal cancer (Biological composite scores)

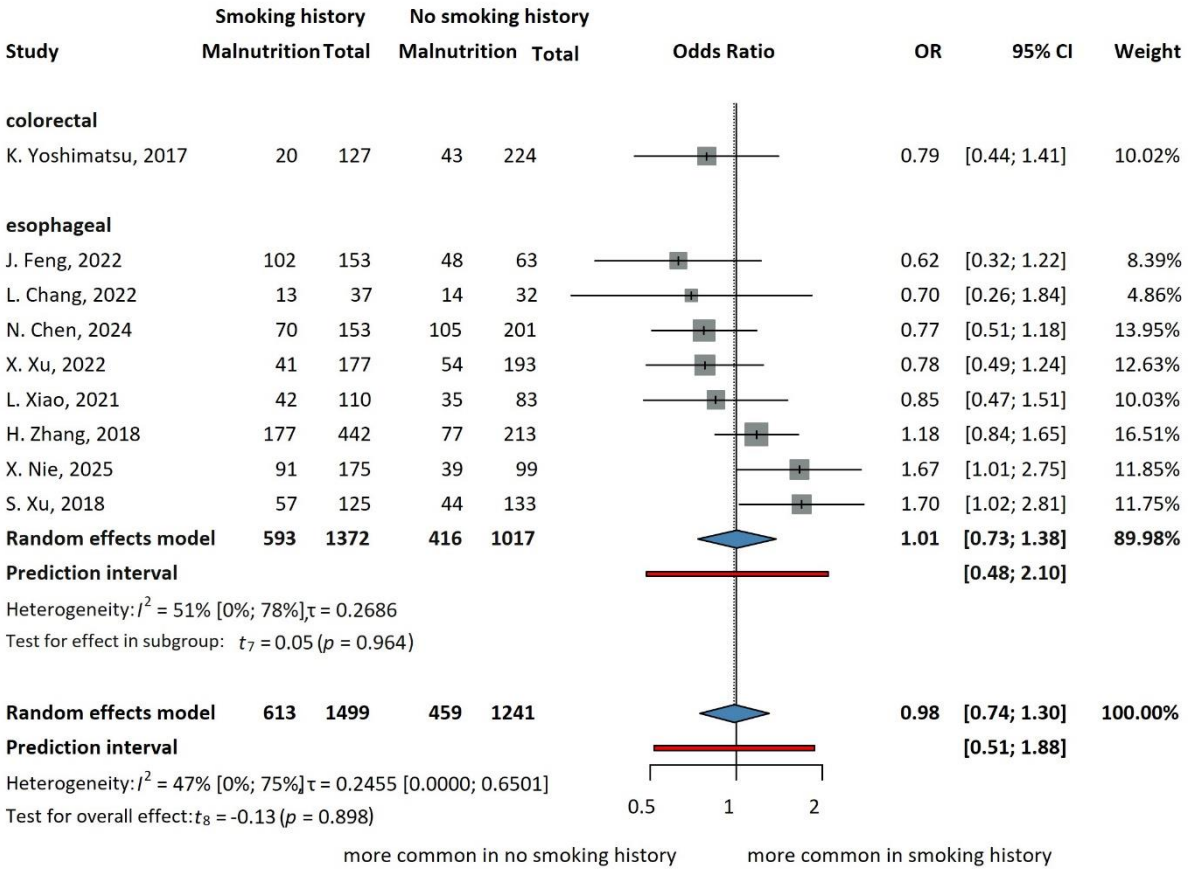


Figure S38.: Association between malnutrition risk and alcohol consumption (active) in gastrointestinal cancer (Symptom-based risk assessment tool)

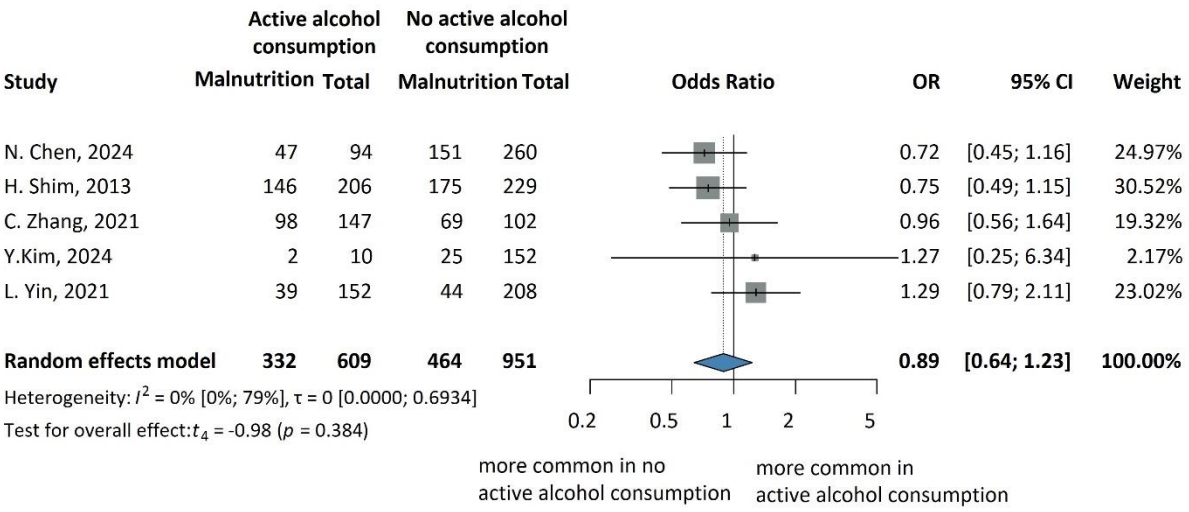


Figure S39.: Association between malnutrition-related complication risk and alcohol consumption (active) in gastrointestinal cancer (Biological composite scores)

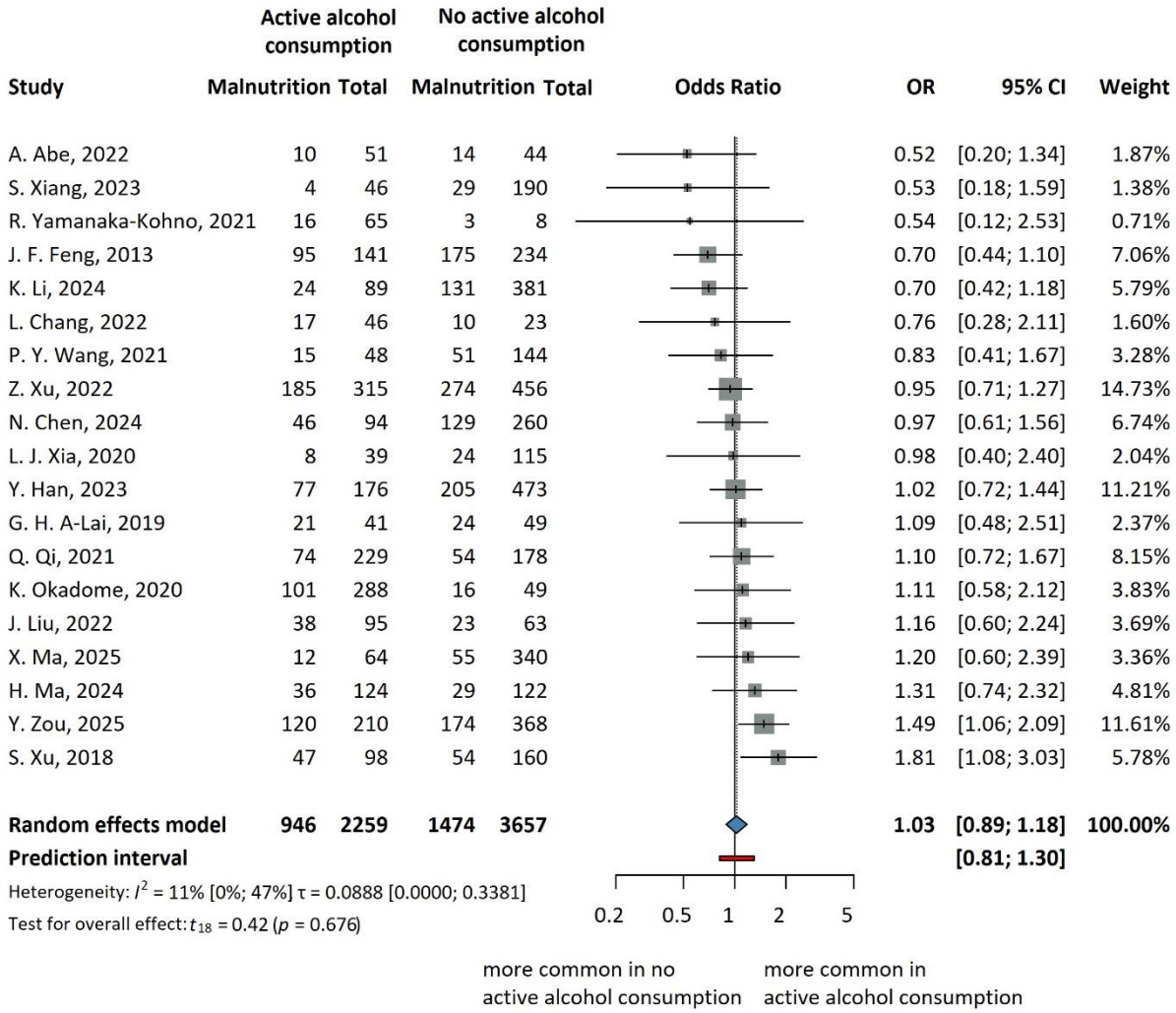


Figure S40.: Association between malnutrition-related complication risk and alcohol consumption (active) in esophageal and other gastrointestinal tract cancer (Biological composite scores)

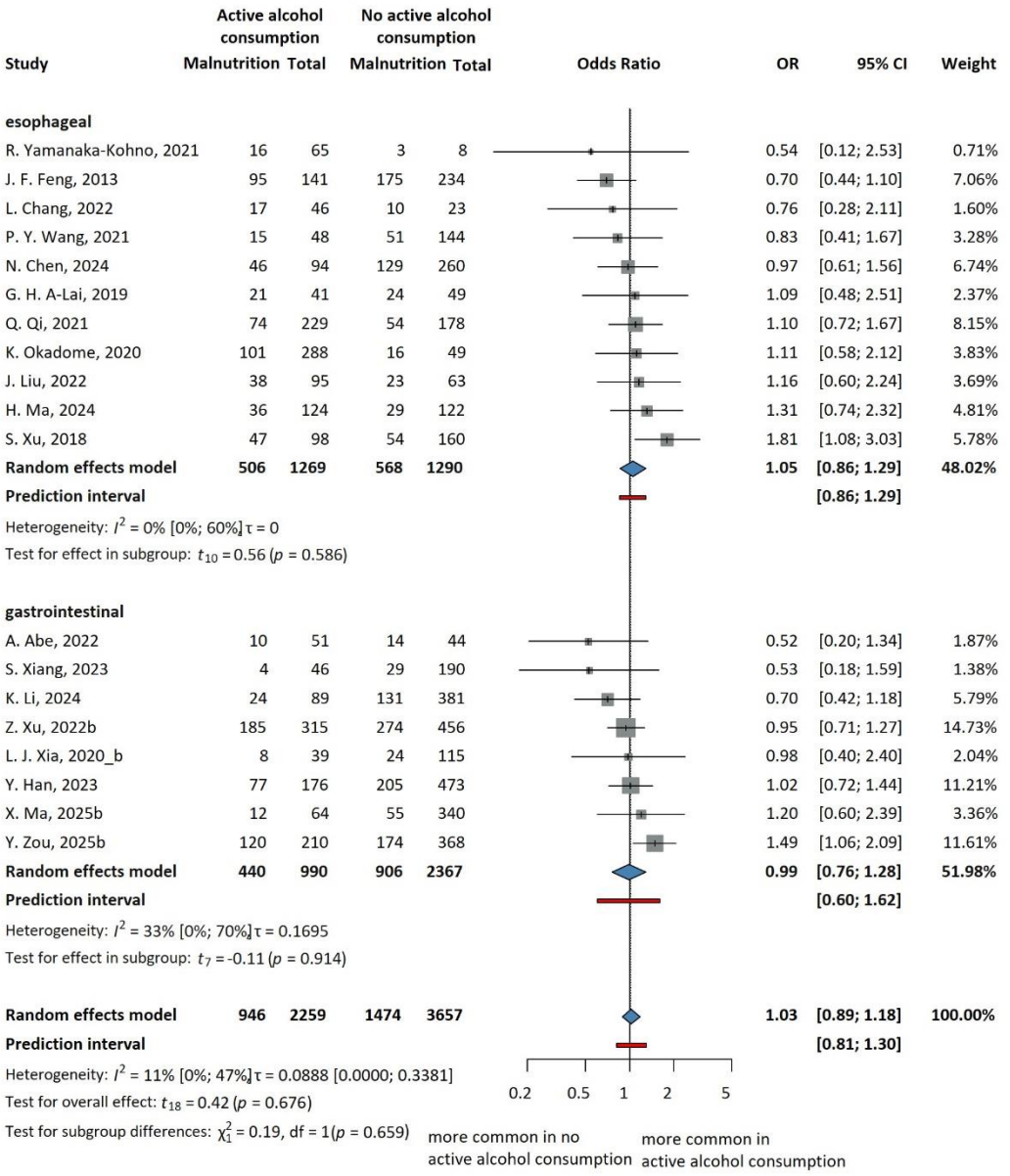


Figure S41.: Association between malnutrition-related complication risk and alcohol consumption (active) in hepatobiliopancreatic cancer (Biological composite scores)

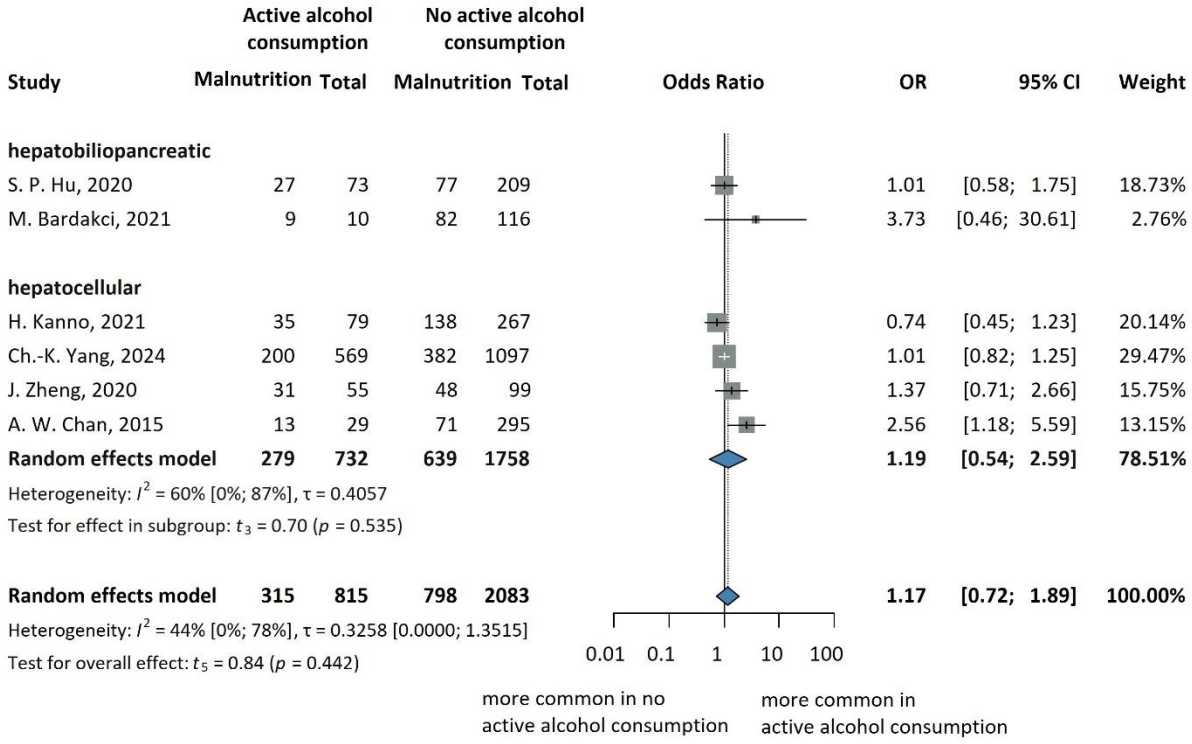


Figure S42.: Association between malnutrition-related complication risk and alcohol consumption (active) in hepatobiliopancreatic cancer [subgroup analysis for hepatocellular carcinoma] (Biological composite scores)

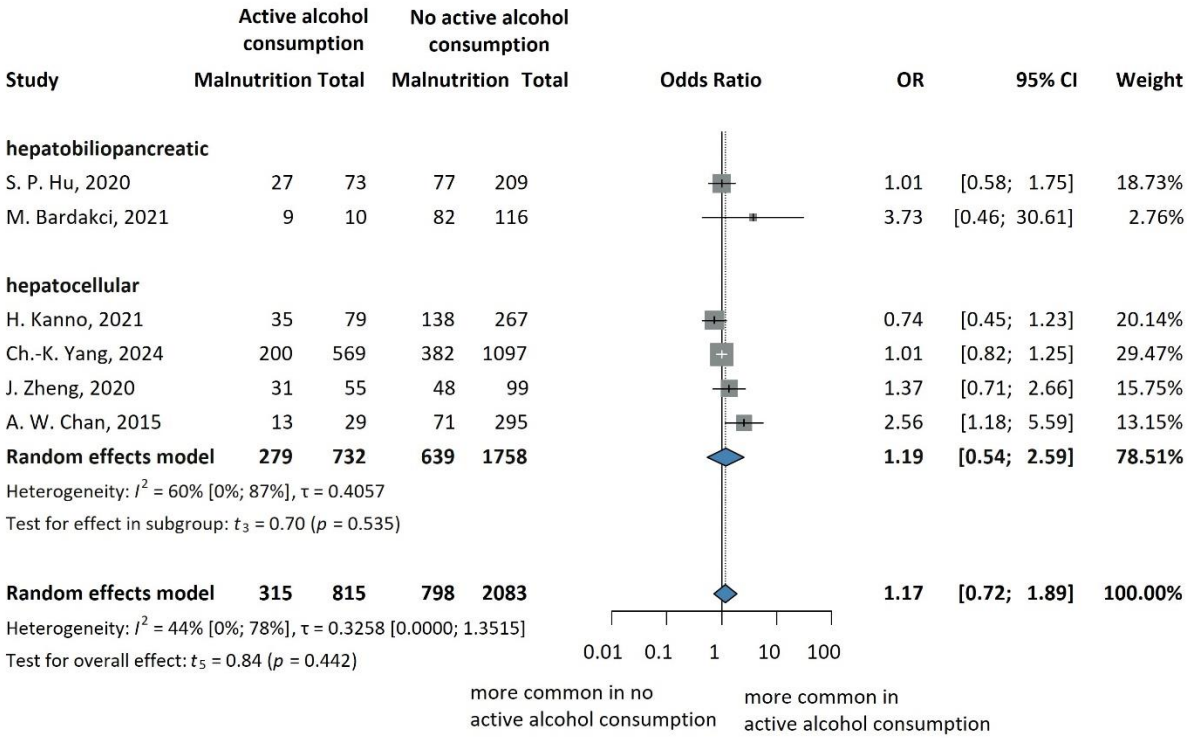


Figure S43.: Association between malnutrition diagnosis and alcohol consumption (active) in esophageal cancer (guideline)

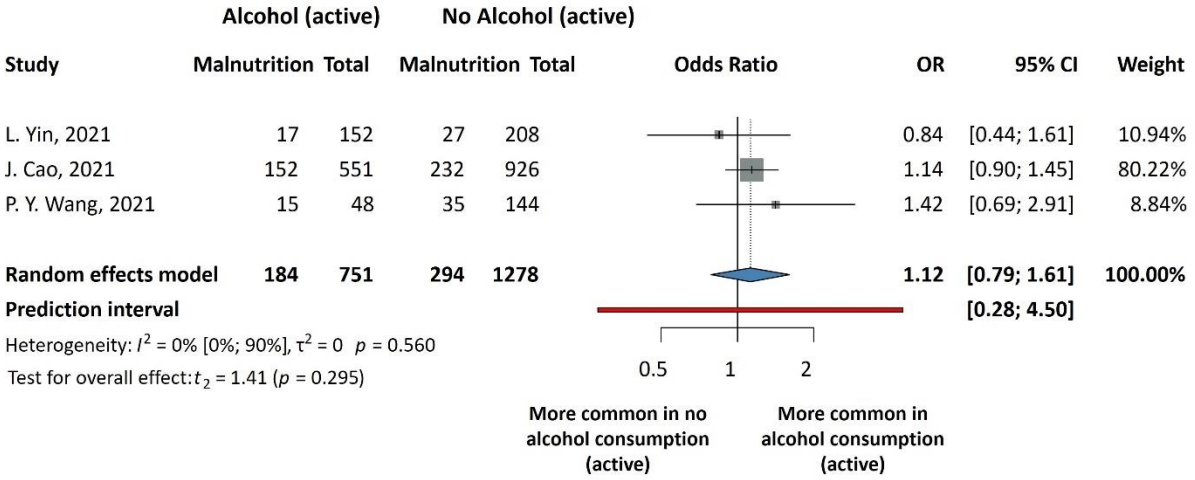


Figure S44.: Association between cachexia and alcohol consumption (active) in gastrointestinal cancer

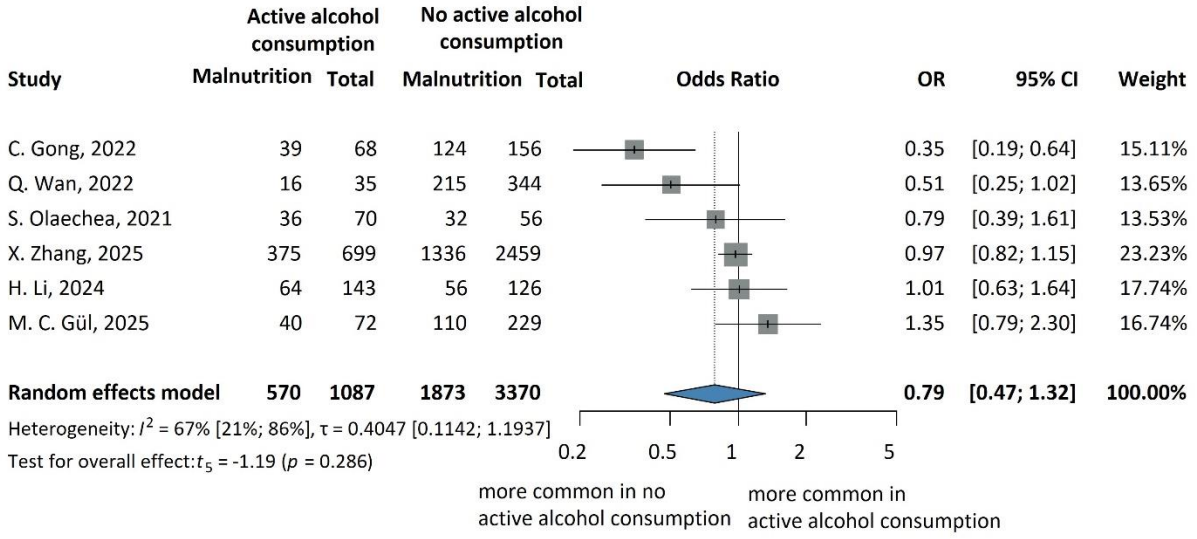


Figure S45.: Association between malnutrition-related complication risk and alcohol consumption (active and history) in hepatobilio-pancreatic cancer [subgroup analysis for hepatocellular cancer] (Biological composite scores)

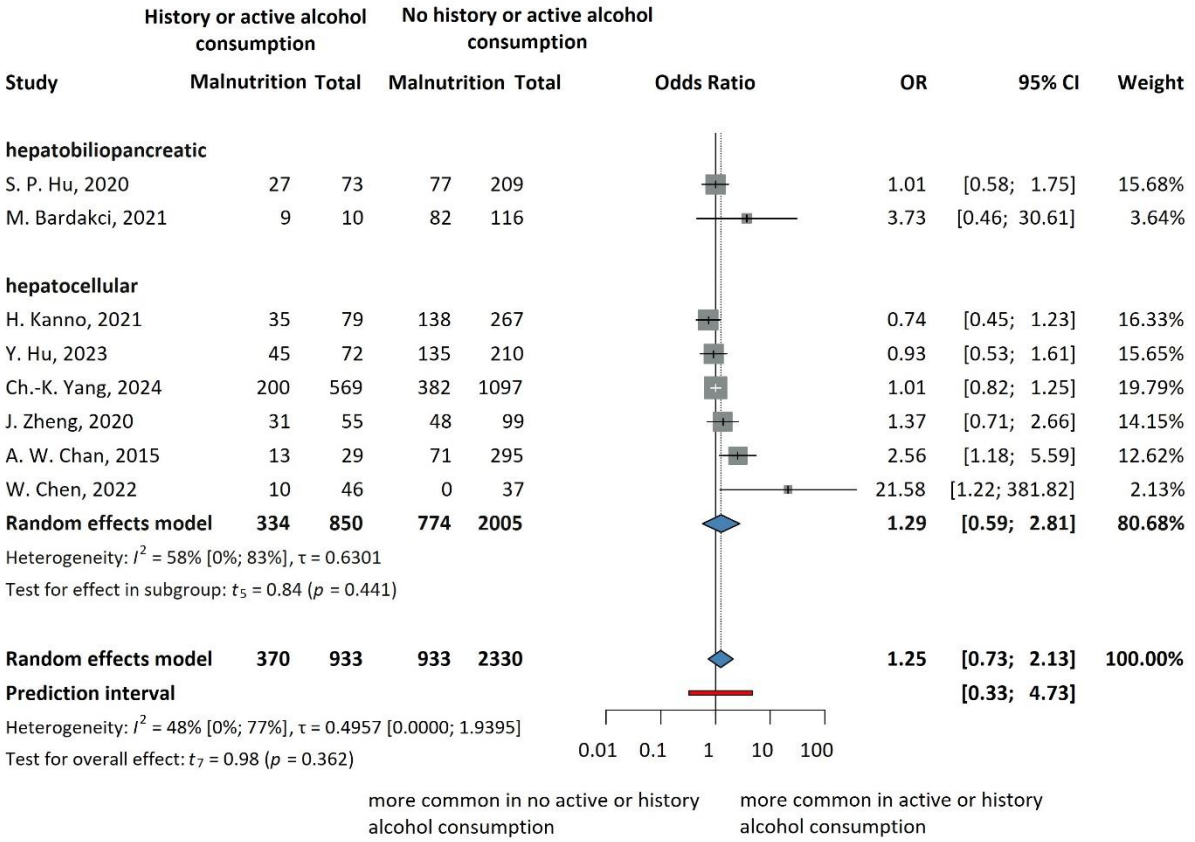


Figure S46.: Association between malnutrition-related complication risk and alcohol consumption (history) in esophageal cancer (Biological composite scores)

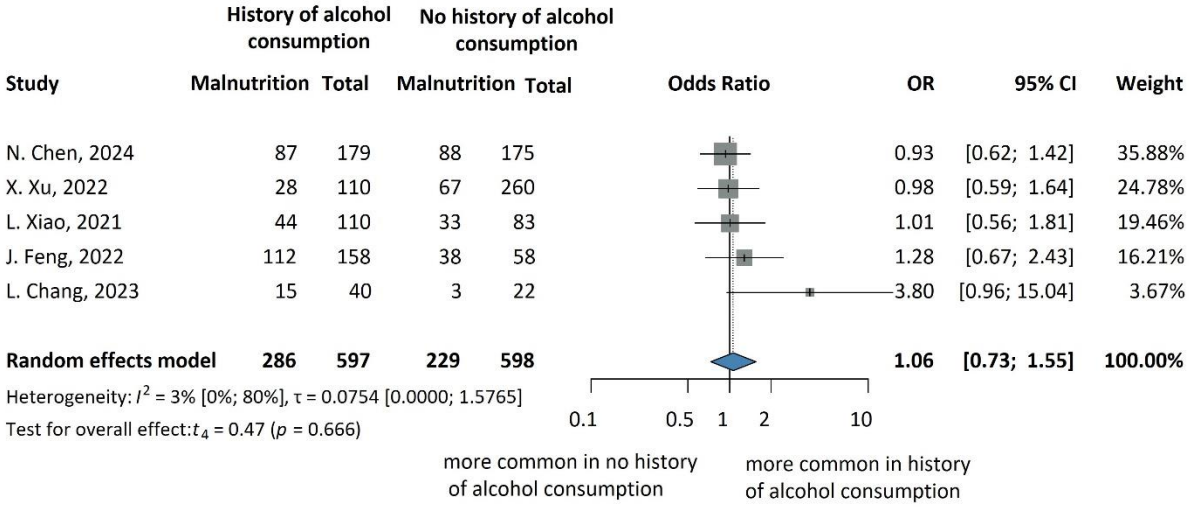


Figure S47.: Association between malnutrition-related complication risk and comorbidities in esophageal and gastric cancer (Biological composite scores)

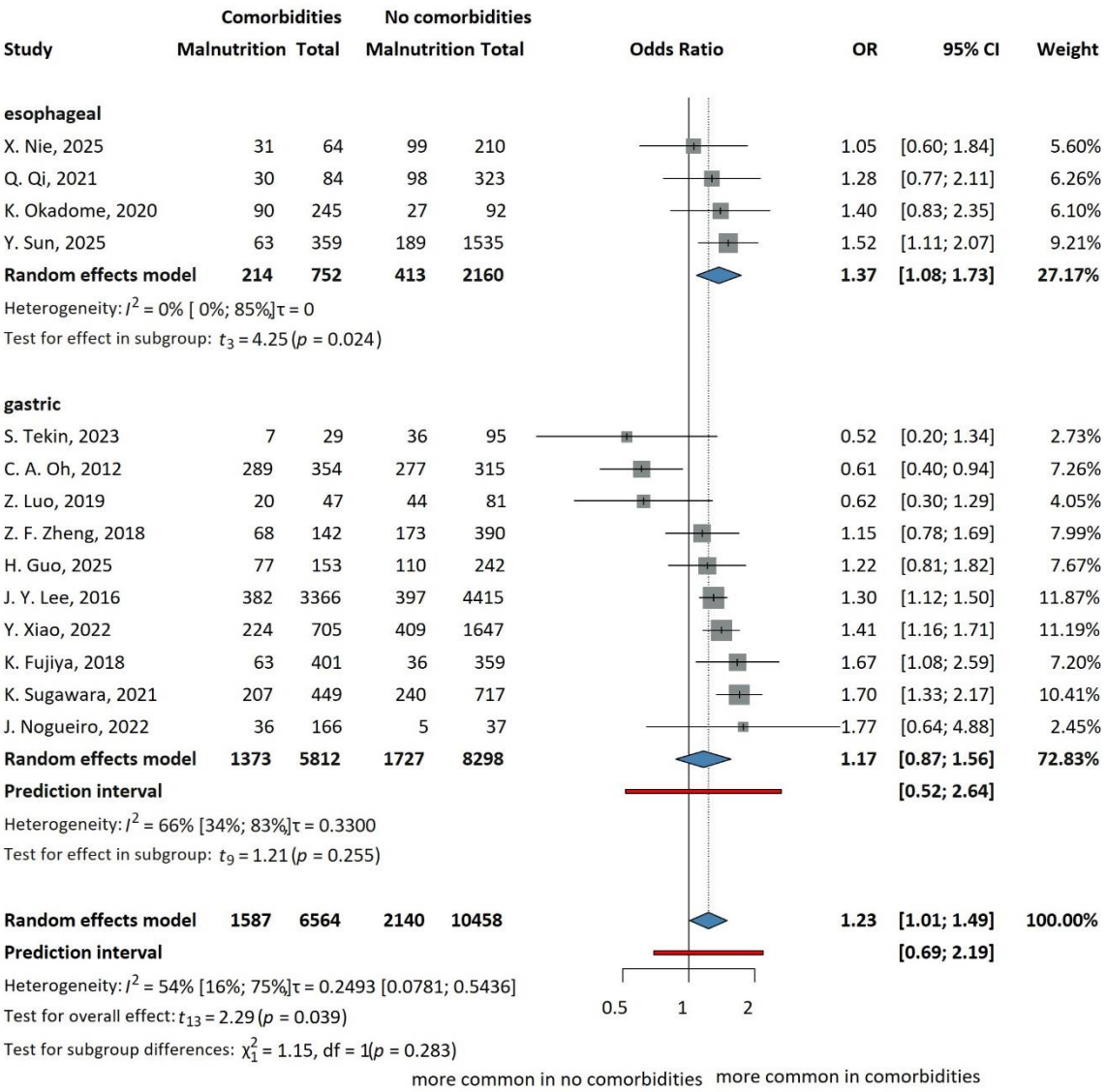
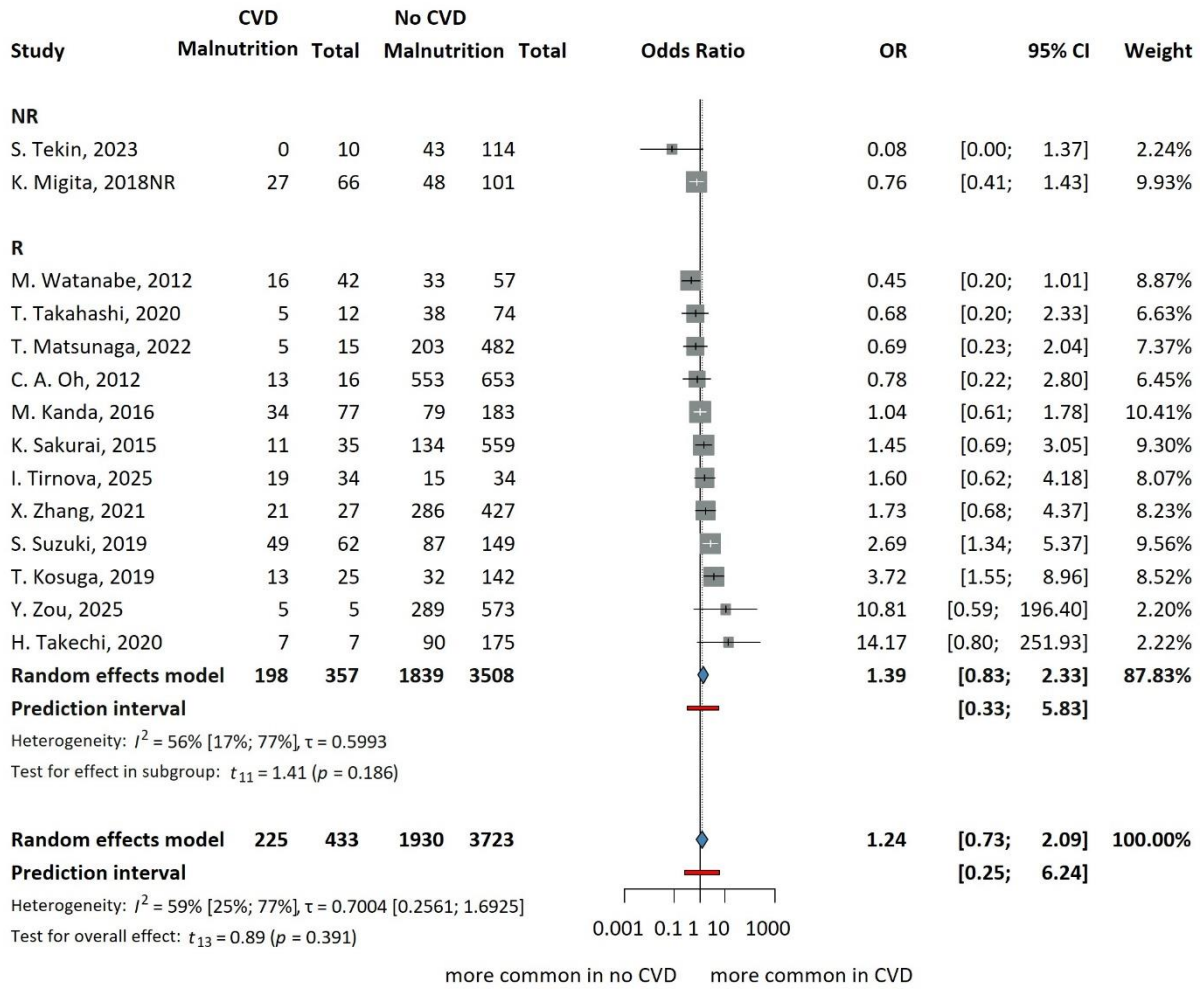
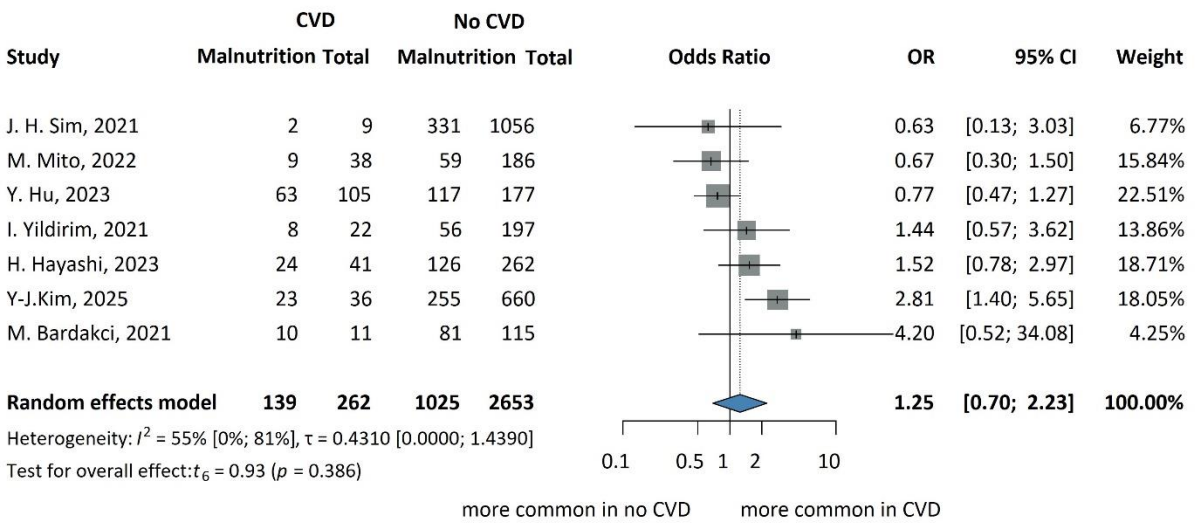


Figure S48.: Association between malnutrition-related complication risk and cardiovascular disease in gastric cancer (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable; CVD= cardiovascular diseases

Figure S49.: Association between malnutrition-related complication risk and cardiovascular disease in hepatobilio-pancreatic cancer (Biological composite scores)



Abbreviation: CVD= cardiovascular diseases

Figure S50.: Association between malnutrition-related complication risk and hypertension in gastrointestinal cancer [subgroup analysis for gastric and colorectal cancer] (Biological composite scores)

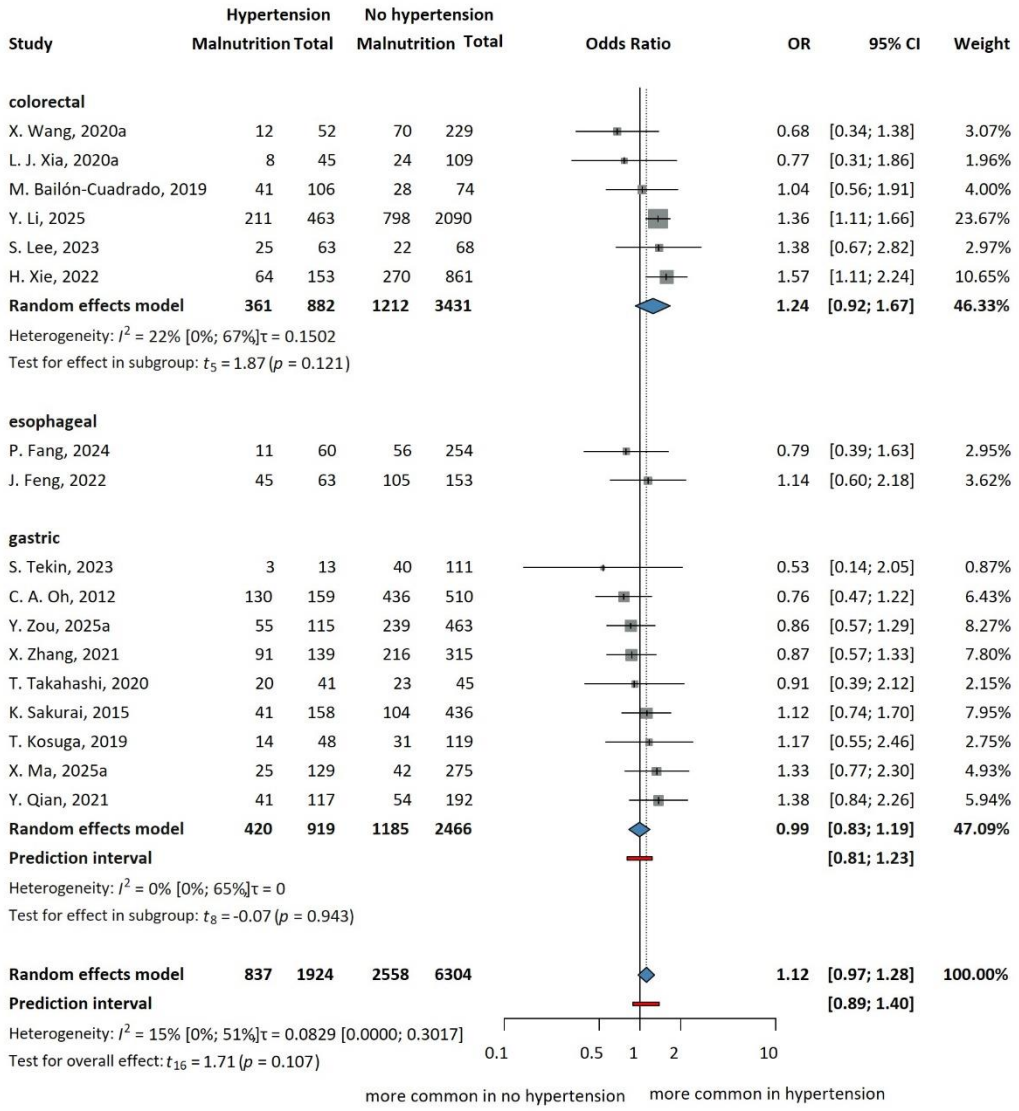


Figure S51.: Association between cachexia and hypertension in gastrointestinal cancer

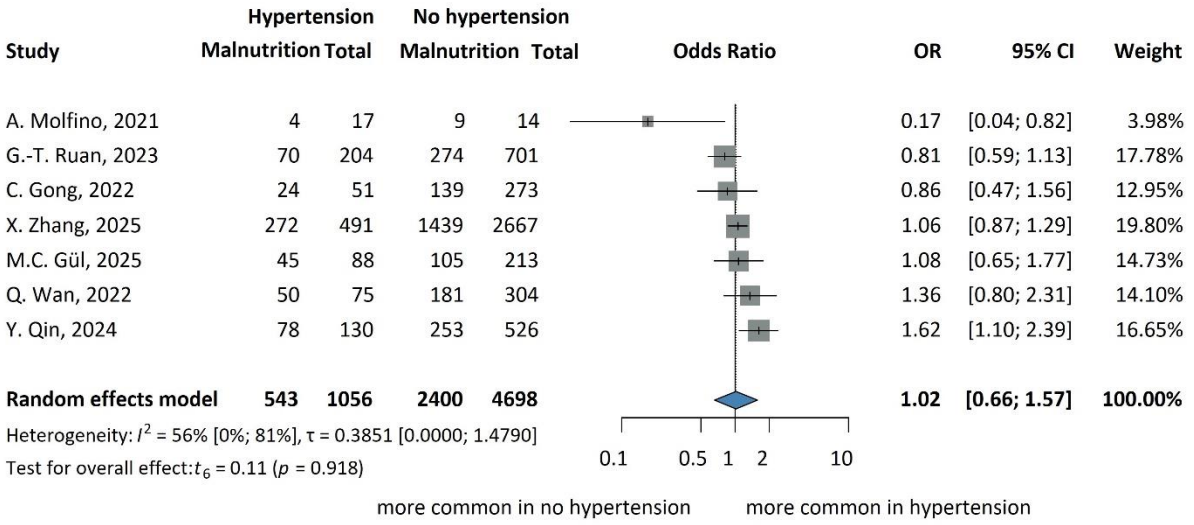
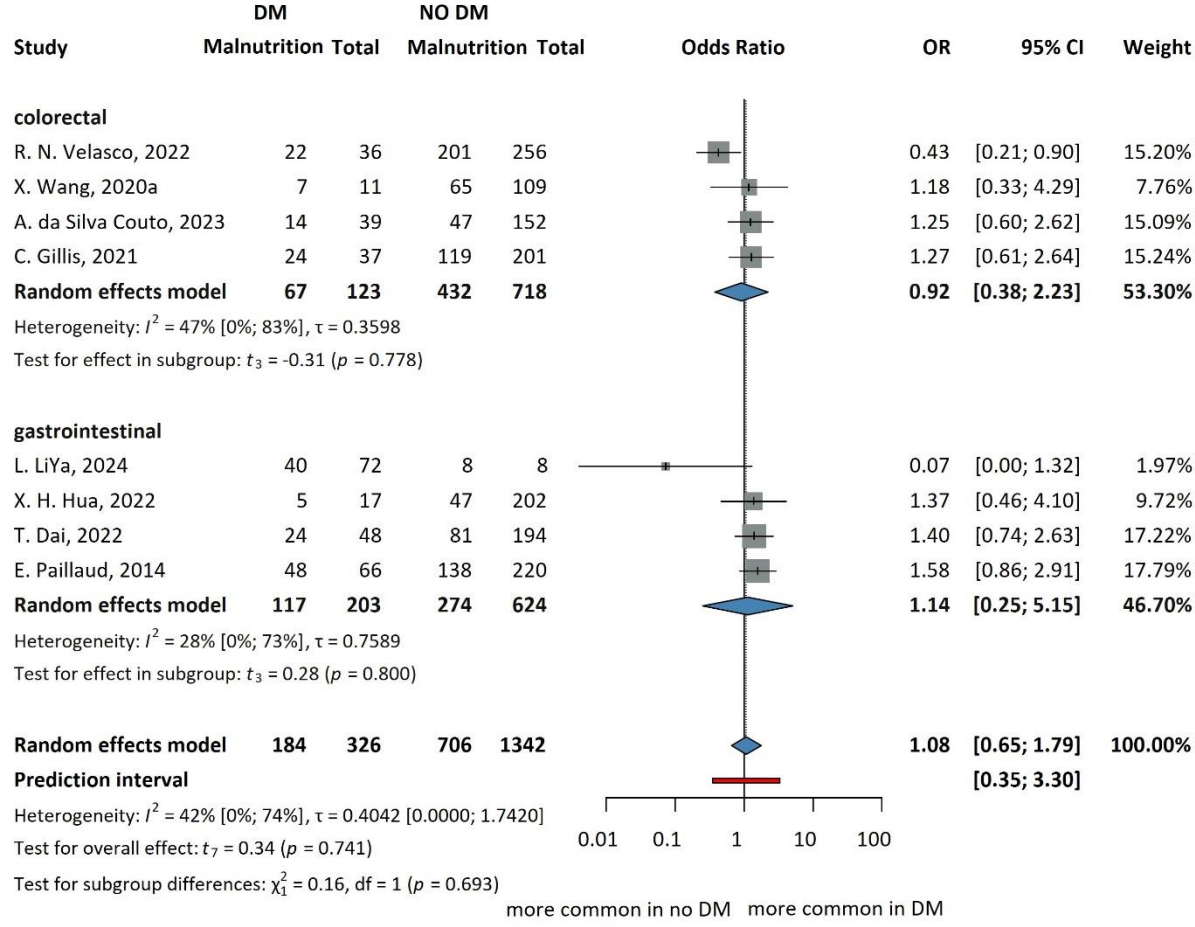
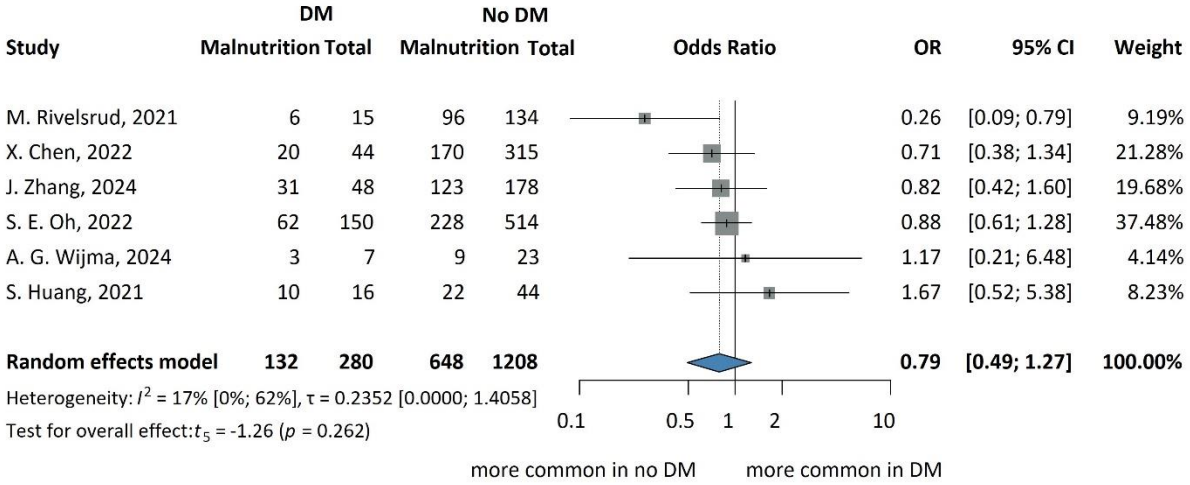


Figure S52.: Association between malnutrition risk and diabetes mellitus in gastrointestinal cancer [subgroup analysis for colorectal cancer] (Symptom-based risk assessment tool)



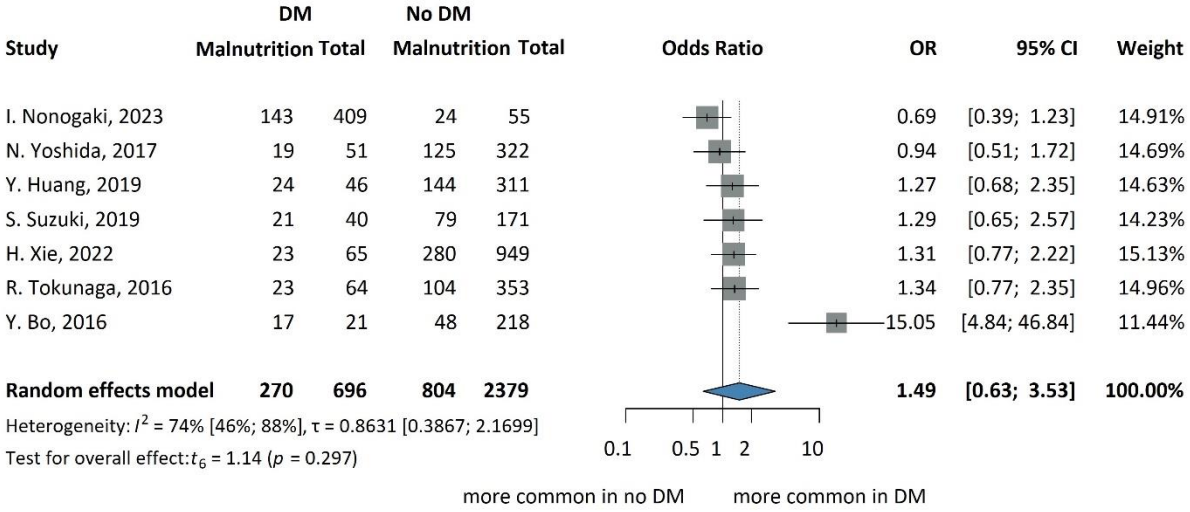
Abbreviation: DM= diabetes mellitus

Figure S53.: Association between malnutrition risk and diabetes mellitus in hepato-biliopancreatic cancer (Symptom-based risk assessment tool)



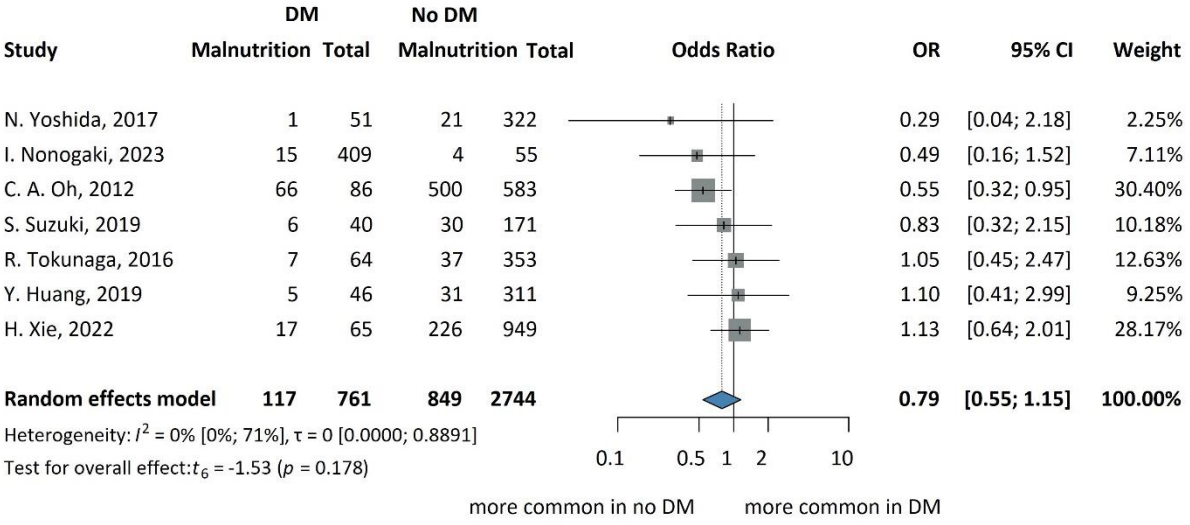
Abbreviation: DM= diabetes mellitus

Figure S54.: Association between mild severity of malnutrition-related complication risk and diabetes mellitus in gastrointestinal cancer (Biological composite scores)



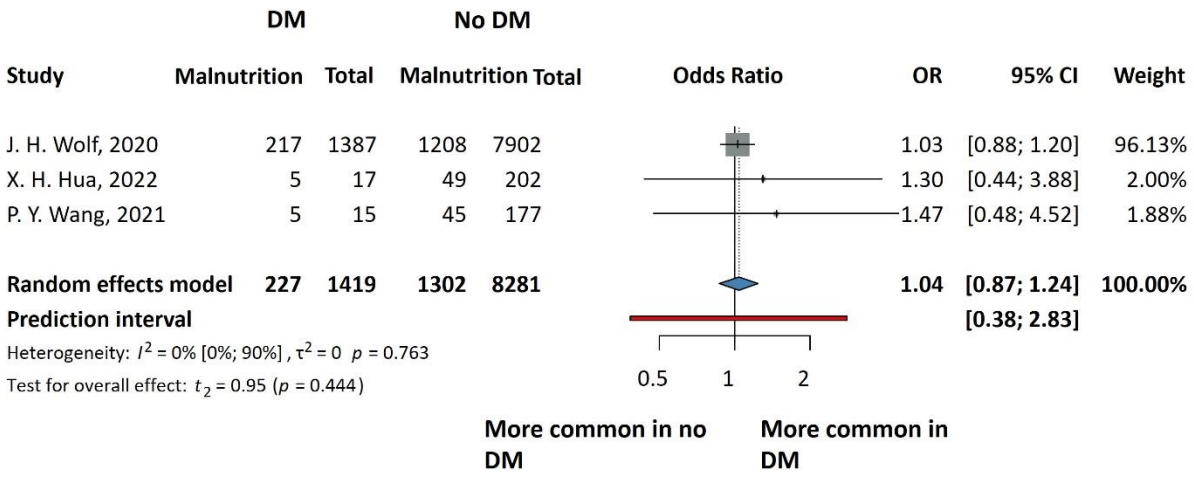
Abbreviation: DM= diabetes mellitus

Figure S55.: Association between moderate or severe severity of malnutrition-related complication risk and diabetes mellitus in gastrointestinal cancer (Biological composite scores)



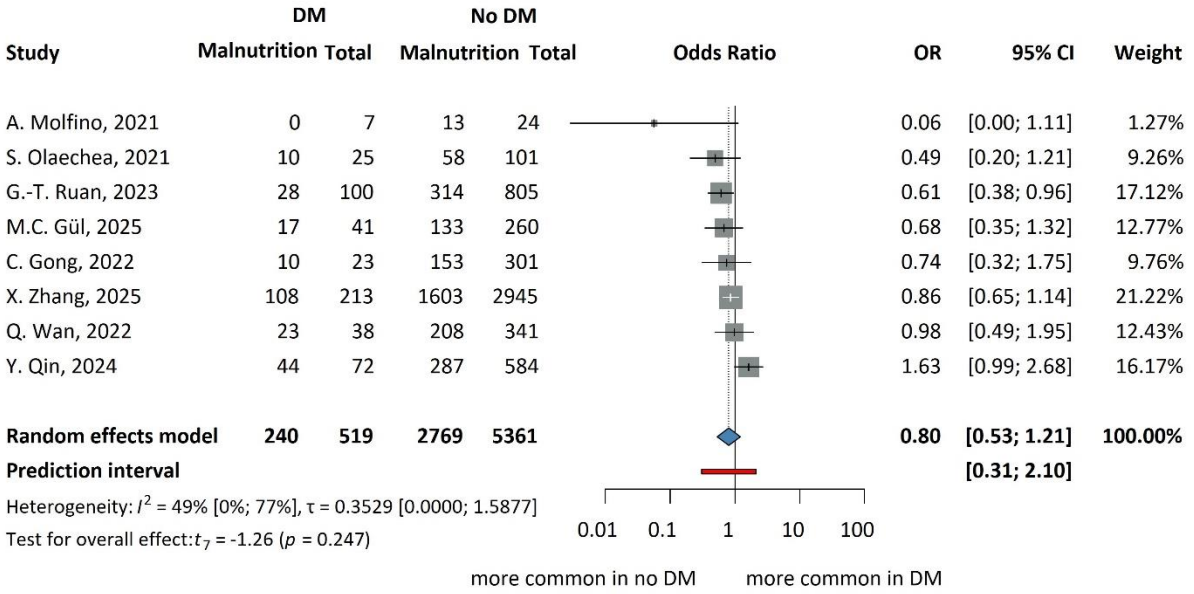
Abbreviation: DM= diabetes mellitus

Figure S56.: Association between malnutrition diagnosis and diabetes mellitus in gastrointestinal cancer (guidelines)



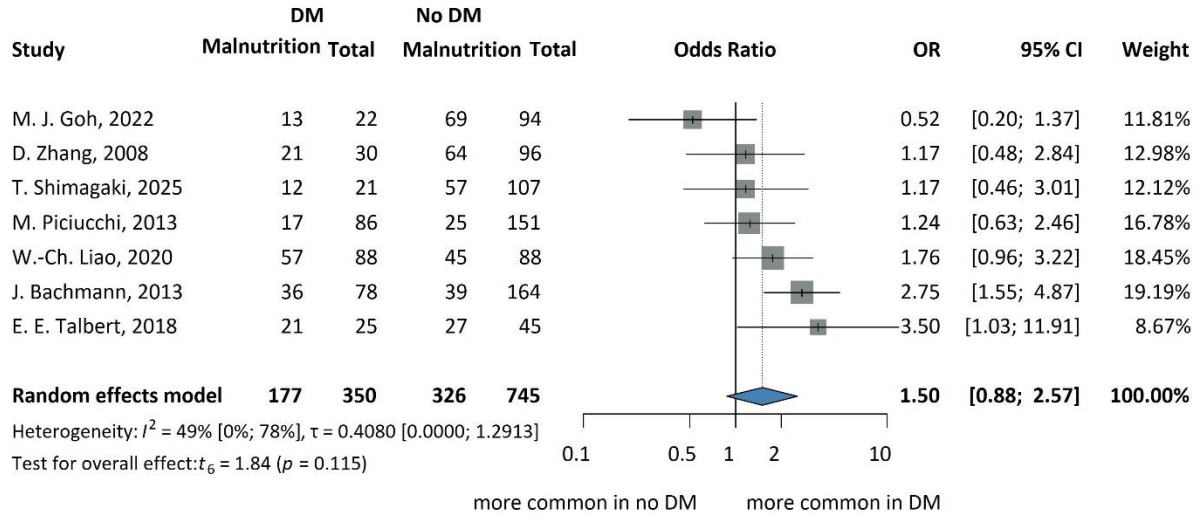
Abbreviation: DM= diabetes mellitus

Figure S57.: Association between cachexia and diabetes mellitus in gastrointestinal cancer



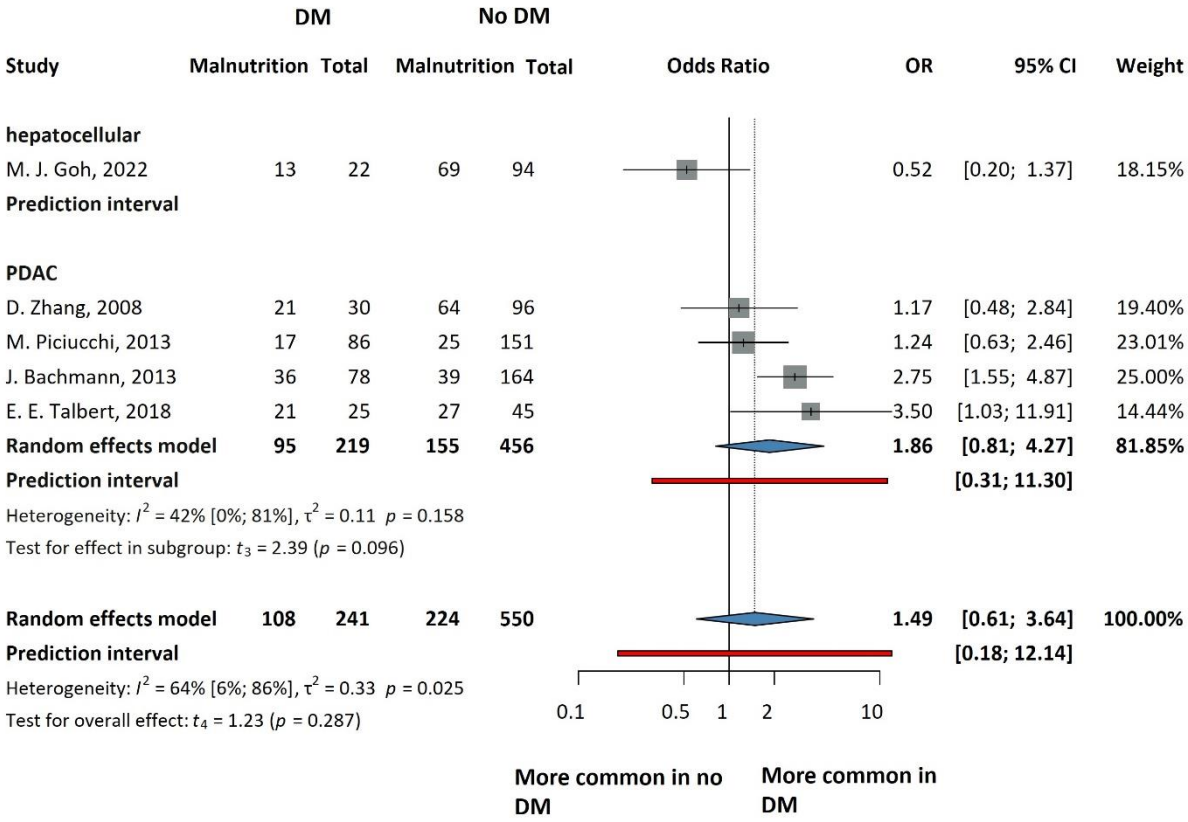
Abbreviation: DM= diabetes mellitus

Figure S58.: Association between cachexia and diabetes mellitus in hepato-biliopancreatic cancer



Abbreviation: DM= diabetes mellitus

Figure S59.: Association between cachexia and diabetes mellitus in pancreatic ductal adenocarcinoma



Abbreviation: DM= diabetes mellitus; PDAC= pancreatic ductal adenocarcinoma

Figure S60.: Association between malnutrition risk and chronic kidney disease in gastrointestinal cancer (Symptom-based risk assessment tool)

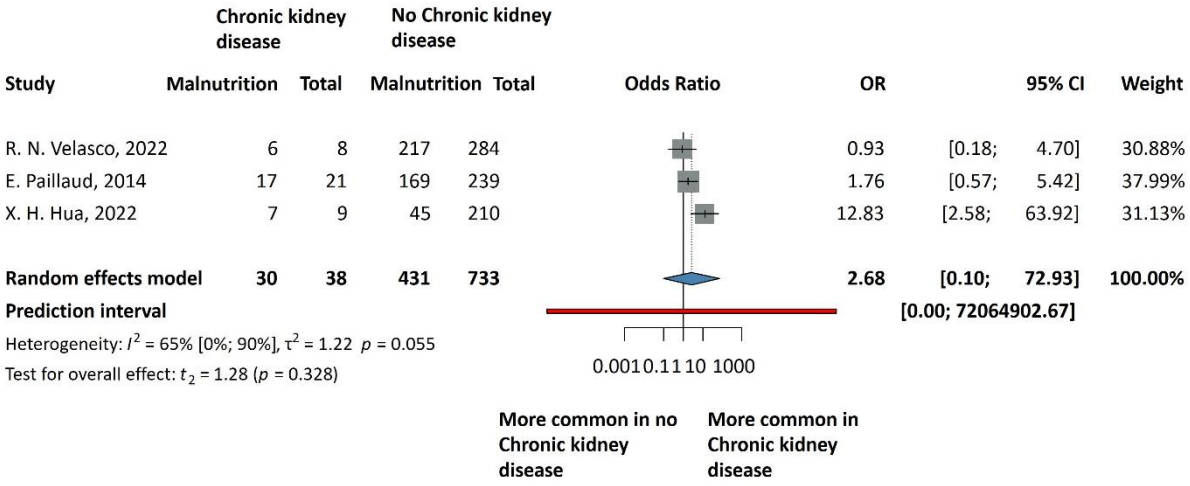
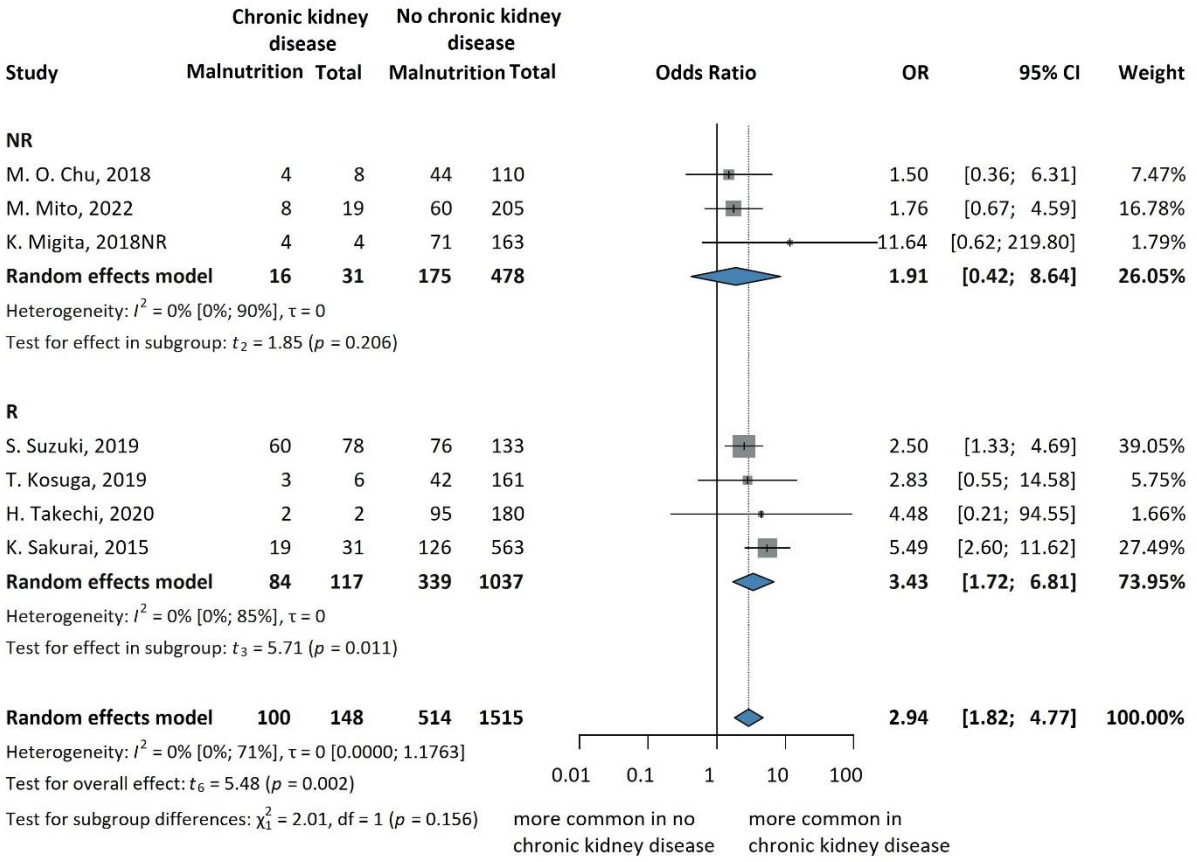


Figure S61.: Association between malnutrition-related complication risk and chronic kidney disease in gastrointestinal cancer (Biological composite scores)



Abbreviation: R= resectable; NR= non-resectable

Figure S62.: Association between malnutrition-related complication risk and chronic respiratory disease in gastrointestinal cancer (Biological composite scores)

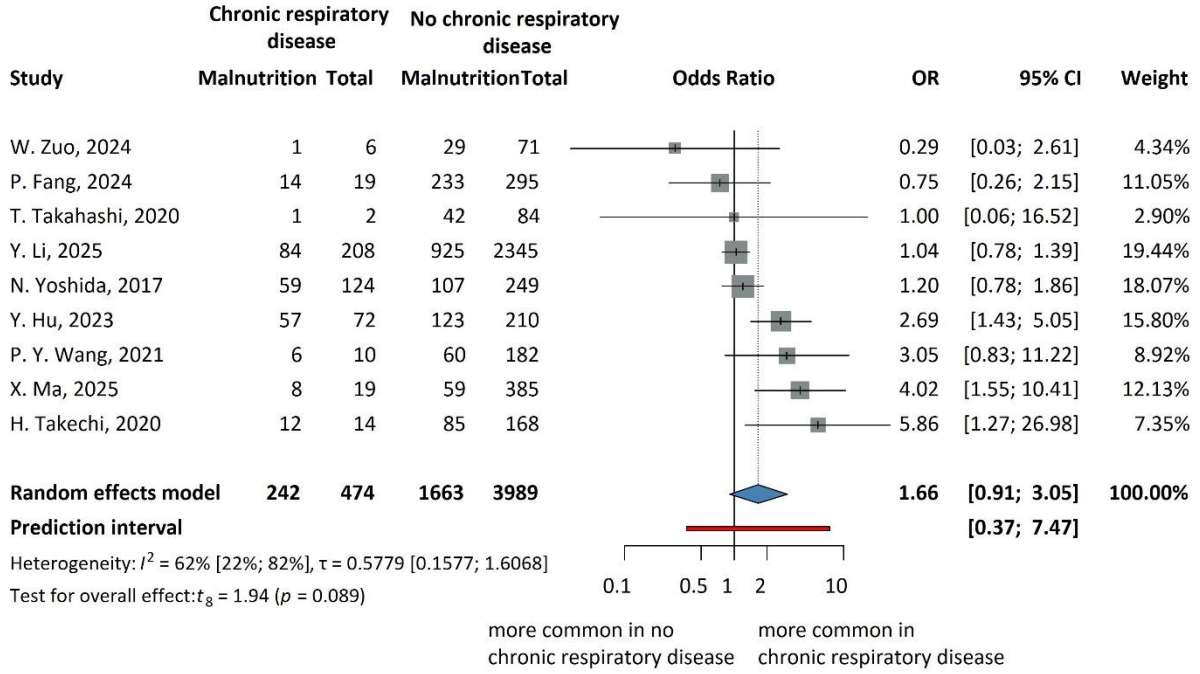


Figure S63.: Association between malnutrition diagnosis and chronic respiratory disease in gastrointestinal cancer (guidelines)

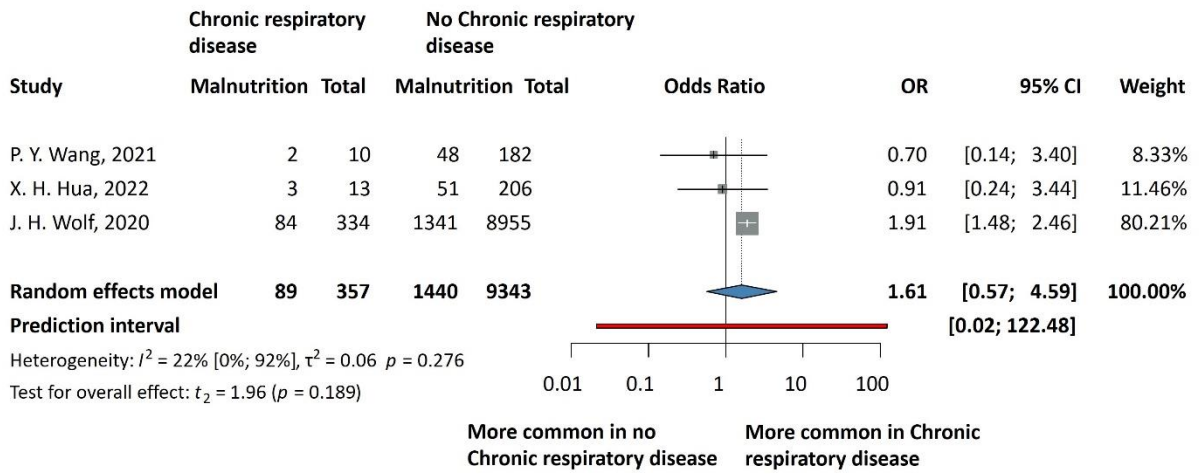
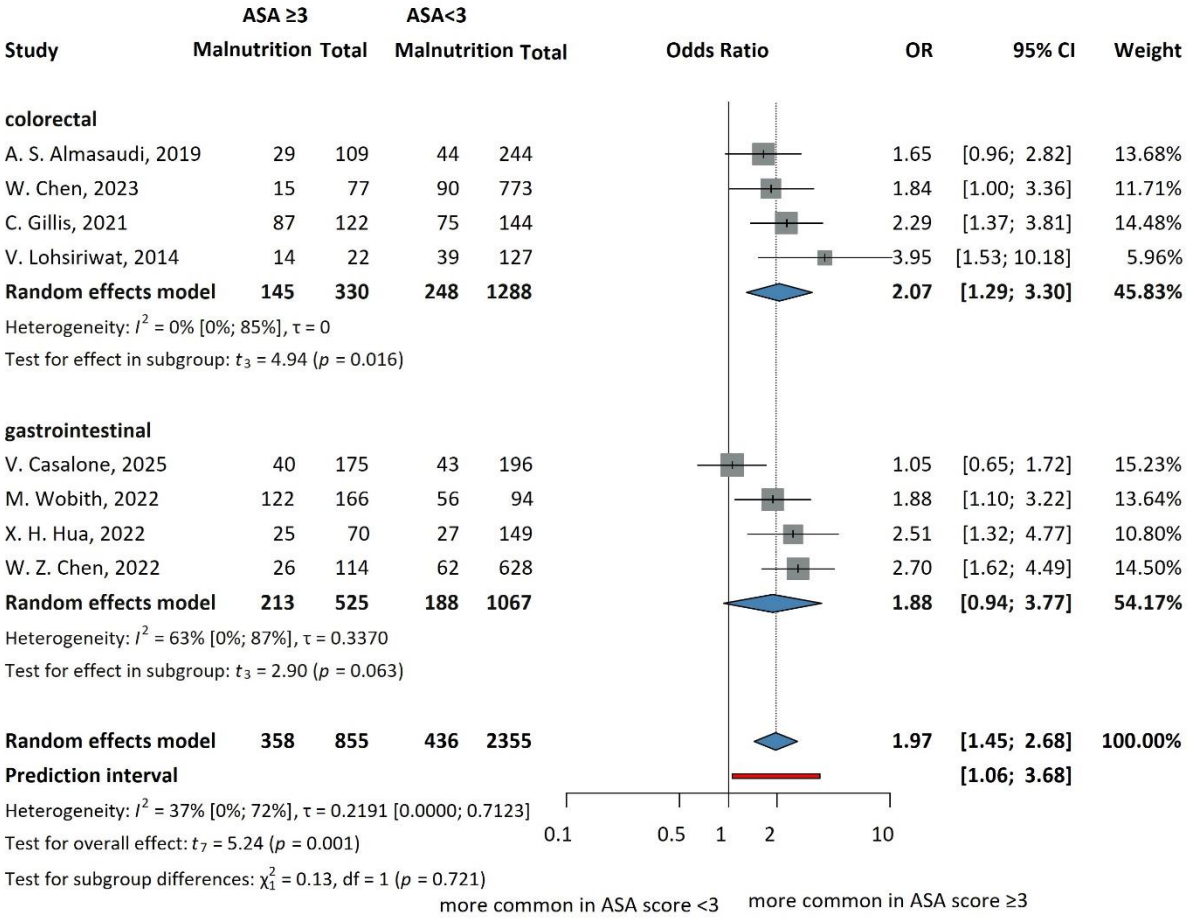
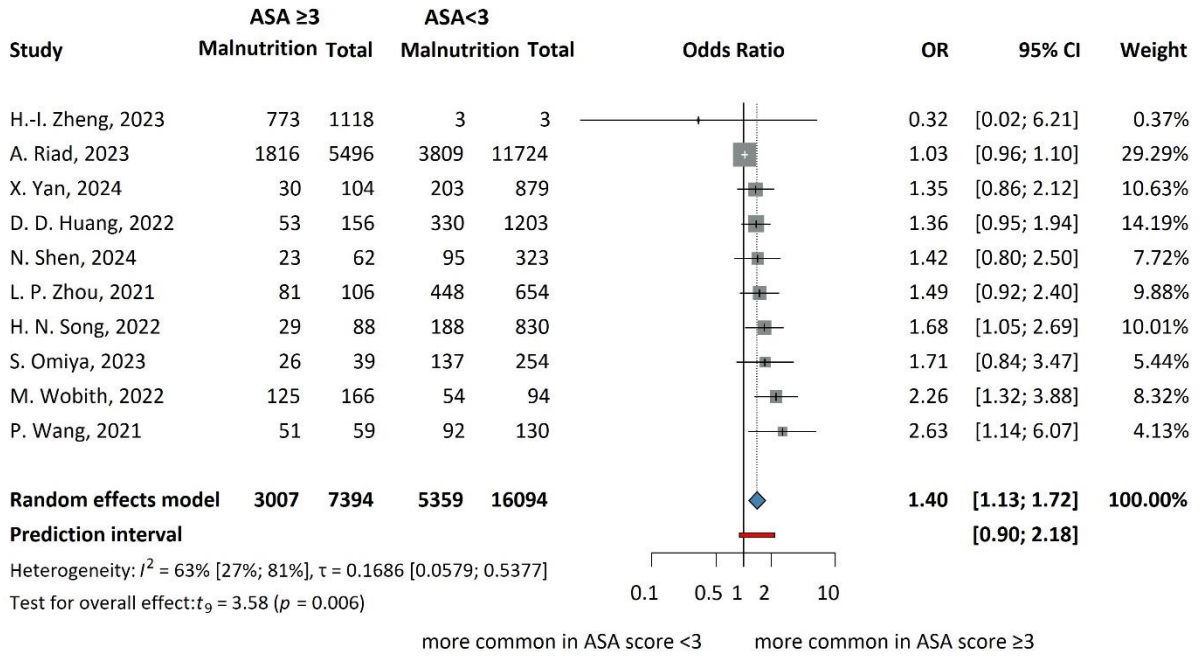


Figure S64.: Association between malnutrition risk and ASA score in gastrointestinal cancer [subgroup analysis for colorectal cancer] (Symptom-based risk assessment tool)



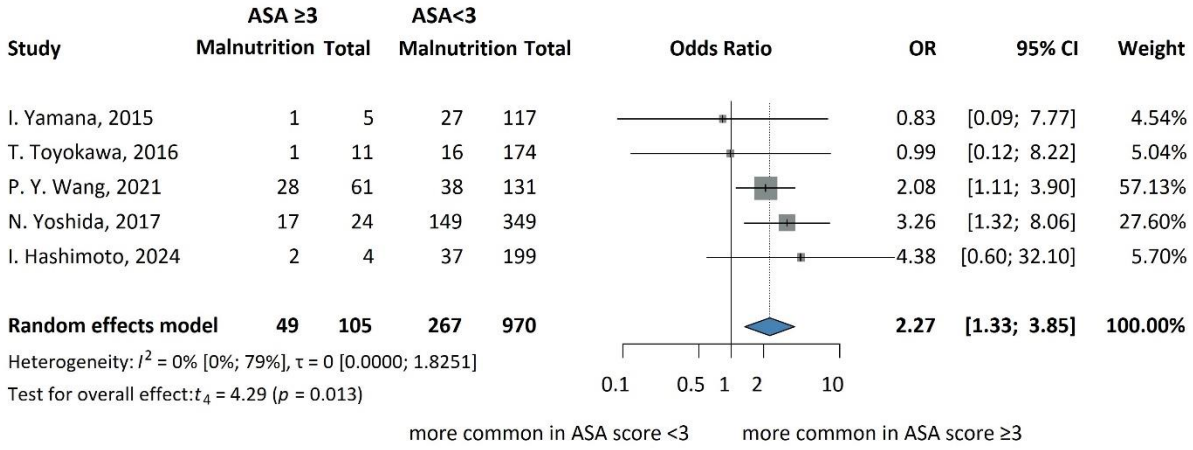
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S65.: Association between malnutrition diagnosis and ASA score in gastrointestinal cancer (GLIM criteria)



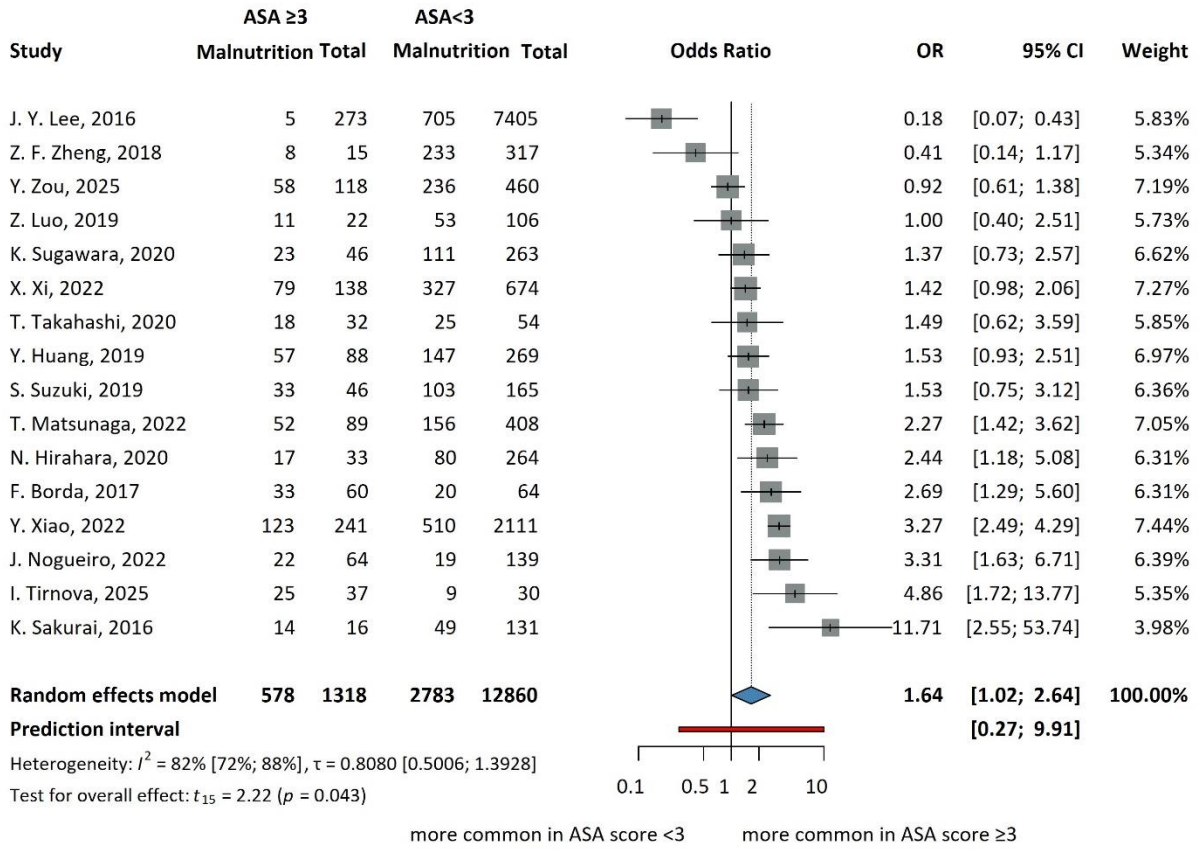
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S66.: Association between malnutrition-related complication risk and ASA score in esophageal cancer (Biological composite scores)



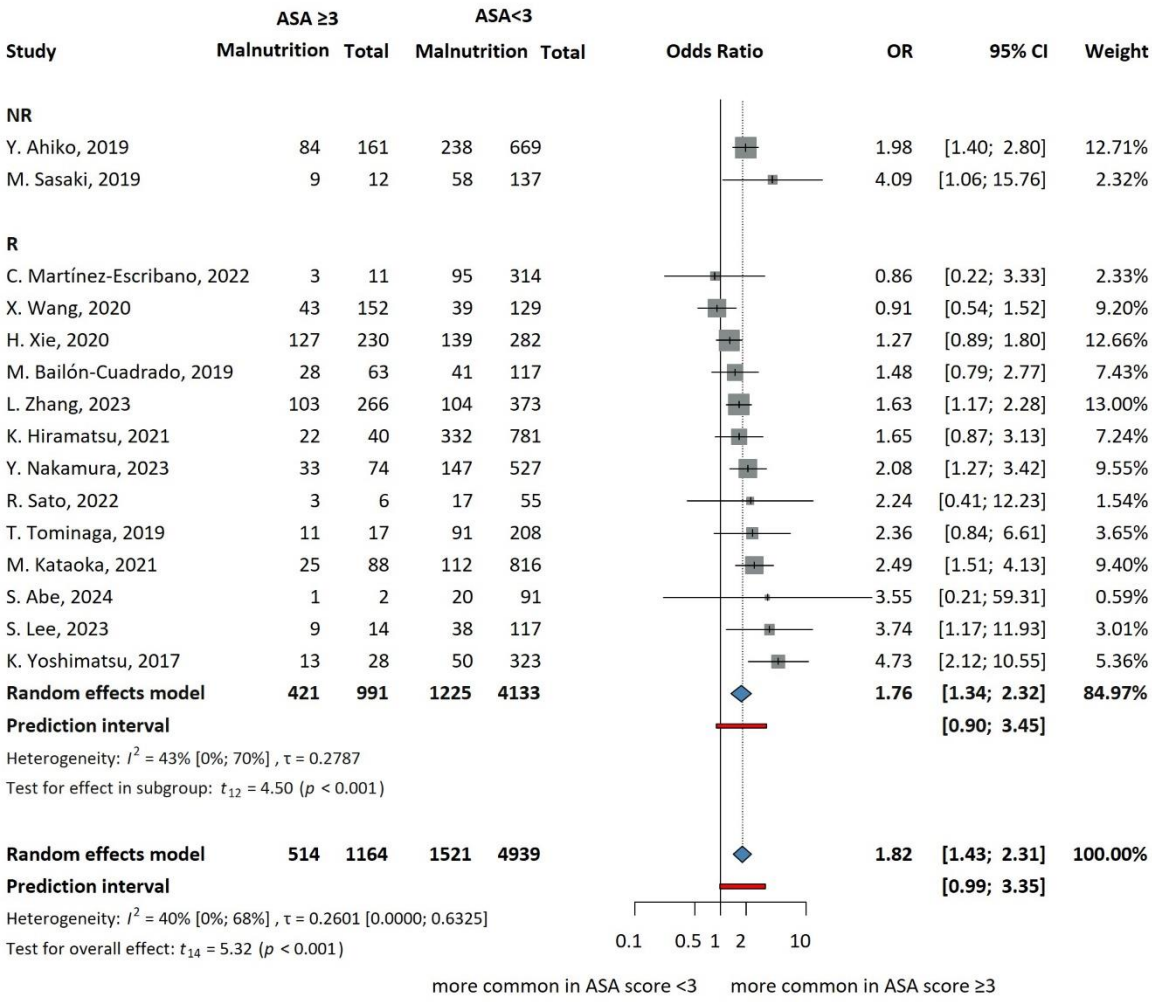
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S67.: Association between malnutrition-related complication risk and ASA score in gastric cancer (Biological composite scores)



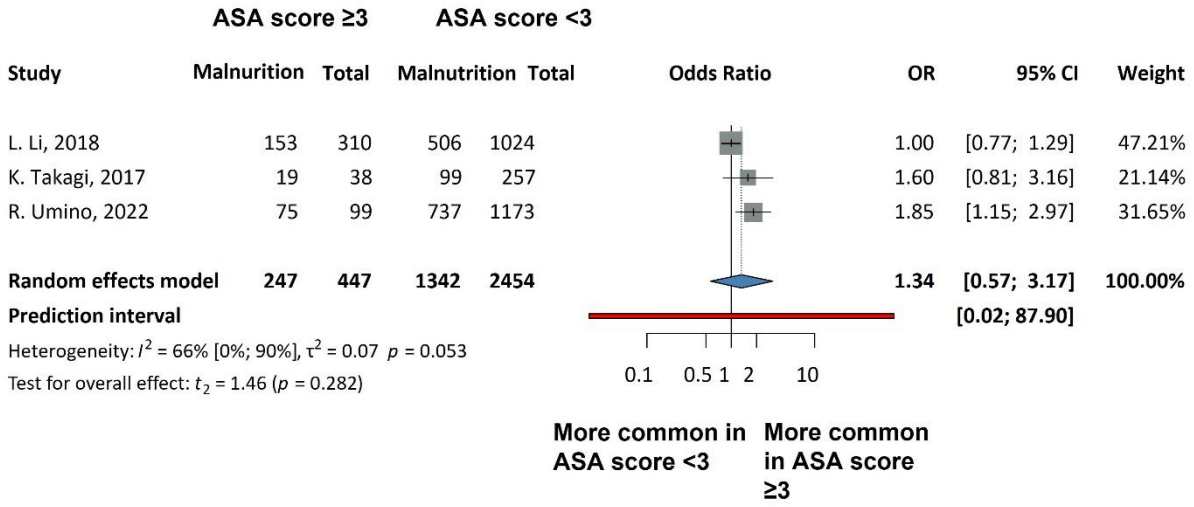
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S68.: Association between malnutrition-related complication risk and ASA score in colorectal cancer (Biological composite scores)



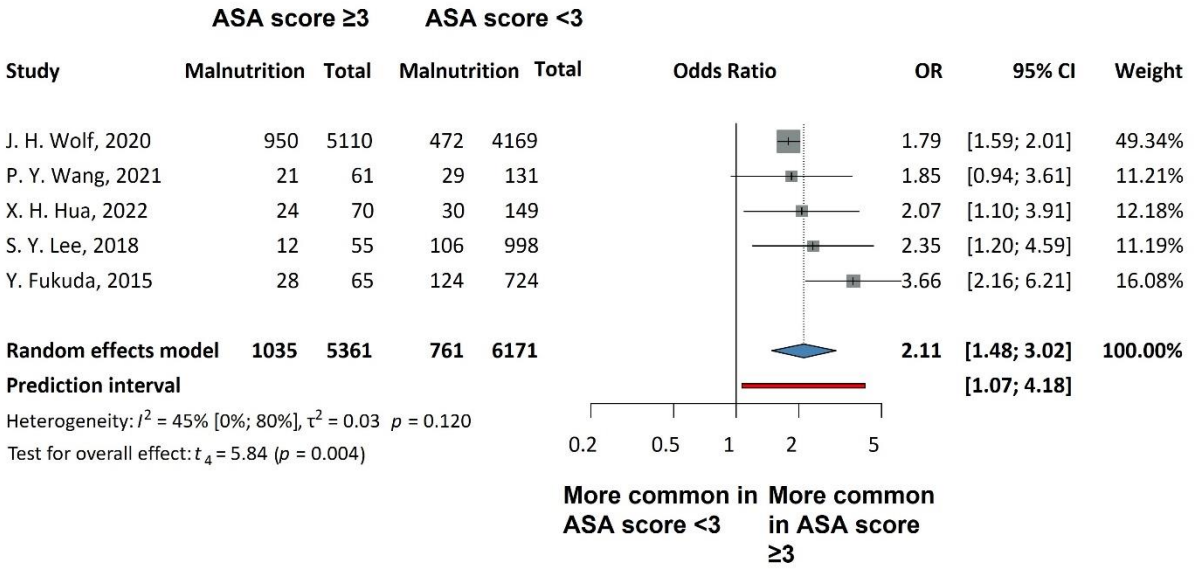
Abbreviation: ASA= American Society of Anesthesiologists Physical Status; R= resectable; NR= non-resectable

Figure S69.: Association between malnutrition-related complication risk and ASA score in hepatocellular carcinoma (Biological composite scores)



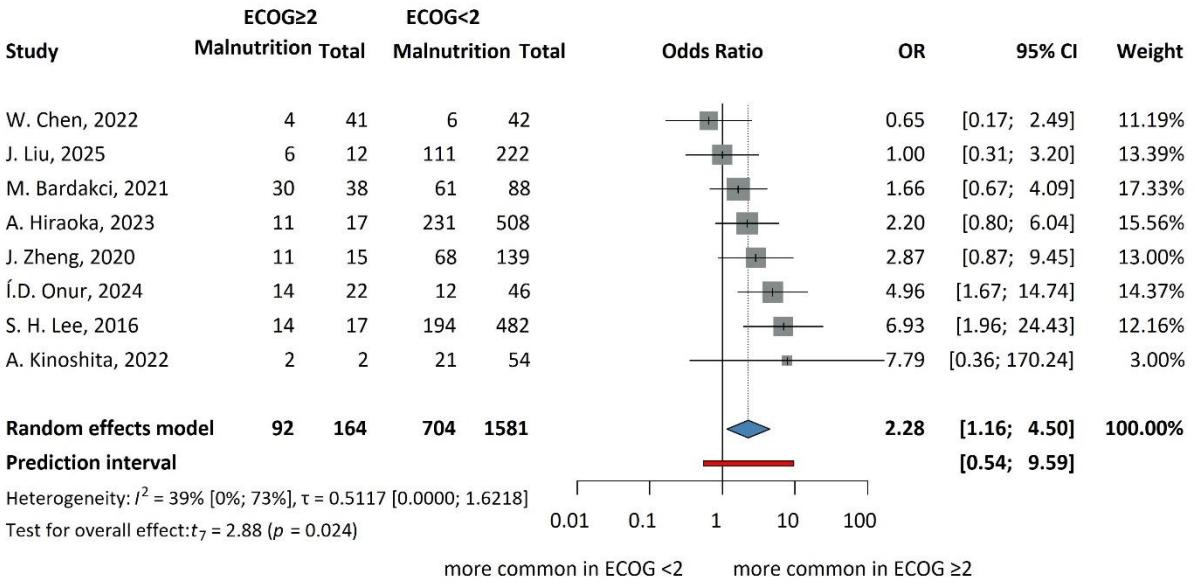
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S70.: Association between malnutrition diagnosis and ASA score in gastrointestinal cancer (guidelines)



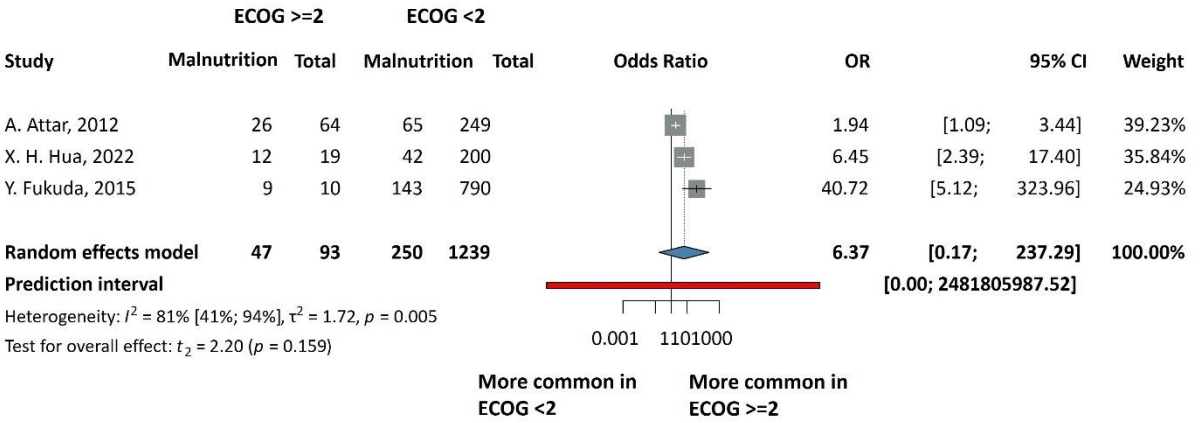
Abbreviation: ASA= American Society of Anesthesiologists Physical Status

Figure S71.: Association between ECOG >=2 and malnutrition-related complication risk in hepato-biliopancreatic cancer patients (Biological composite scores)



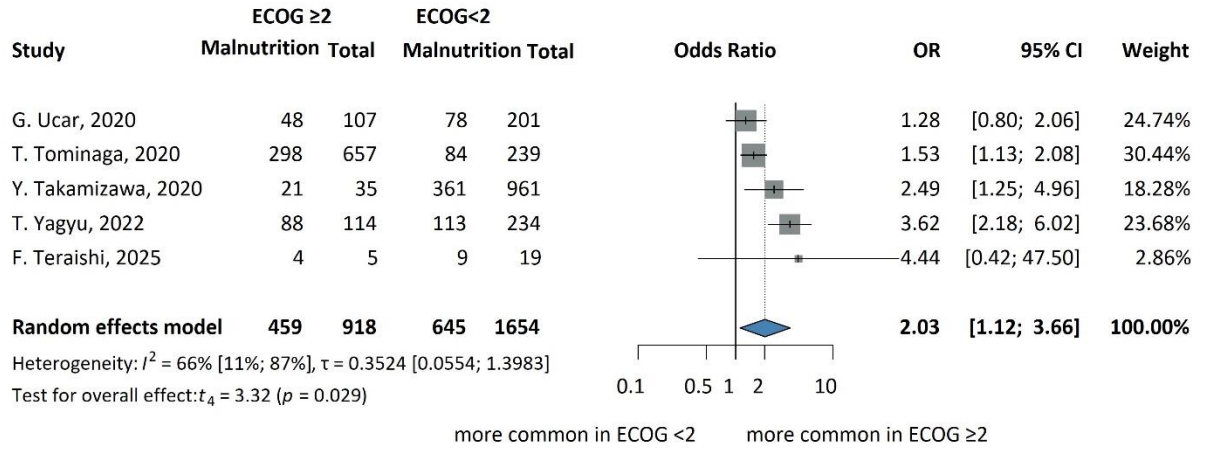
Abbreviations: ECOG= Eastern Cooperative Oncology Group

Figure S72.: Association between ECOG >=2 and malnutrition diagnosis in gastrointestinal cancer (guideline)



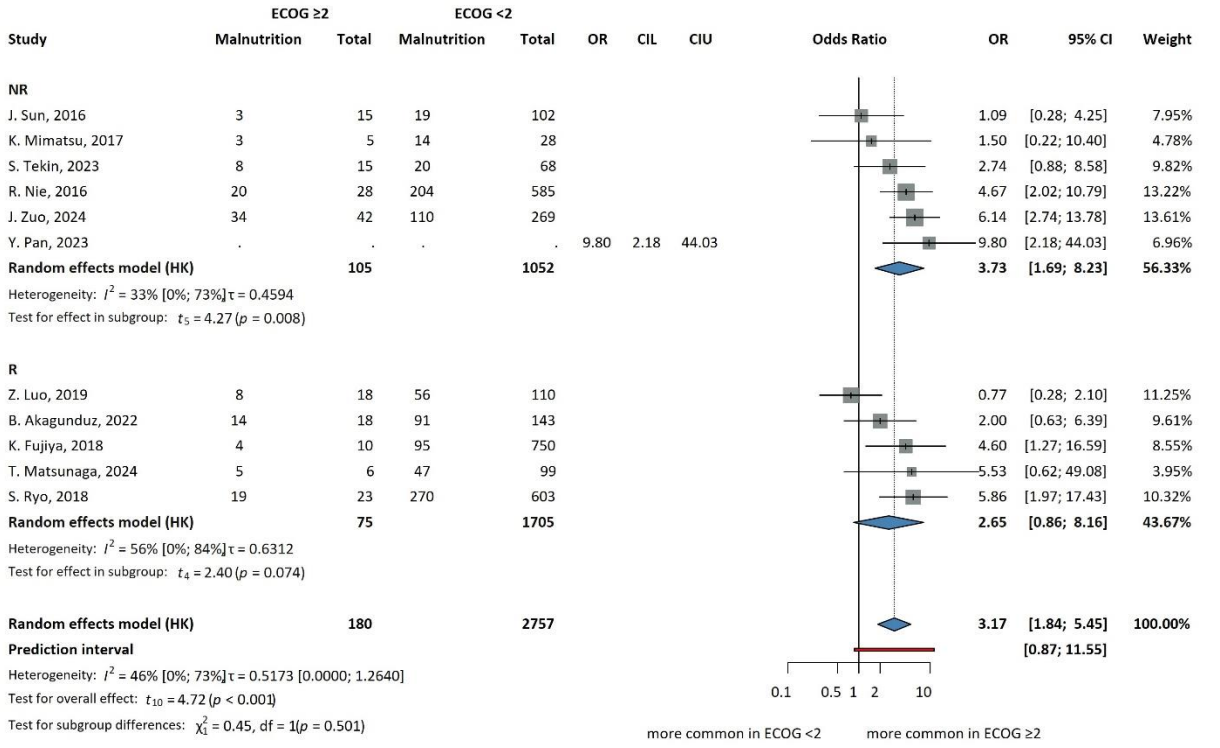
Abbreviations: ECOG= Eastern Cooperative Oncology Group

Figure S73.: Association between ECOG >=2 and malnutrition-related complication risk in colorectal patients (Biological composite scores)



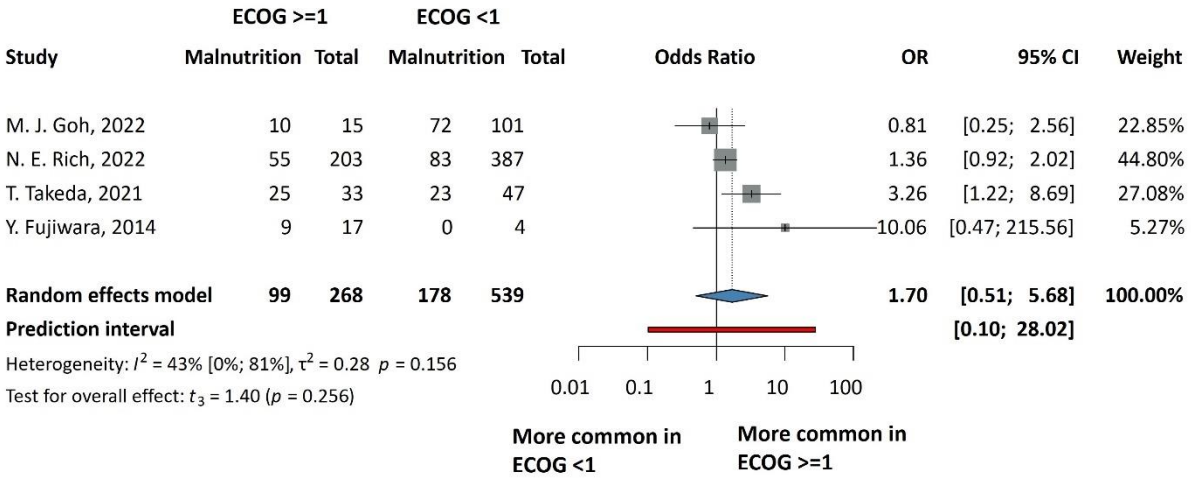
Abbreviations: ECOG= Eastern Cooperative Oncology Group

Figure S74.: Association between ECOG >=2 and malnutrition-related complication risk in gastric patients (Biological composite scores)



Abbreviations: ECOG= Eastern Cooperative Oncology Group; R= resectable; NR= non-resectable

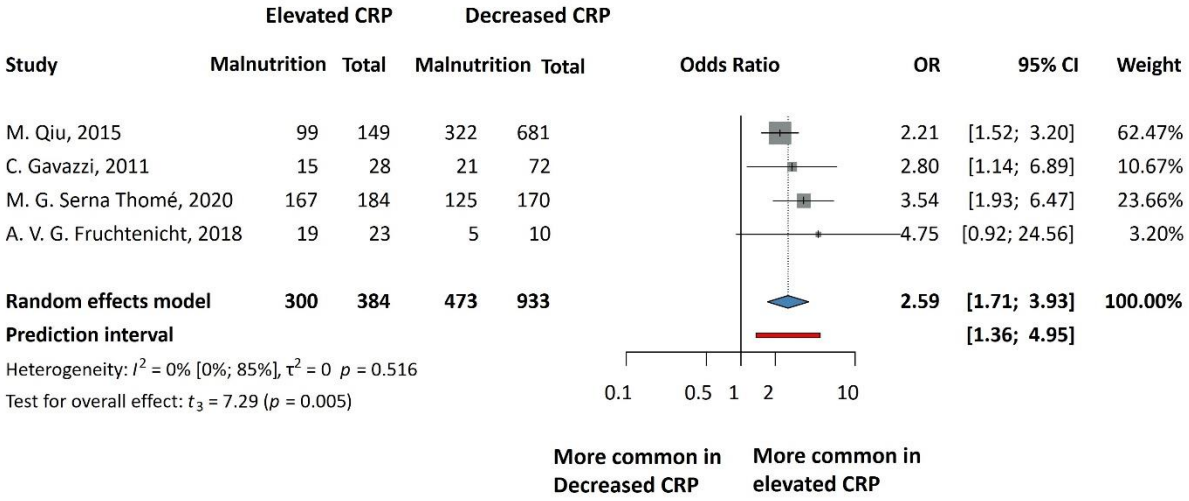
Figure S75.: Association between ECOG >=1 and cachexia in HBP patients



Abbreviations: ECOG= Eastern Cooperative Oncology Group

Supplementary Document S11: Individual forest plots for inflammation and other biological parameters: Figure S76-S96

Figure S76.: Association between malnutrition risk and serum CRP level in gastrointestinal cancer (Symptom-based risk assessment tool)



Abbreviations: CRP= C-reactive protein

Figure S77.: Association between malnutrition-related complication risk and serum lymphocyte count in gastrointestinal/gastric cancer (Biological composite scores)

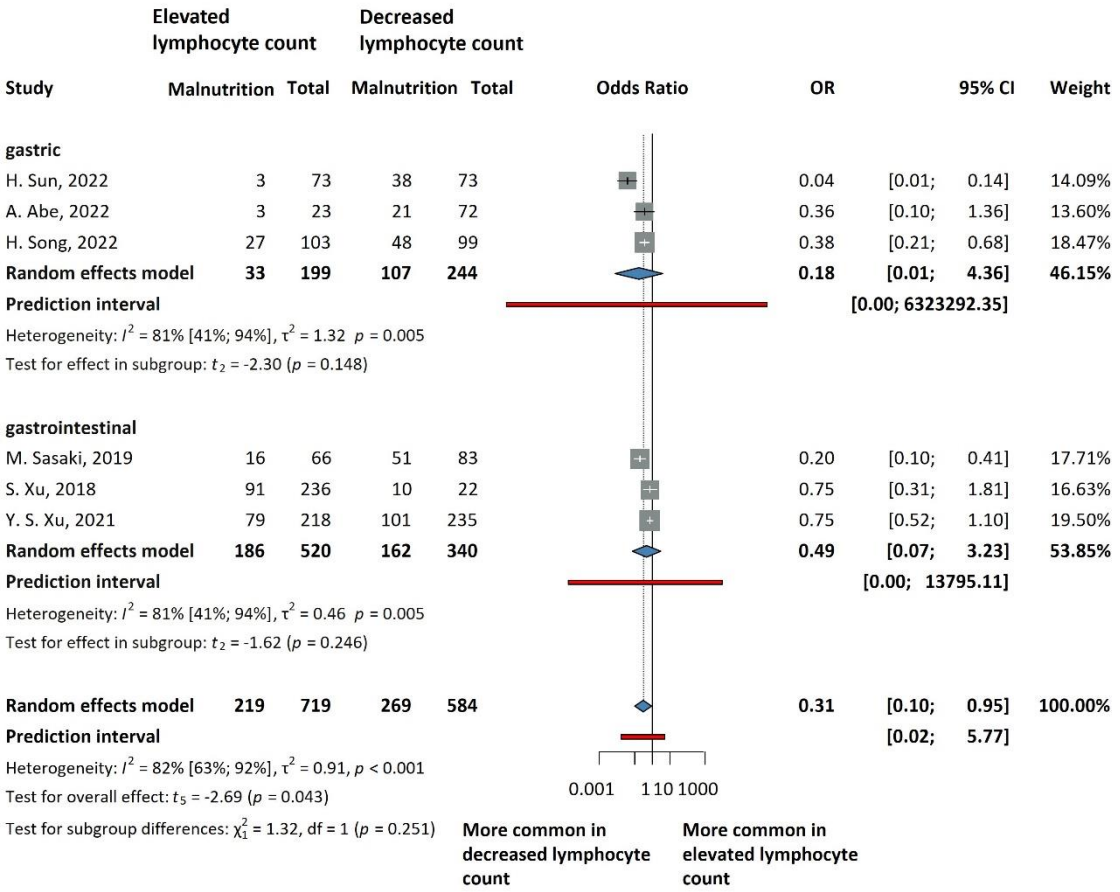


Figure S78.: Association between malnutrition-related complication risk and serum lymphocyte count in gastrointestinal cancer (Biological composite scores)

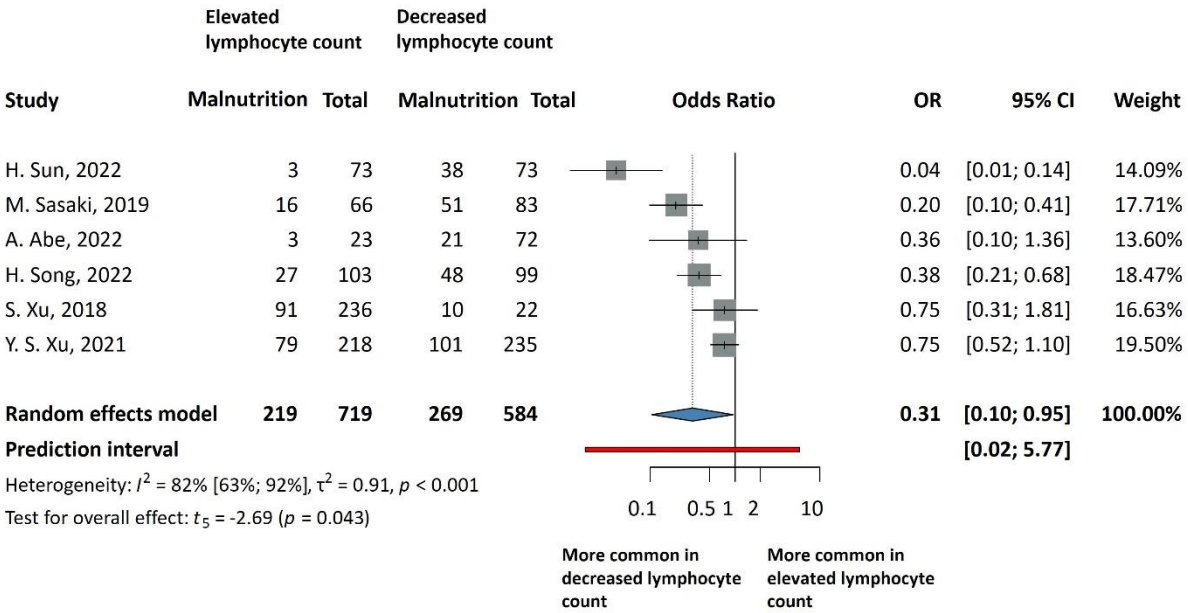


Figure S79.: Association between malnutrition-related complication risk and serum lymphocyte-monocyte ratio in gastrointestinal cancer (Biological composite scores)

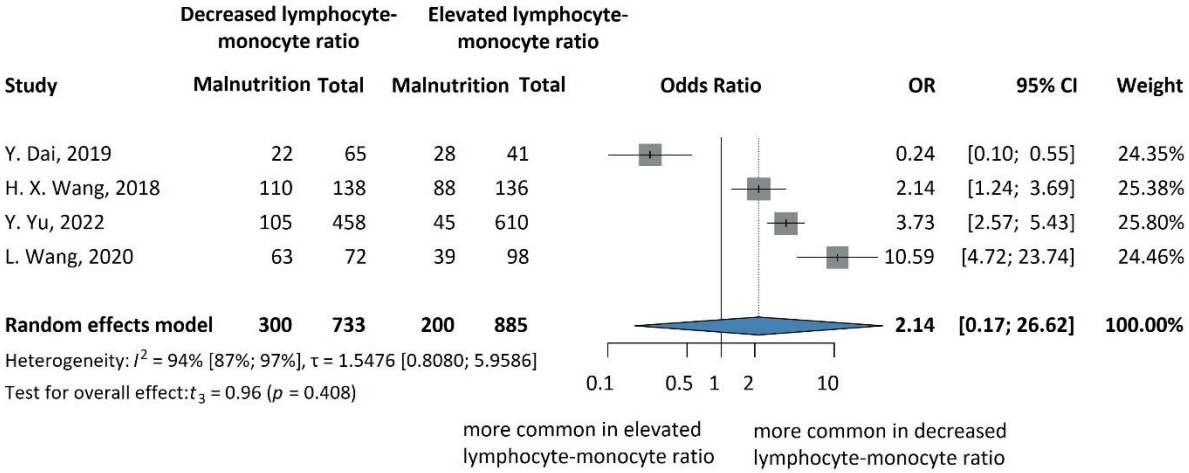


Figure S80.: Association between malnutrition-related complication risk and serum neutrophil-lymphocyte ratio in esophageal cancer (Biological composite scores)

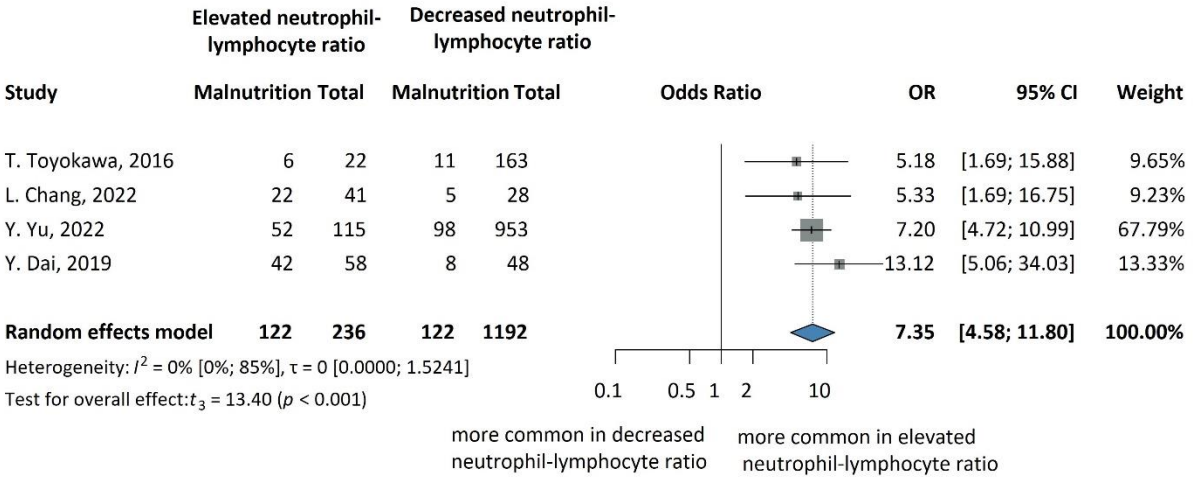


Figure S81.: Association between malnutrition-related complication risk and serum neutrophil-lymphocyte ratio in gastric cancer (Biological composite scores)

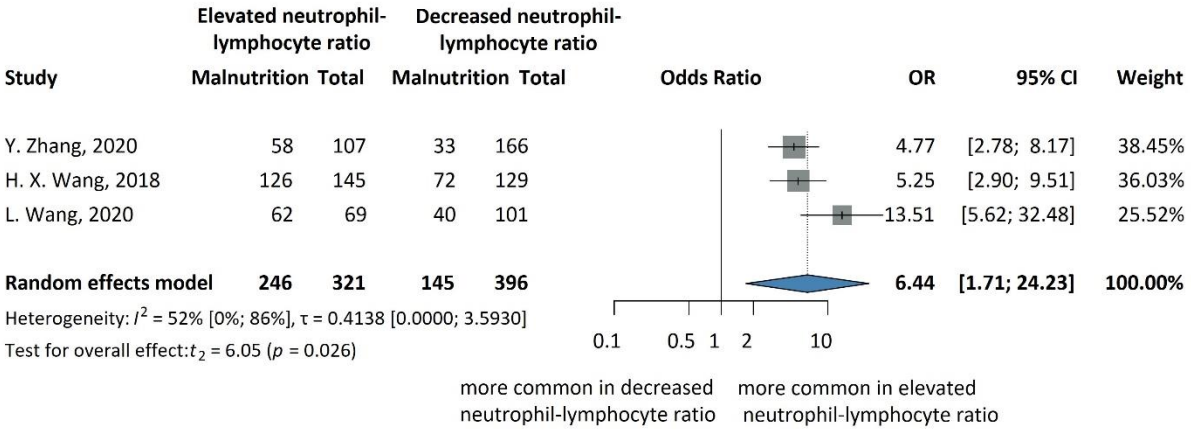


Figure S82.: Association between malnutrition-related complication risk and serum neutrophil-lymphocyte ratio in colorectal cancer (Biological composite scores)

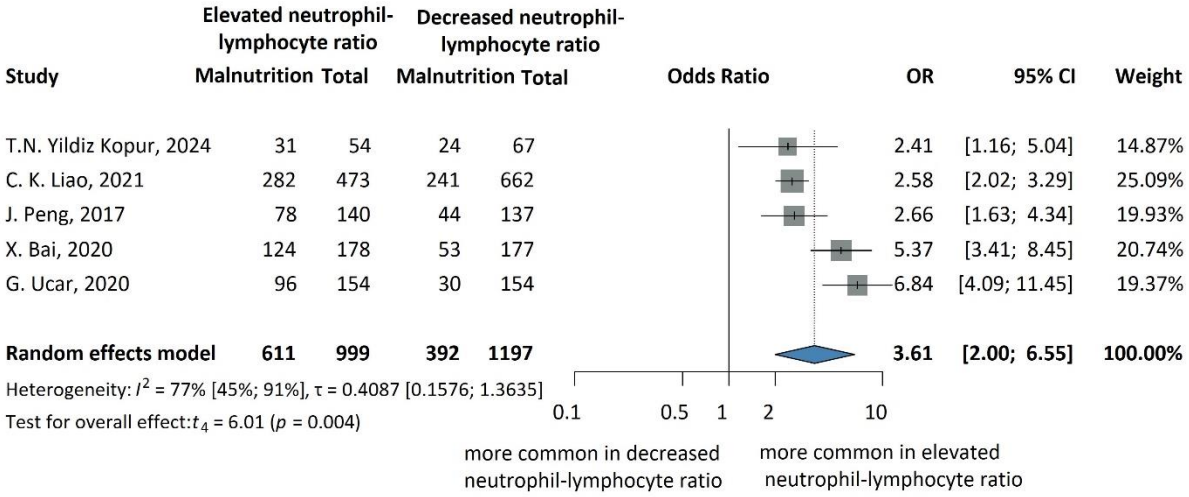


Figure S83.: Association between malnutrition-related complication risk and serum platelet-lymphocyte ratio in upper gastrointestinal cancer (Biological composite scores)

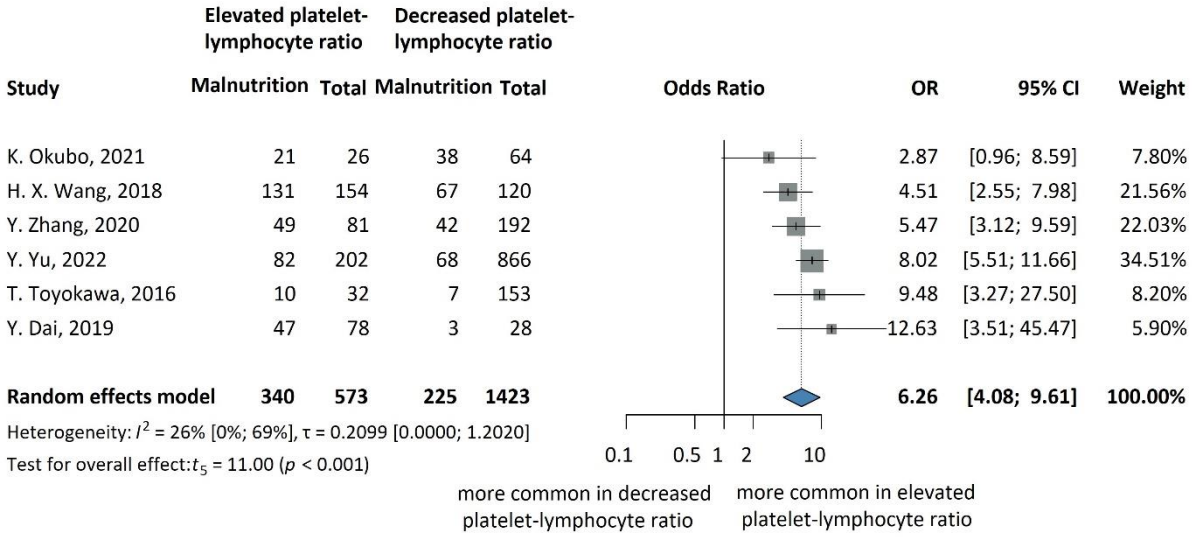


Figure S84.: Association between malnutrition-related complication risk and serum platelet-lymphocyte ratio in colorectal cancer (Biological composite scores)

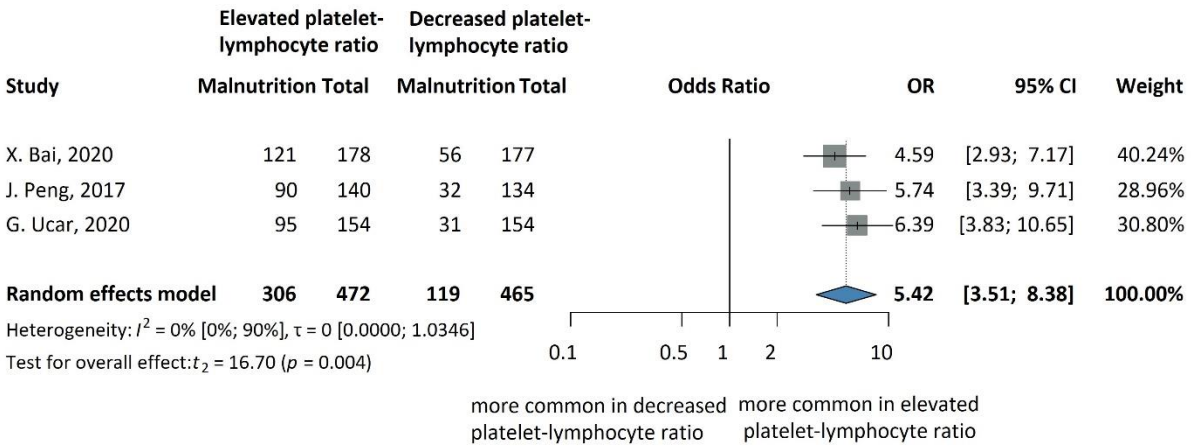
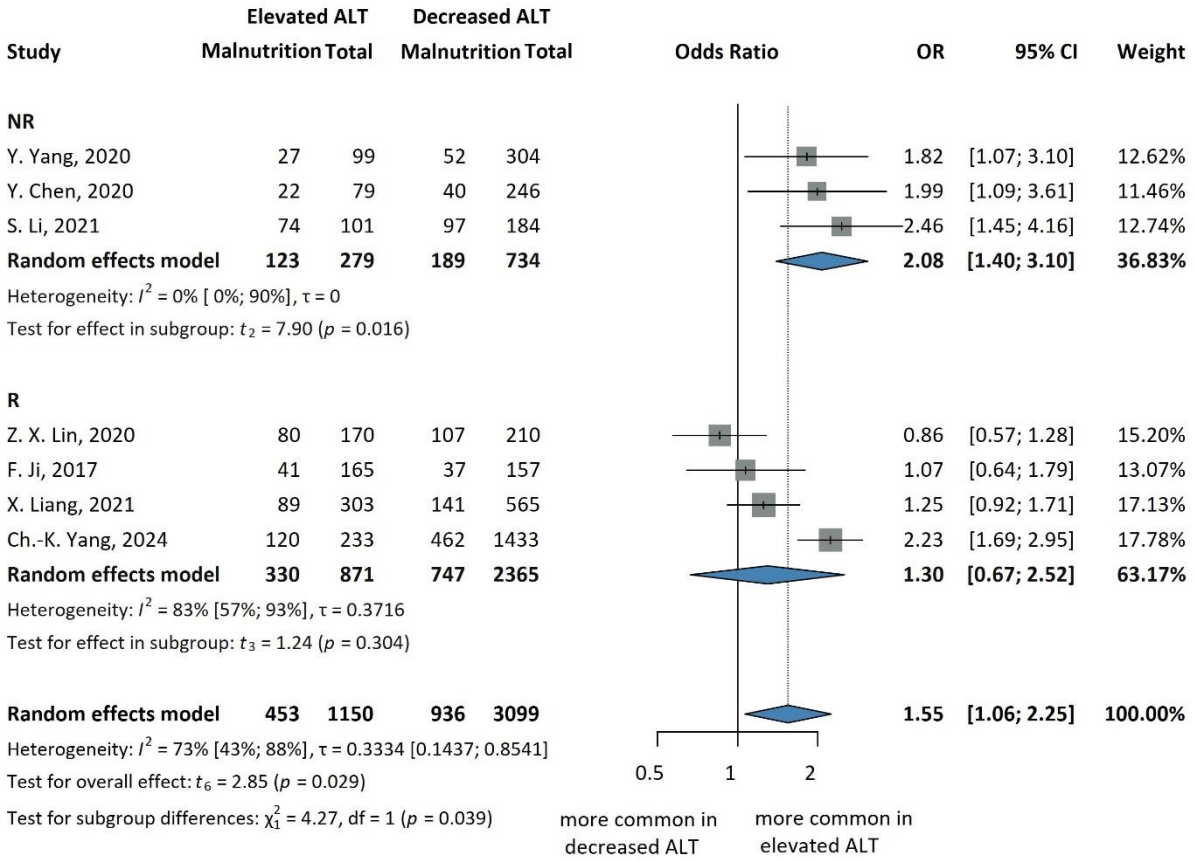
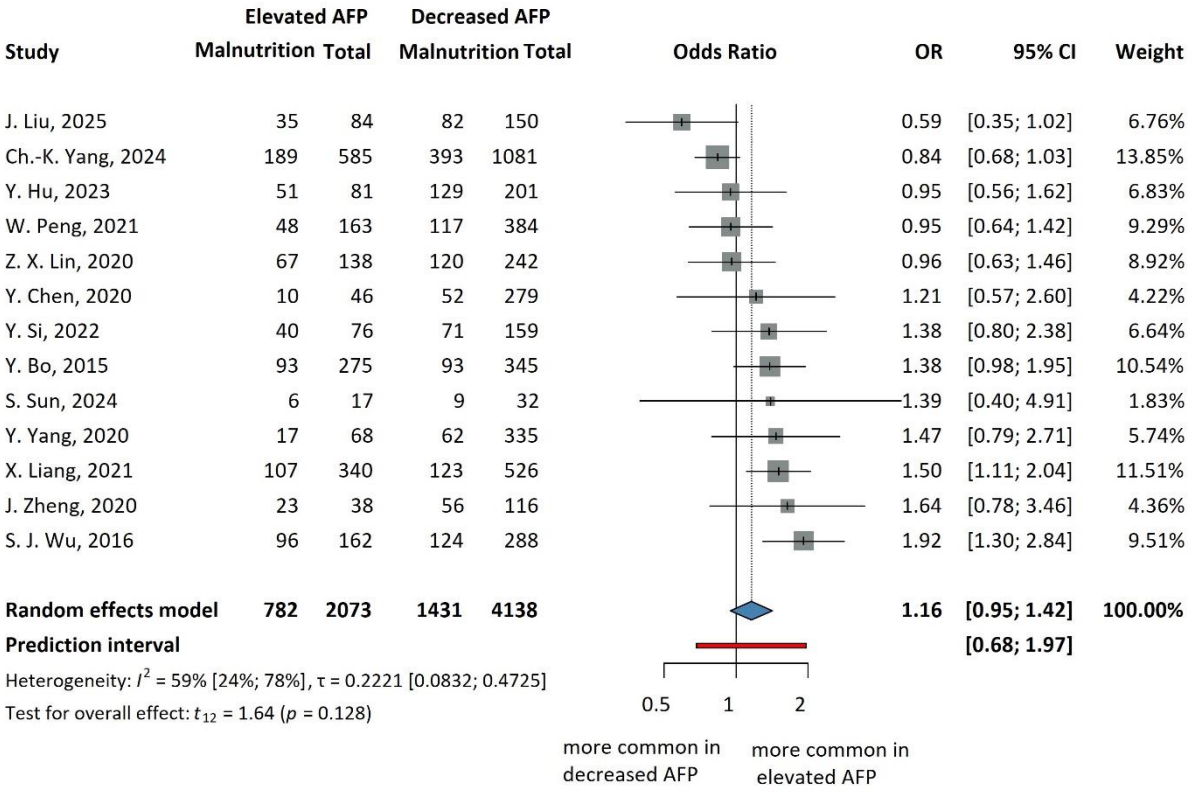


Figure S85.: Association between malnutrition-related complication risk and serum alanine aminotransferase (ALT) level in hepatocellular carcinoma (Biological composite scores)



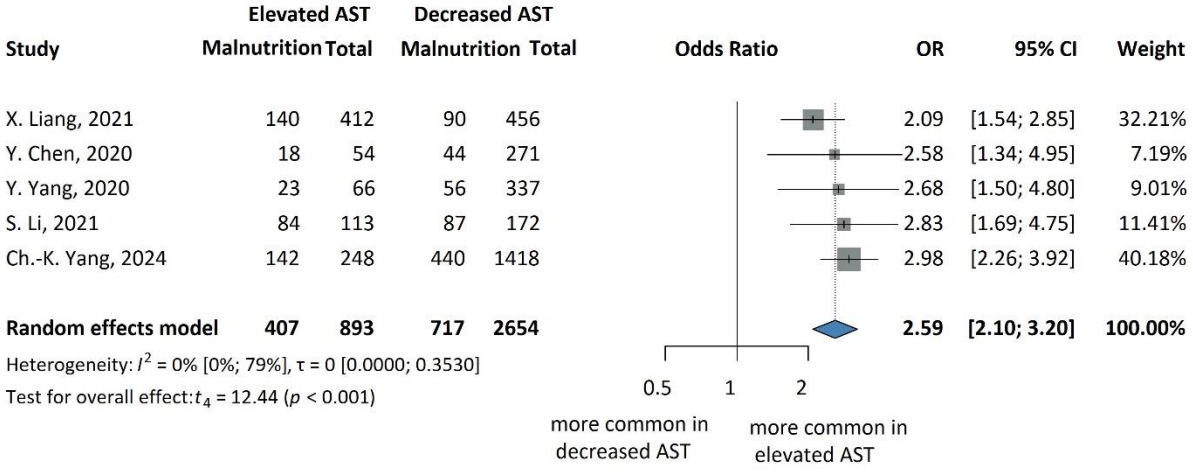
Abbreviations: R= resectable; NR= non-resectable; ALT= alanine aminotransferase

Figure S86.: Association between malnutrition-related complication risk and serum alpha-fetoprotein (AFP) (cut off 400 ng/ml) level in hepatocellular carcinoma (Biological composite scores)



Abbreviations: AFP= alfa fetoprotein

Figure S87.: Association between malnutrition-related complication risk and serum aspartate aminotransferase (AST) level in hepatocellular carcinoma (Biological composite scores)



Abbreviations: AST= aspartate aminotransferase

Figure S88.: Association between malnutrition-related complication risk and anaemia in gastrointestinal cancer [subgroup analysis for gastric cancer] (Biological composite scores)

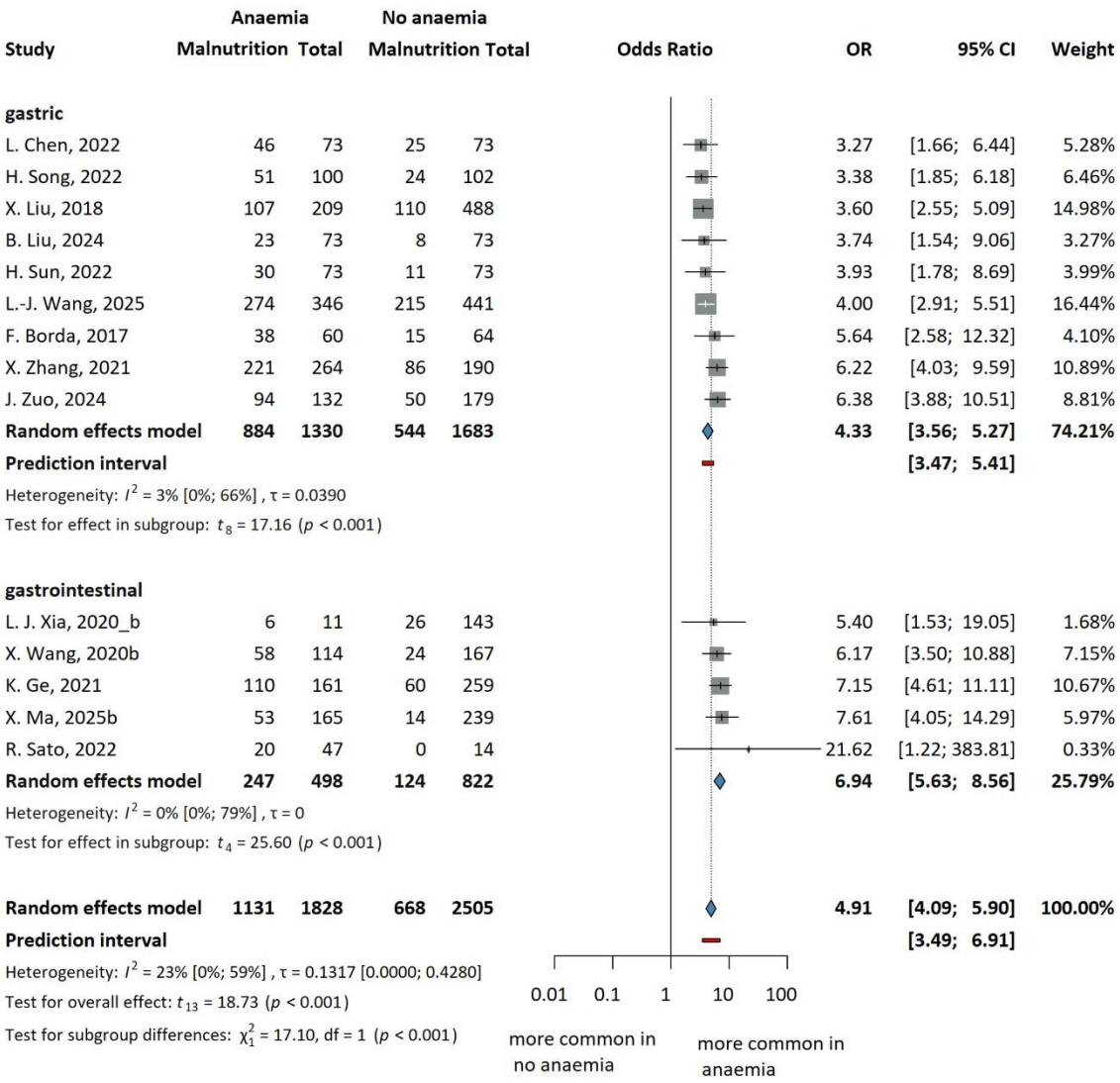
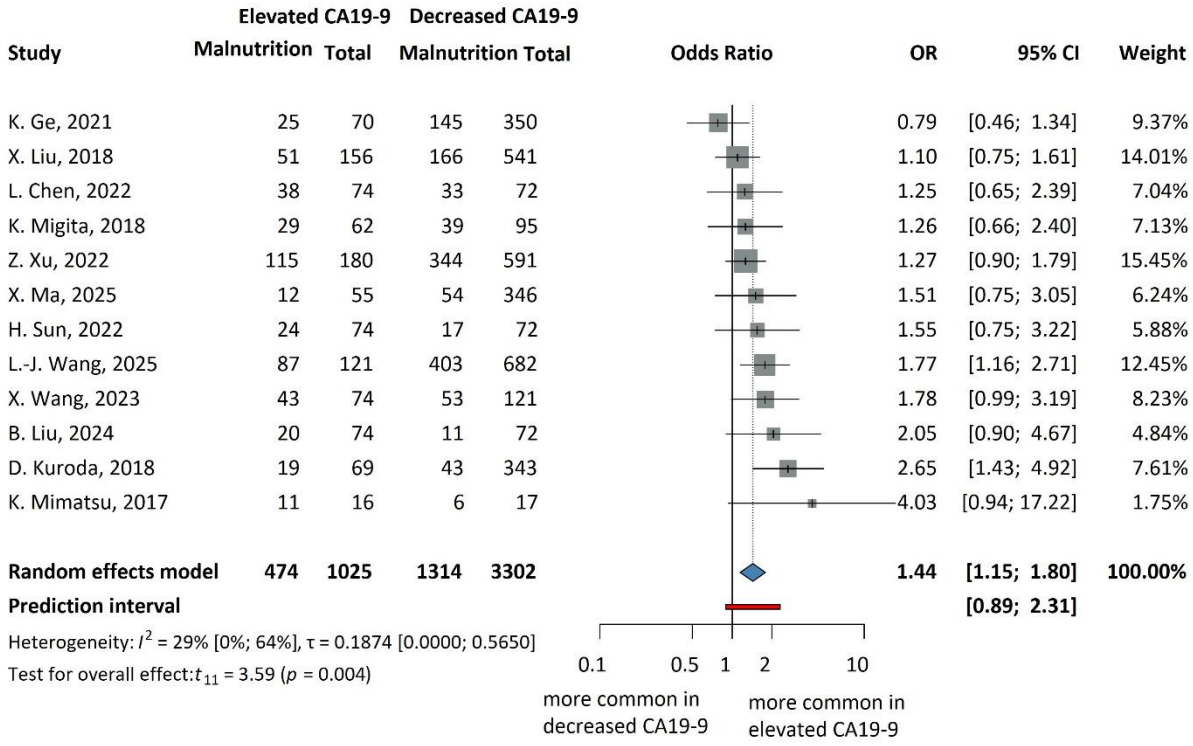
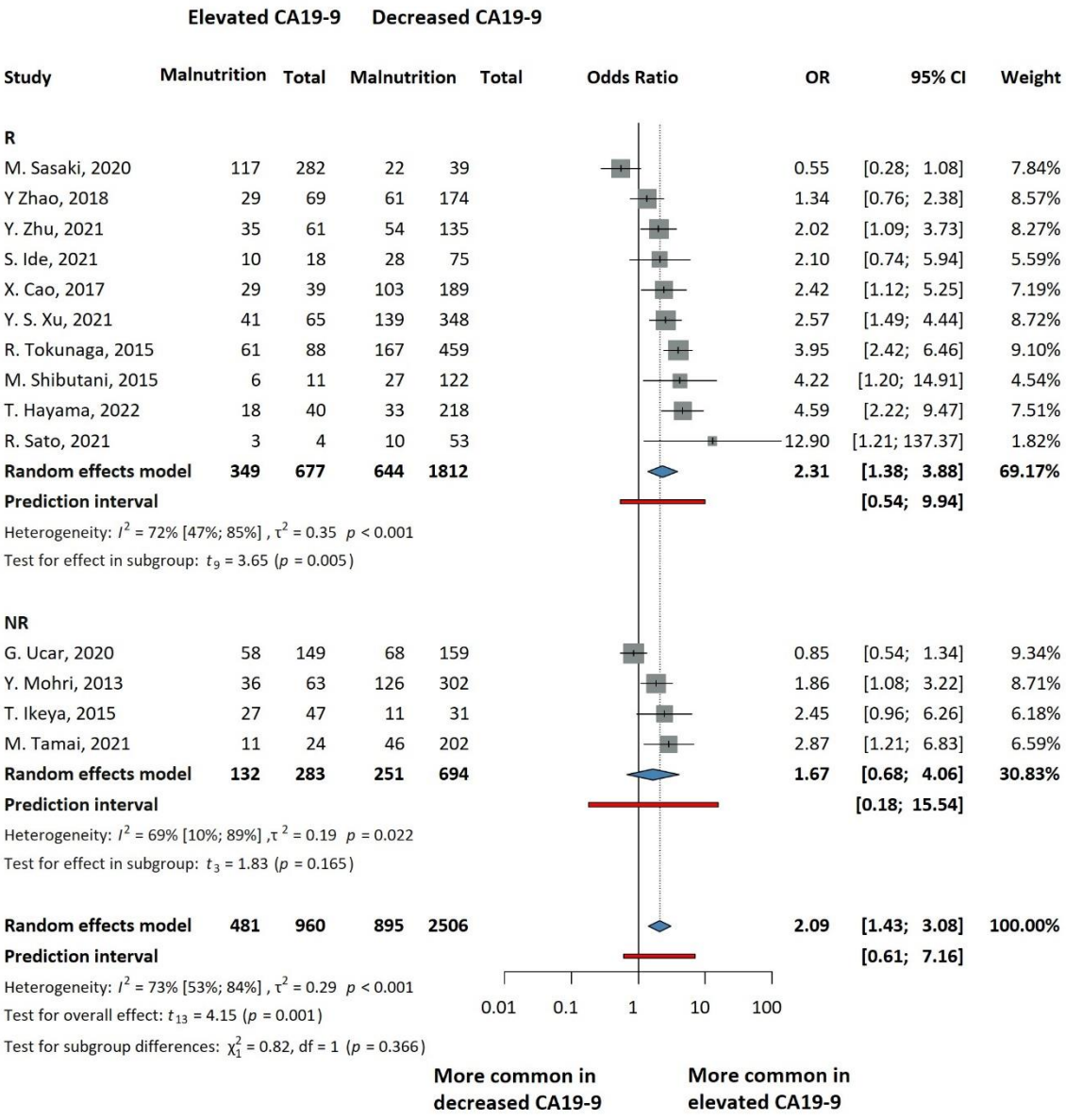


Figure S89.: Association between malnutrition-related complication risk and serum CA 19-9 level in upper-gastrointestinal cancer (Biological composite scores)



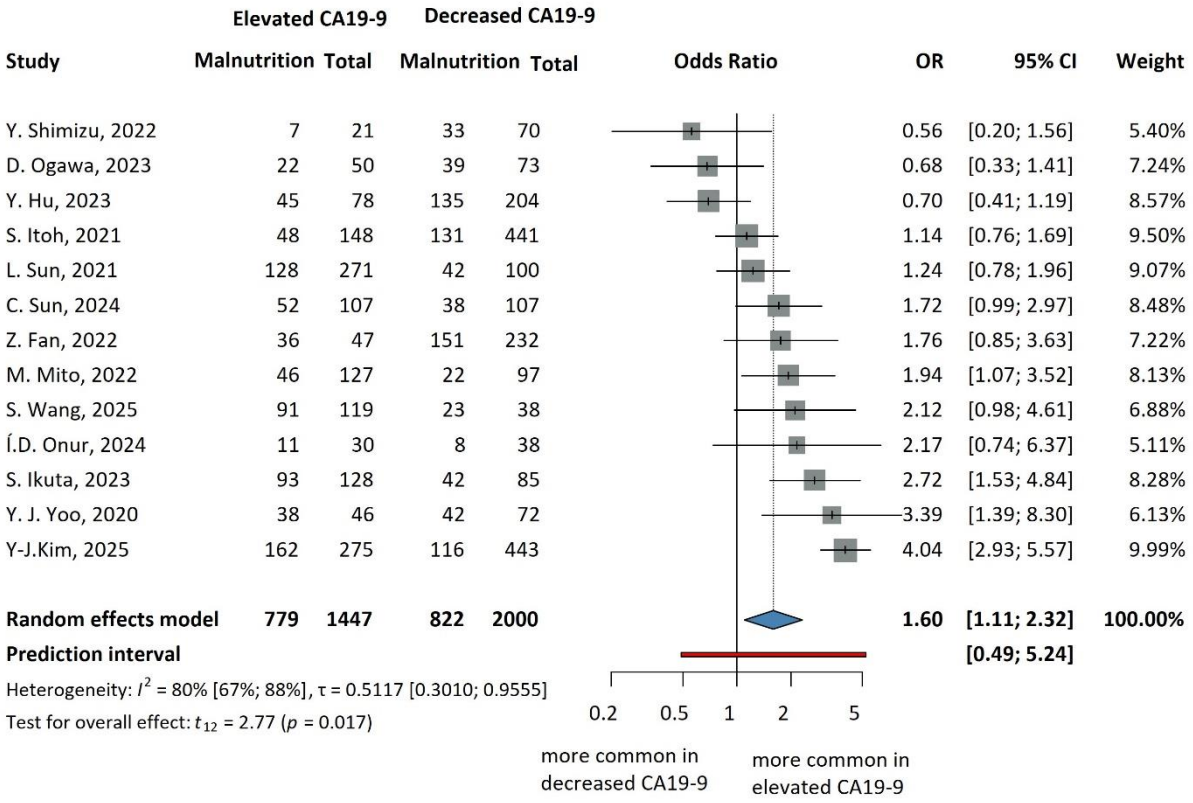
Abbreviations: CA19-9= cancer antigen 19-9

Figure S90.: Association between malnutrition-related complication risk and serum CA 19-9 level in colorectal cancer (Biological composite scores)



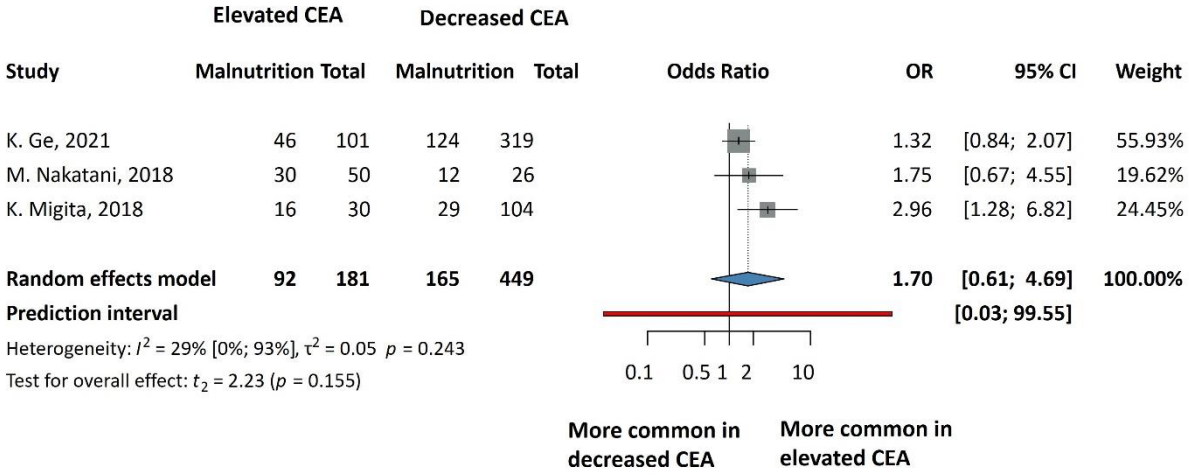
Abbreviations: CA19-9= cancer antigen 19-9; R= resectable; NR= non-resectable

Figure S91.: Association between malnutrition-related complication risk and serum CA 19-9 level in hepato-biliopancreatic cancer (Biological composite scores)



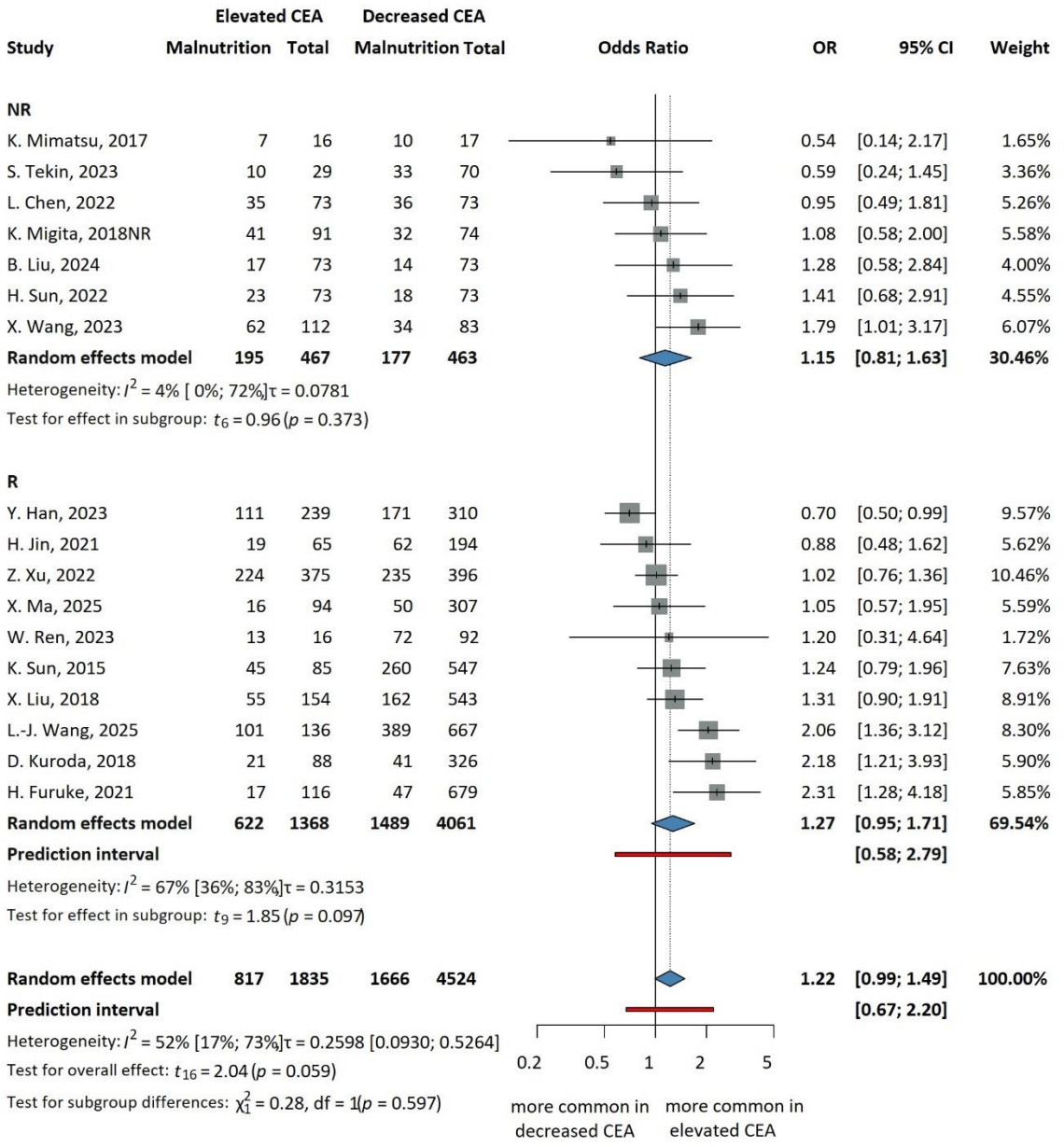
Abbreviations: CA19-9= cancer antigen 19-9

Figure S92.: Association between malnutrition-related complication risk and serum CEA level in esophageal cancer (Biological composite scores)



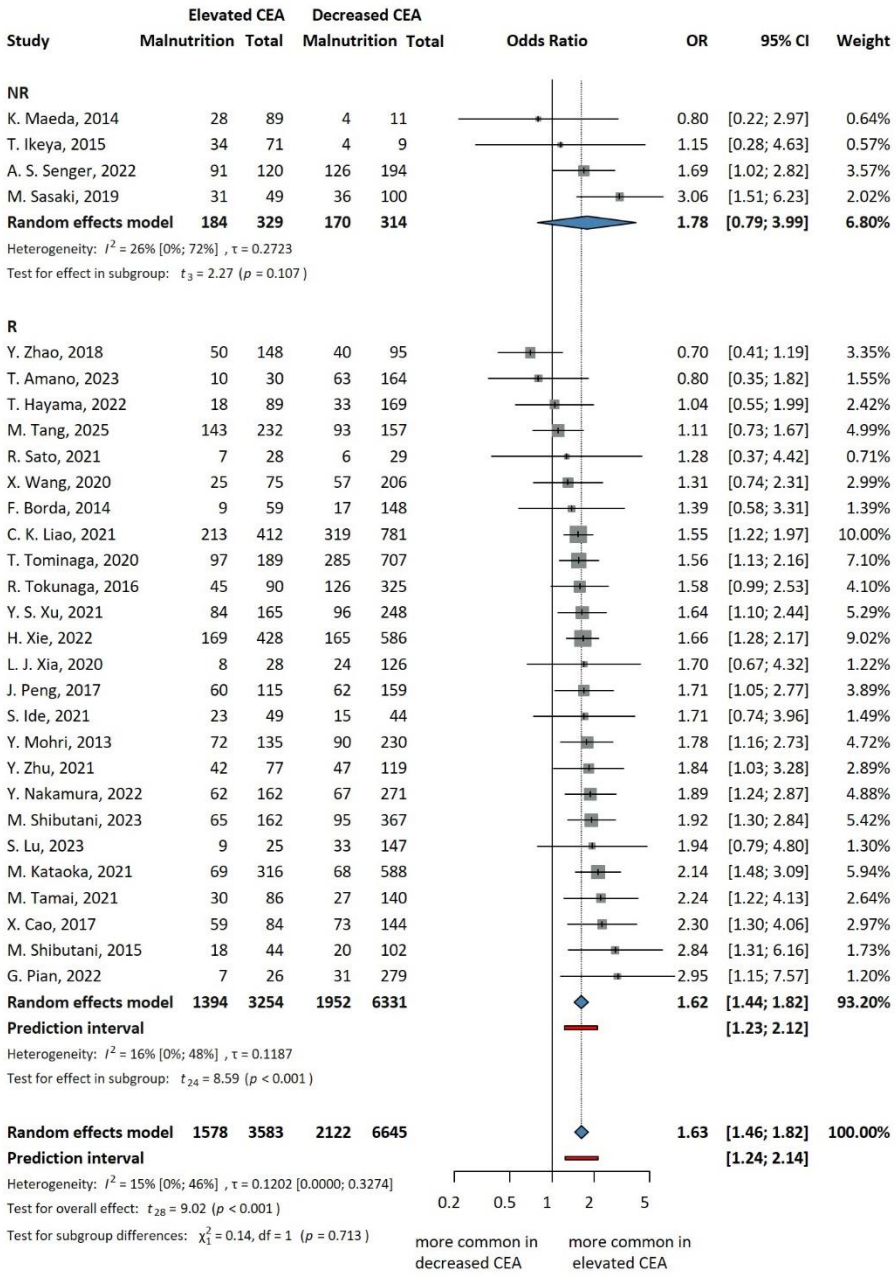
Abbreviations: CEA= carcinoembryonic antigen

Figure S93.: Association between malnutrition-related complication risk and serum CEA level in gastric cancer (Biological composite scores)



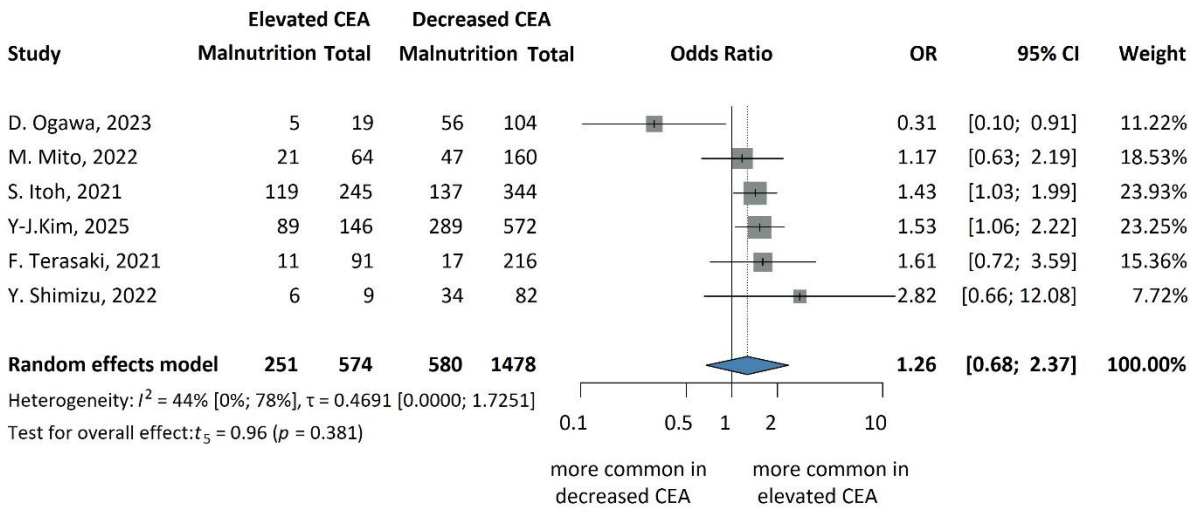
Abbreviations: CEA= carcinoembryonic antigen; R= resectable; NR= non-resectable

Figure S94.: Association between malnutrition-related complication risk and serum CEA level in colorectal cancer (Biological composite scores)



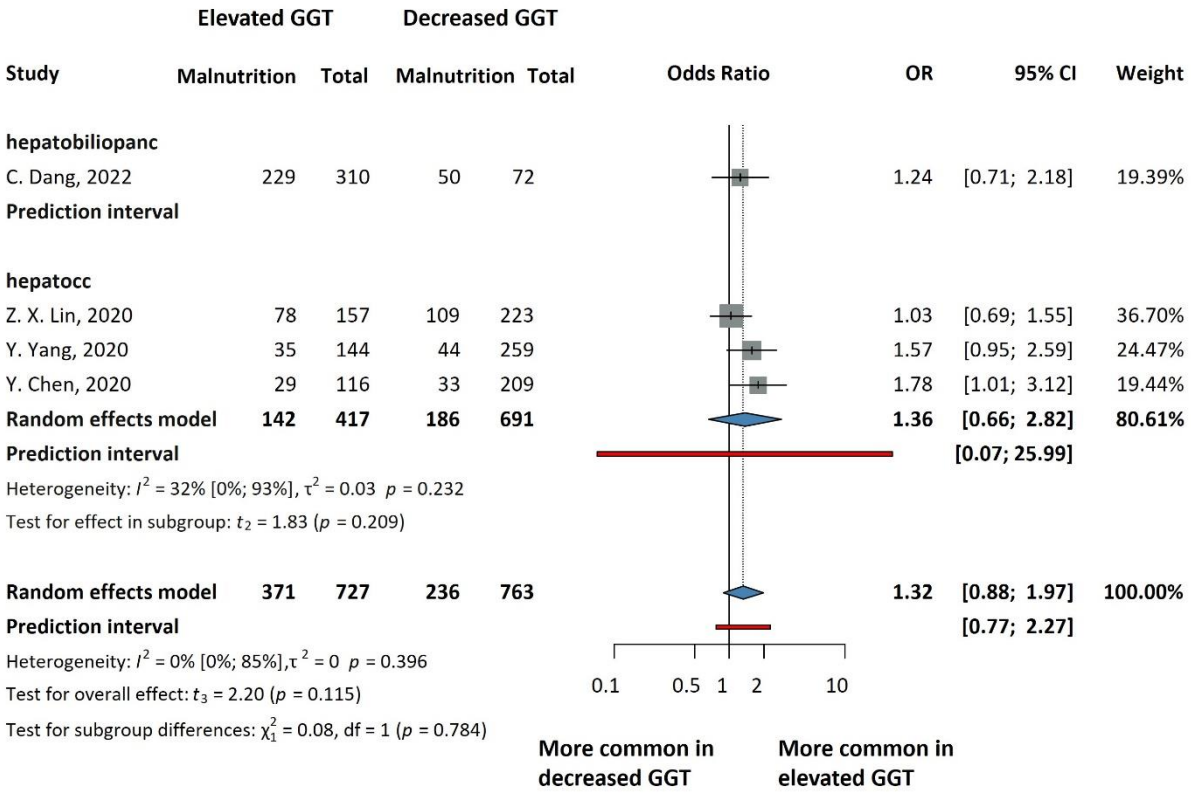
Abbreviations: CEA= carcinoembryonic antigen; R= resectable; NR= non-resectable

Figure S95.: Association between malnutrition-related complication risk and serum CEA level in hepato-biliopancreatic cancer (Biological composite scores)



Abbreviations: CEA= carcinoembryonic antigen

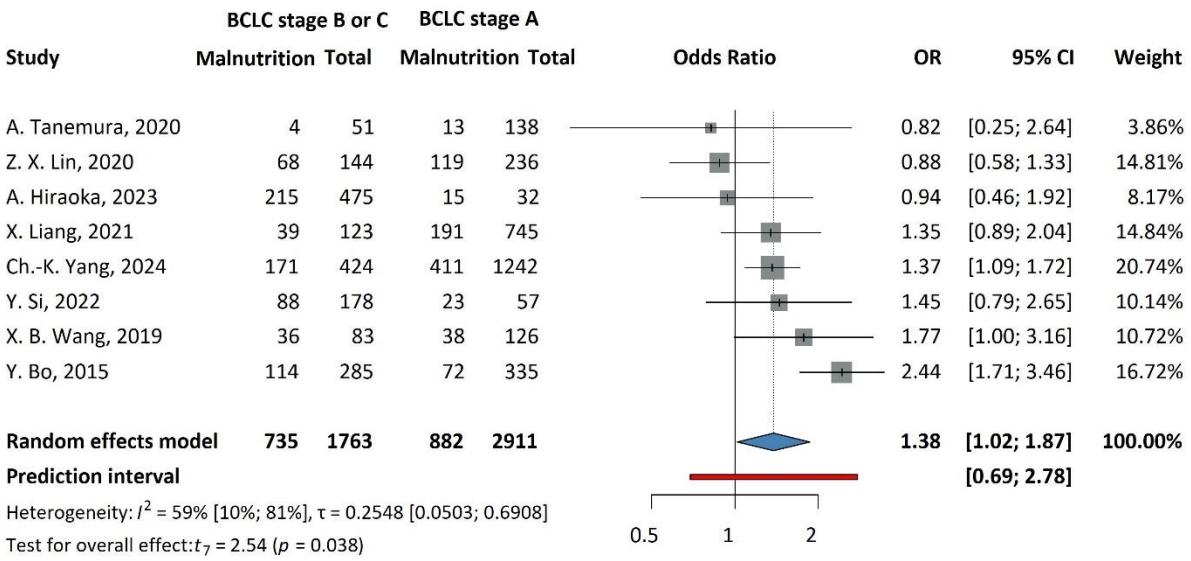
Figure S96.: Association between malnutrition-related complication risk and serum GGT level in hepato-biliopancreatic cancer [subgroup analysis for hepatocellular carcinoma] (Biological composite scores)



Abbreviations: GGT= gamma-glutamyl transferase

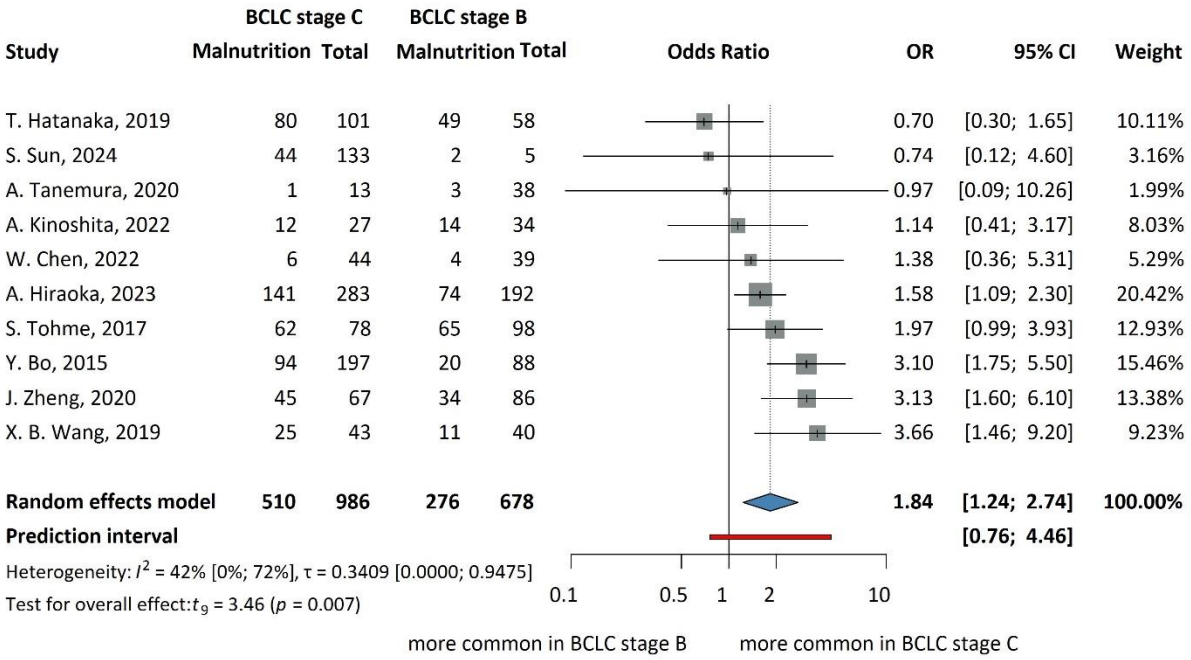
Supplementary Document S12: Individual forest plots for tumour characteristics: Figure S97-S121

Figure S97.: Association between malnutrition-related complication risk and BCLC stage in hepatocellular carcinoma (Biological composite scores)



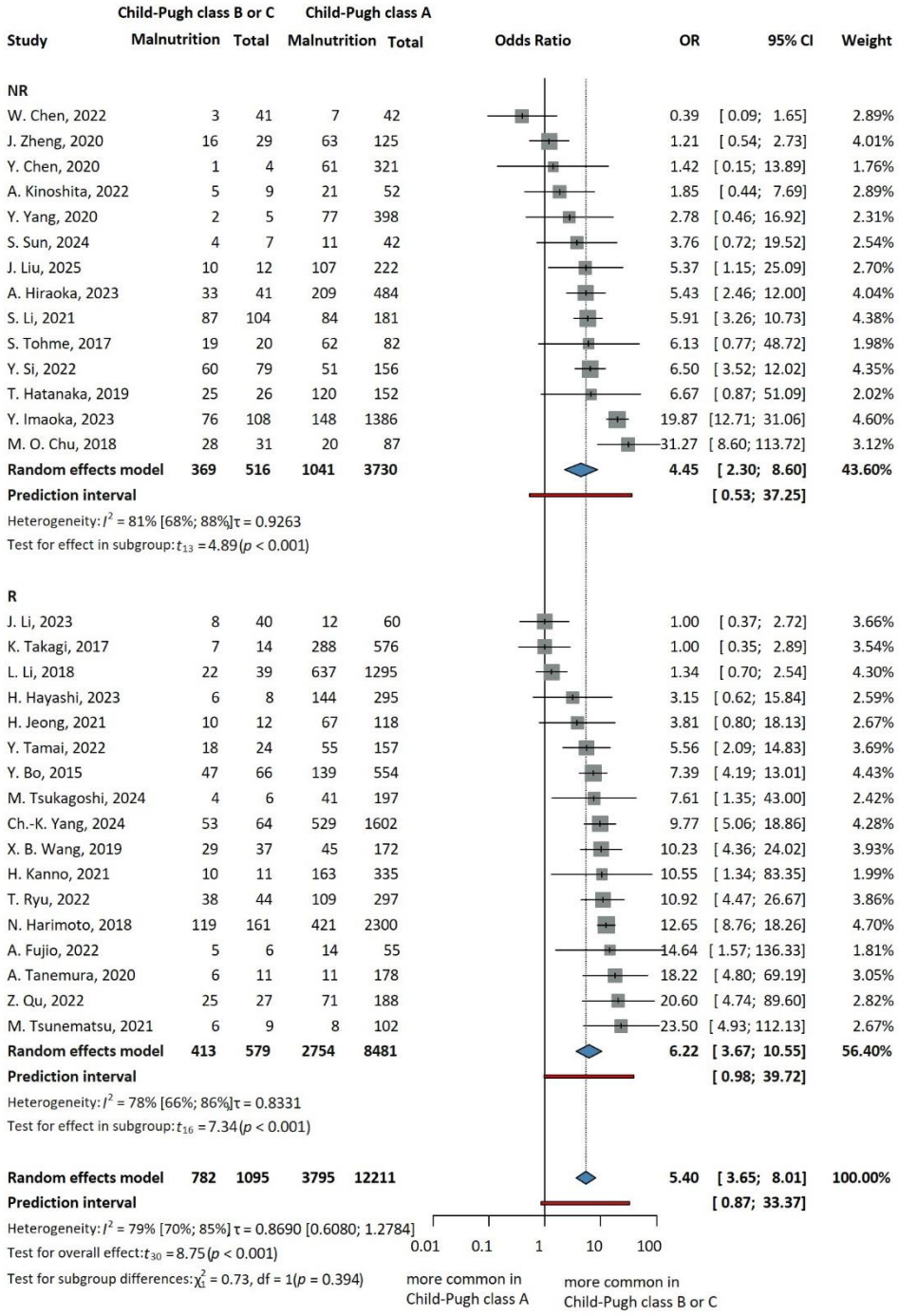
Abbreviations: BCLC= Barcelona Clinic Liver Cancer

Figure S98.: Association between malnutrition-related complication risk and BCLC stage in hepatocellular carcinoma (Biological composite scores)



Abbreviations: BCLC= Barcelona Clinic Liver Cancer

Figure S99.: Association between malnutrition-related complication risk and Child-Pugh class in hepatocellular carcinoma (Biological composite scores)



Abbreviations: R= resectable; NR= non-resectable

Figure S100.: Association between malnutrition-related complication risk and N stage in esophageal squamous cell carcinoma (Biological composite scores)

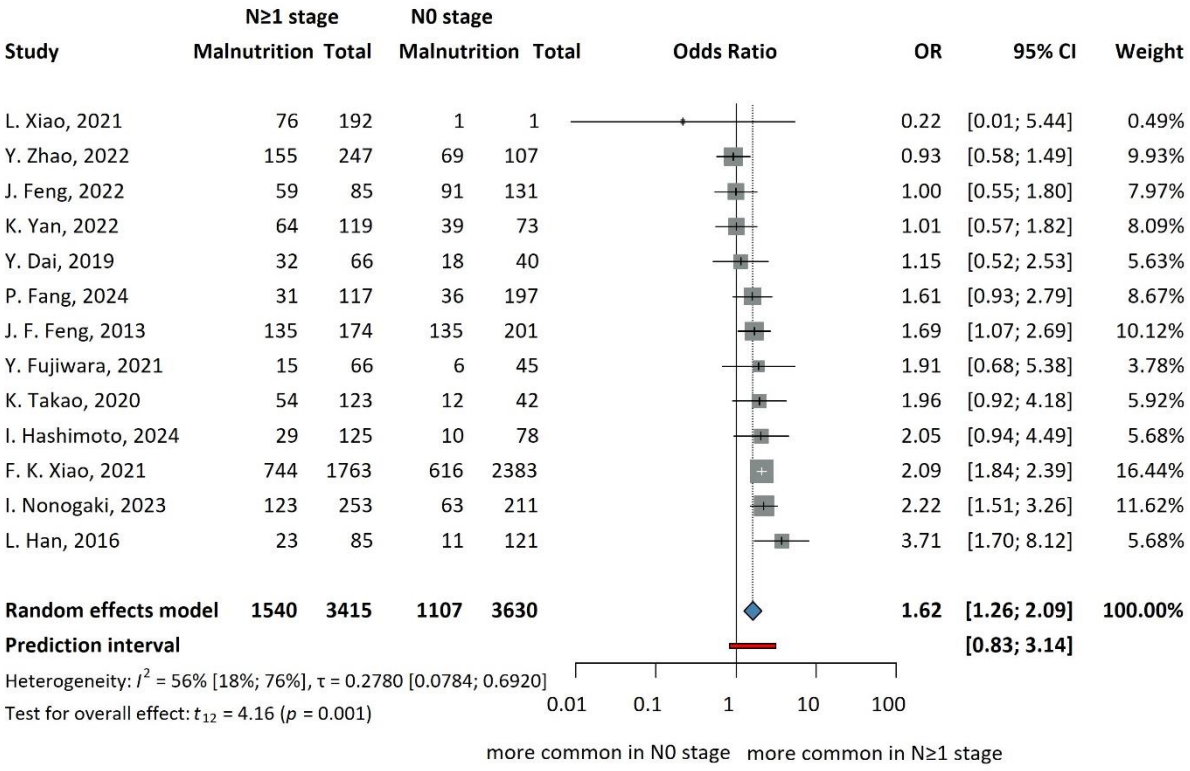


Figure S101.: Association between malnutrition-related complication risk and N stage in gastric cancer (Biological composite scores)

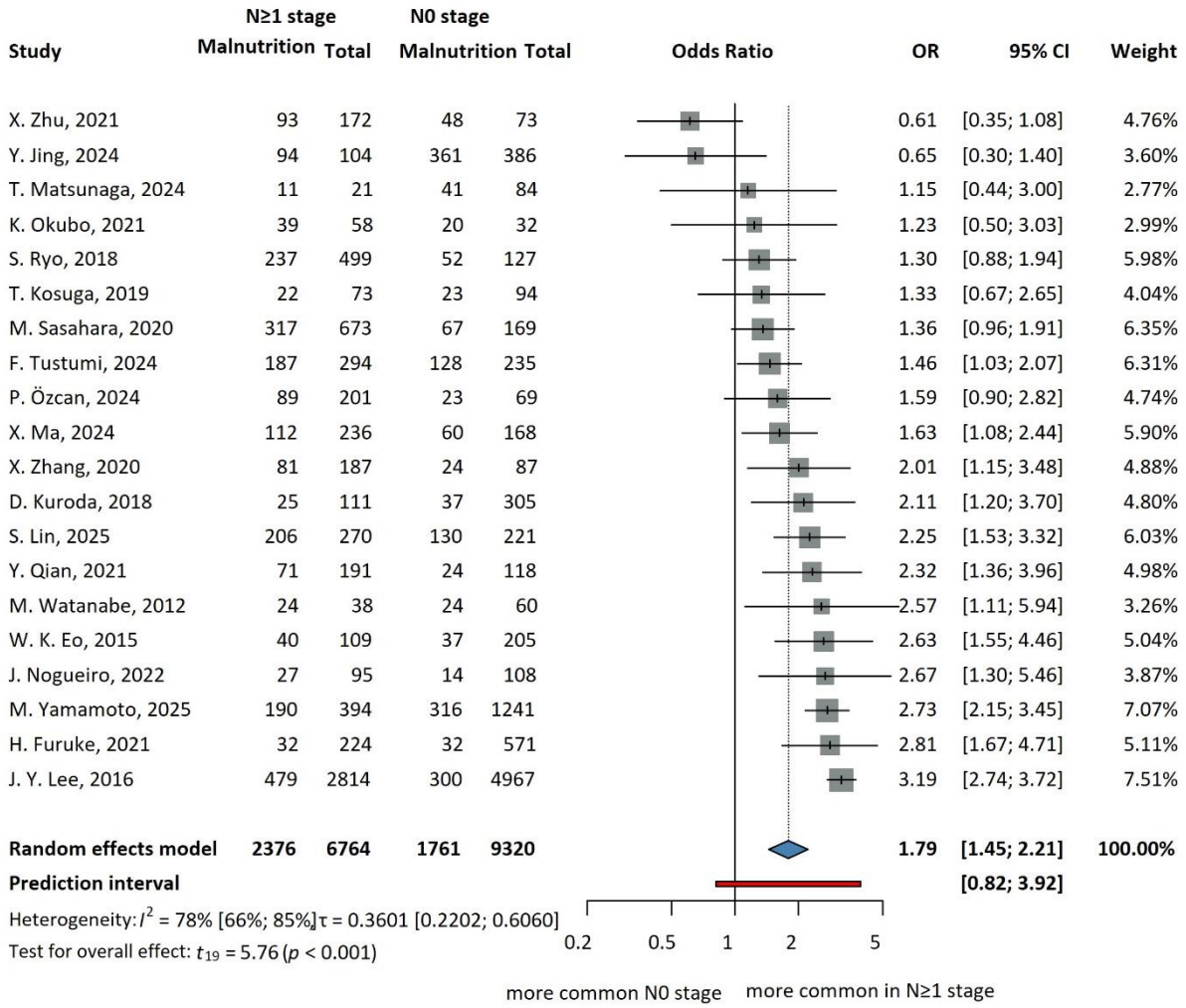


Figure S102.: Association between malnutrition-related complication risk and N stage in colorectal cancer (Biological composite scores)

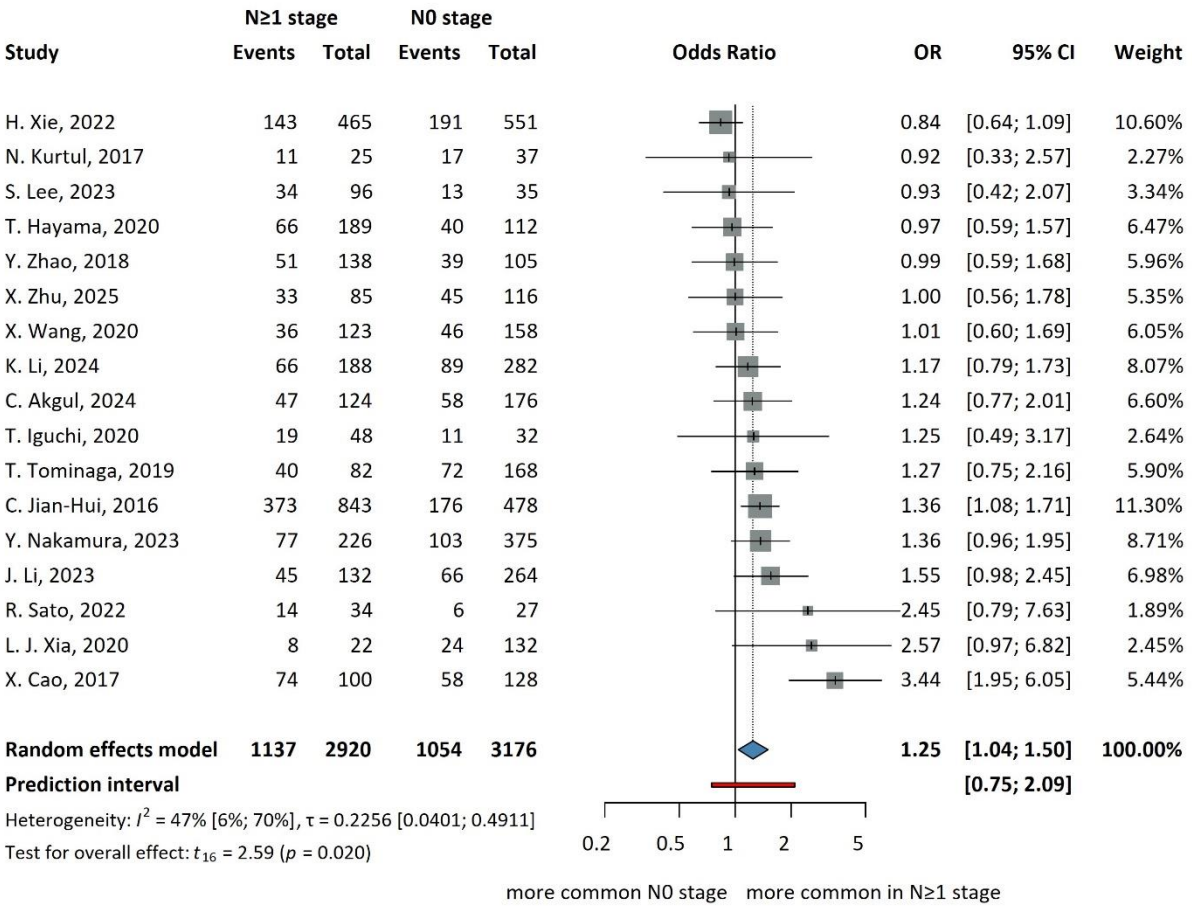


Figure S103.: Association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)

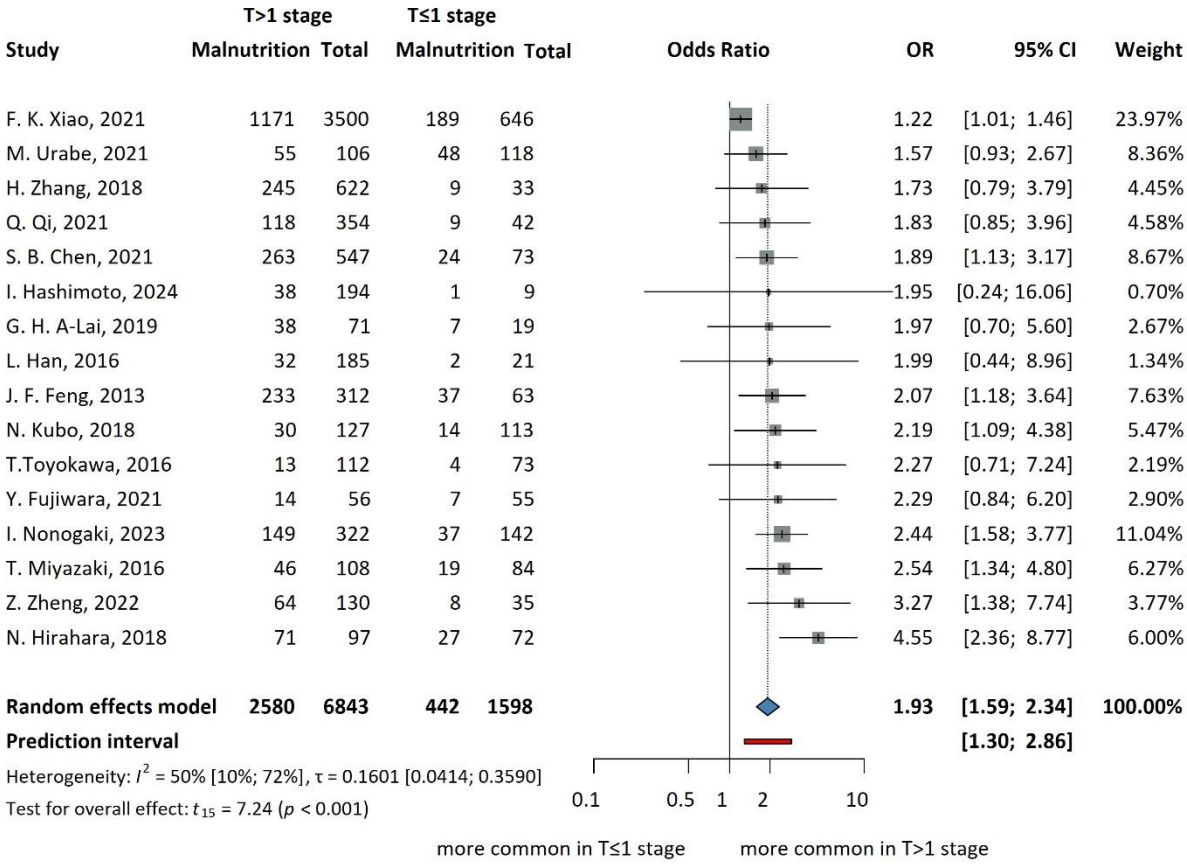


Figure S104.: Association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)

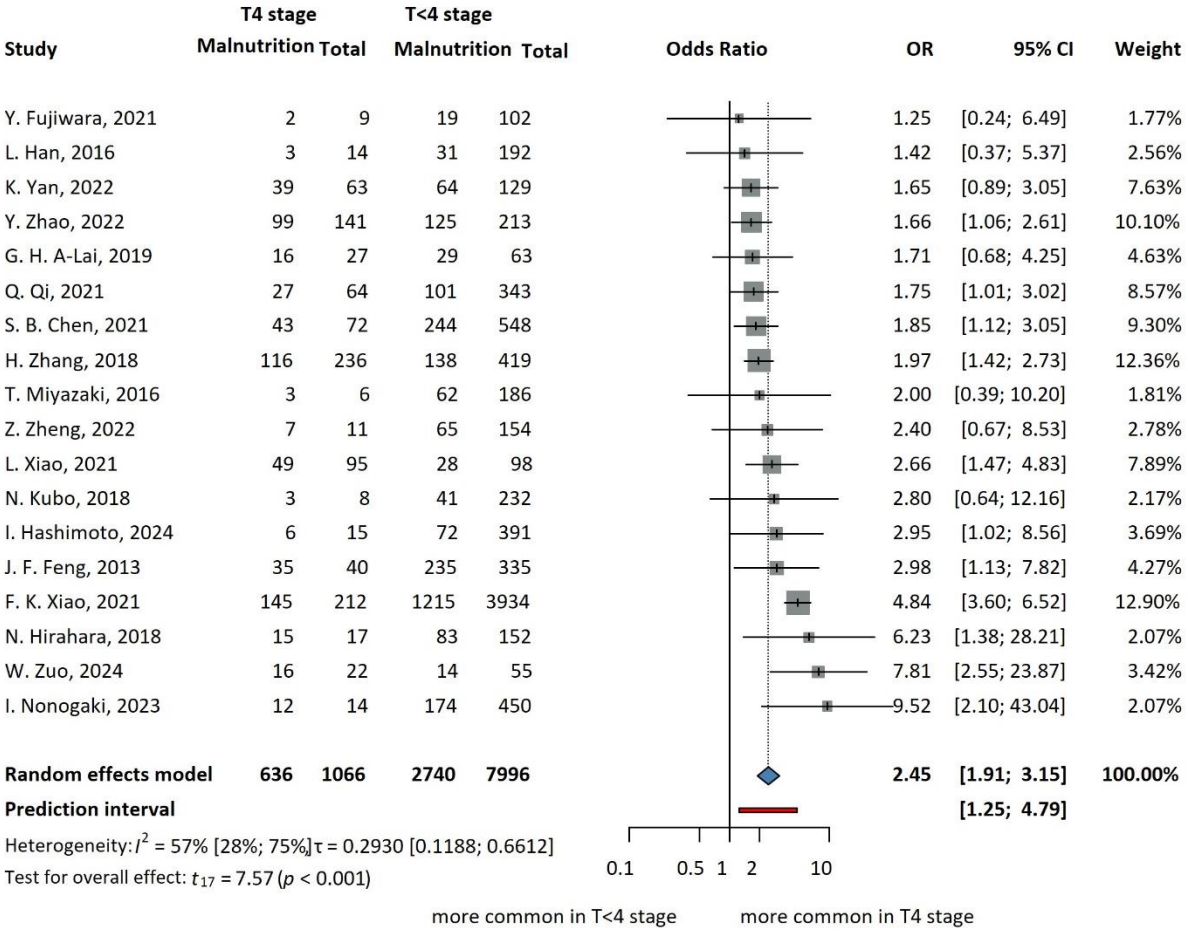


Figure S105.: Association between malnutrition-related complication risk and T stage in gastric cancer (Biological composite scores)

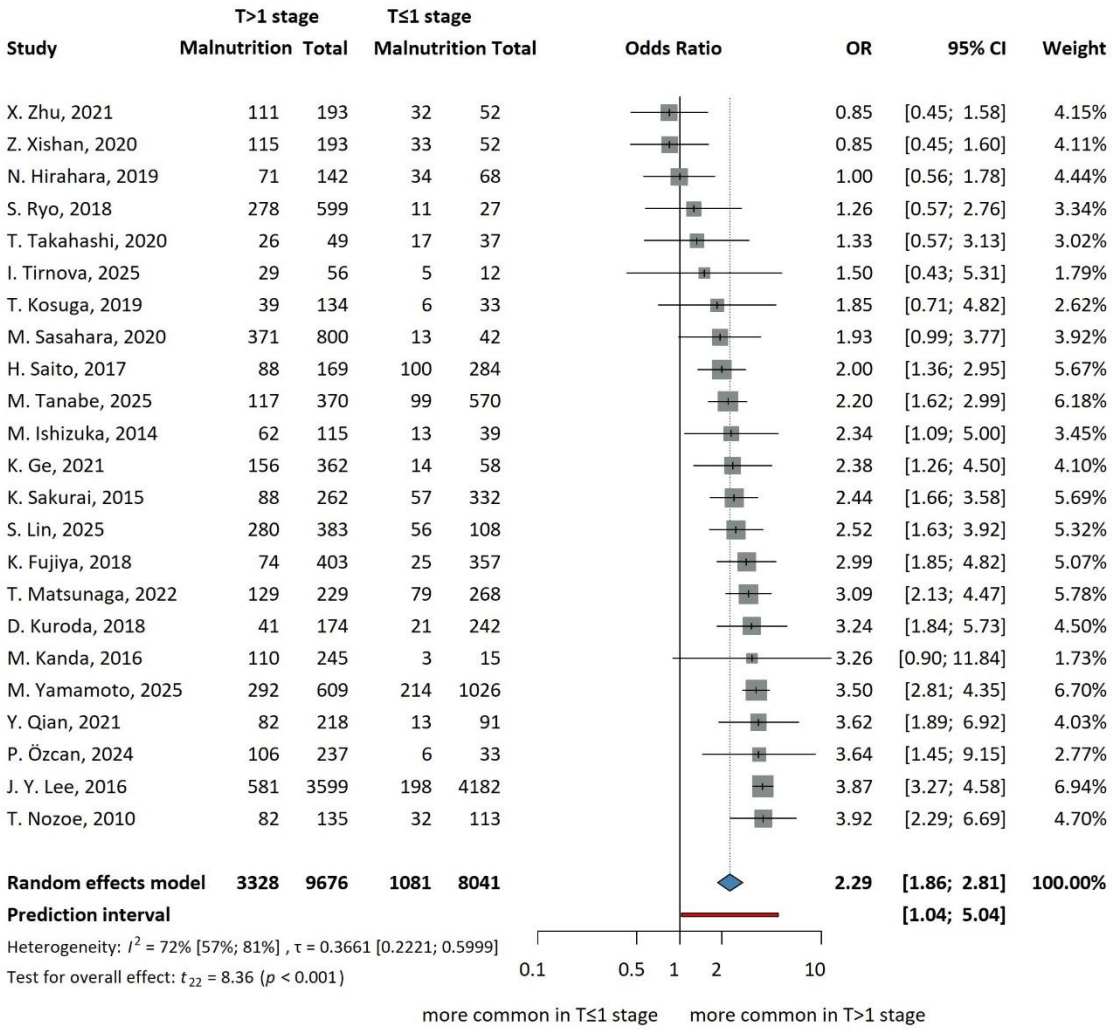


Figure S106.: Association between malnutrition-related complication risk and T stage in gastric cancer (Biological composite scores)

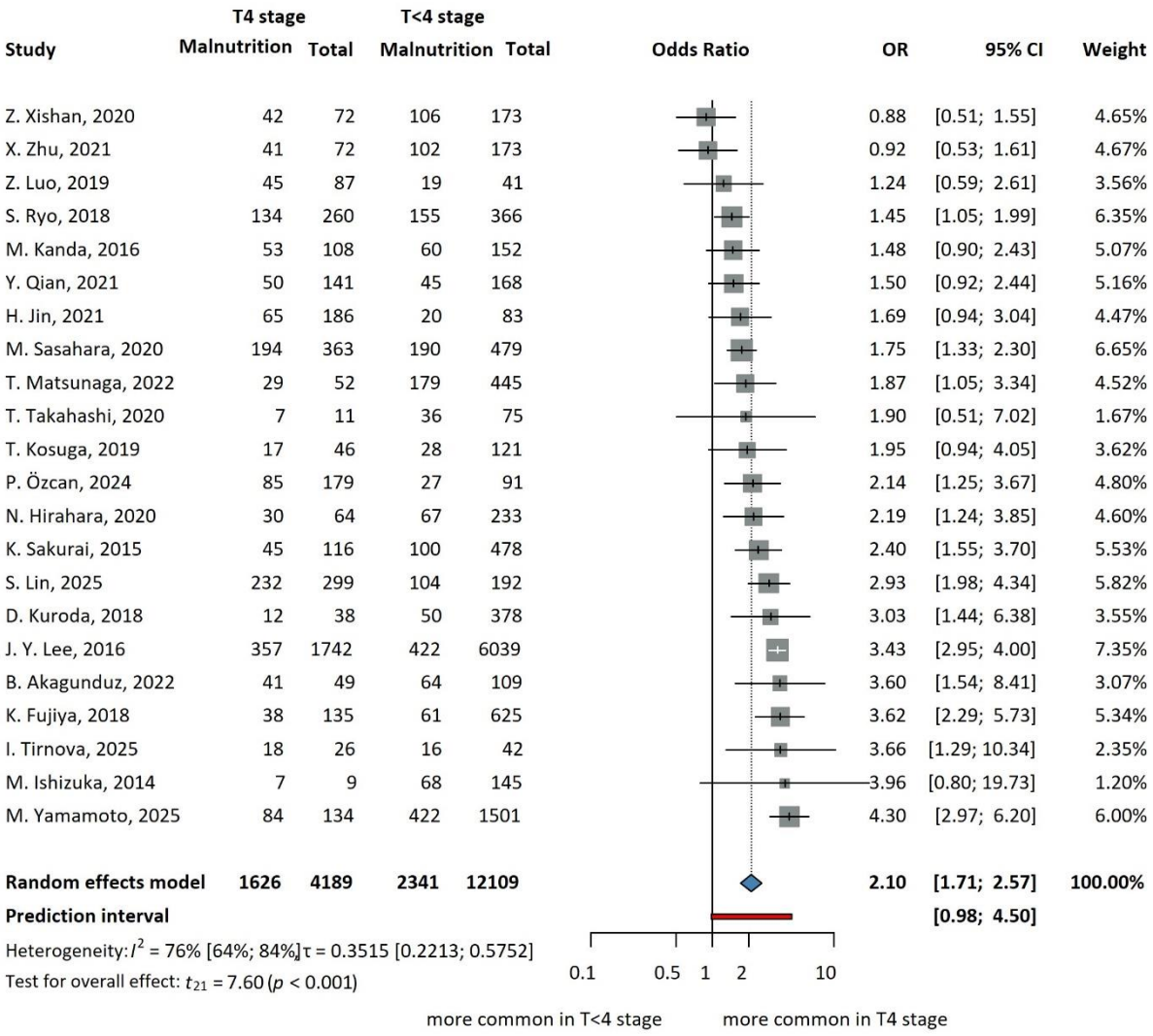


Figure S107.: Association between malnutrition-related complication risk and T stage in colorectal cancer (Biological composite scores)

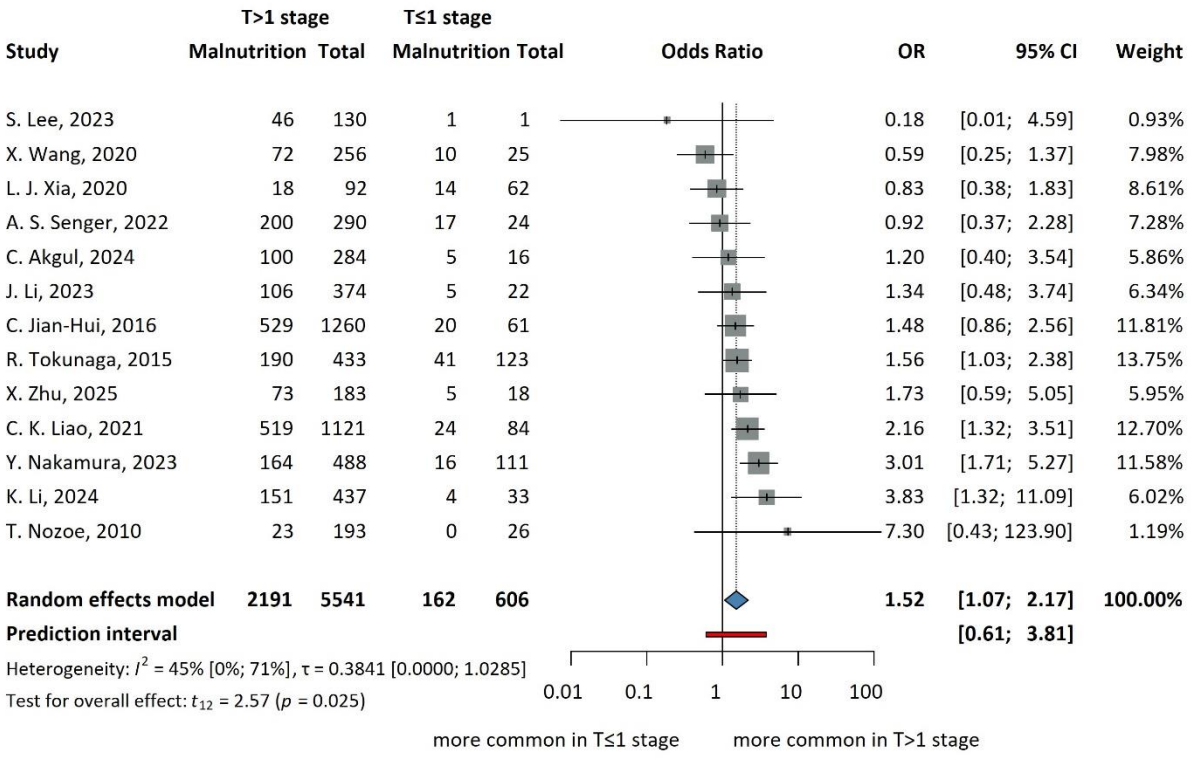


Figure S108.: Association between malnutrition-related complication risk and T stage in colorectal cancer (Biological composite scores)

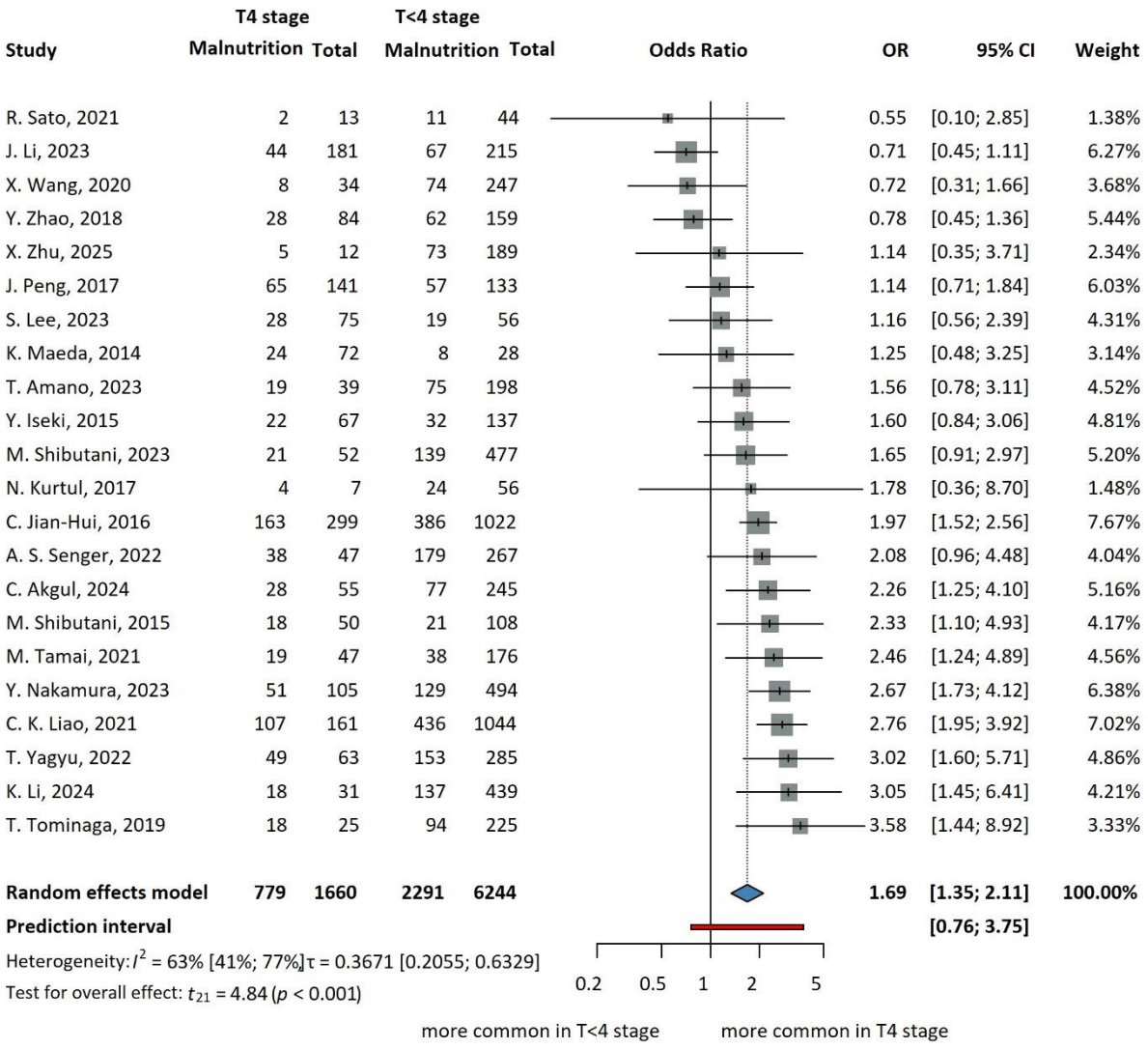


Figure S109.: Association between malnutrition-related complication risk and gastric tumor location (Biological composite scores)

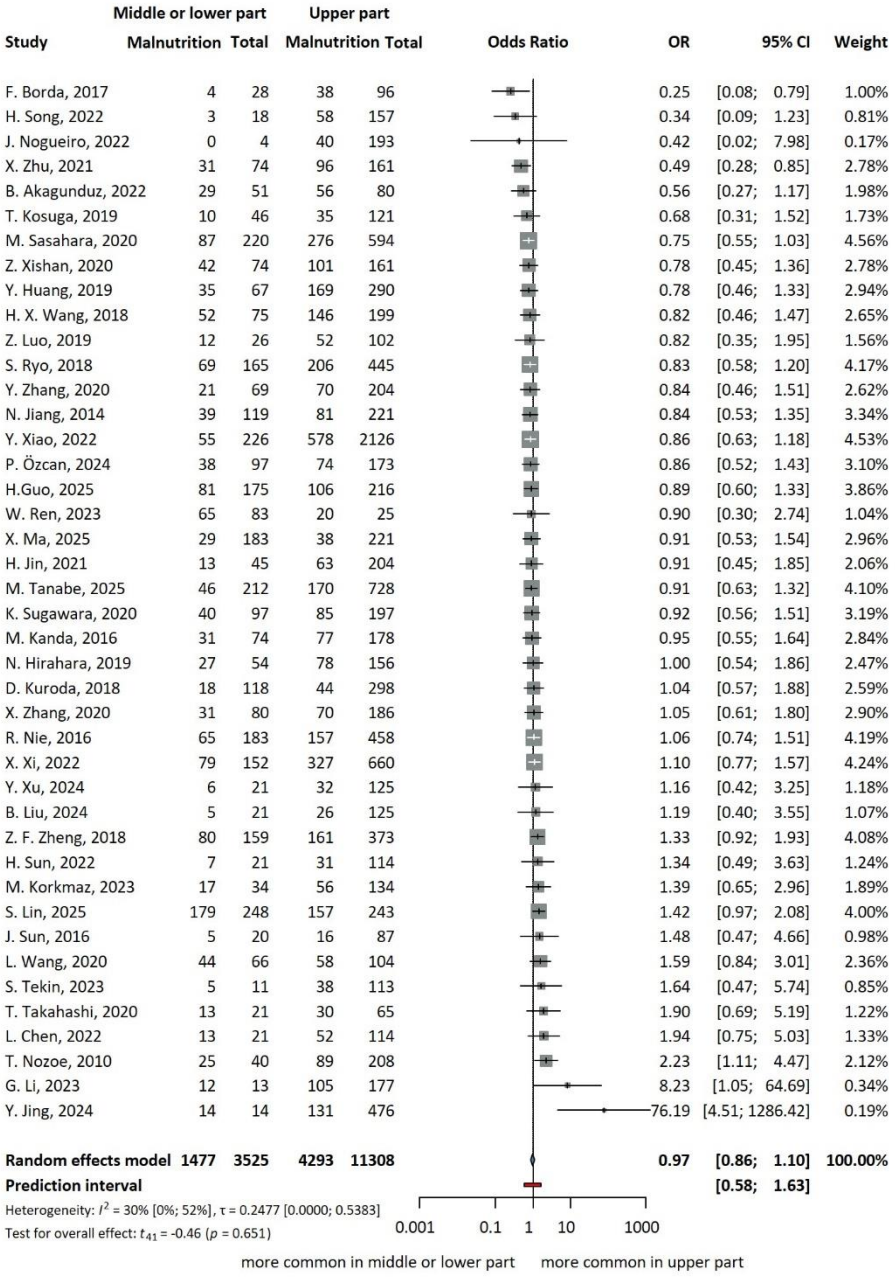


Figure S110.: Association between malnutrition-related complication risk and esophagus tumour location (Biological composite scores)

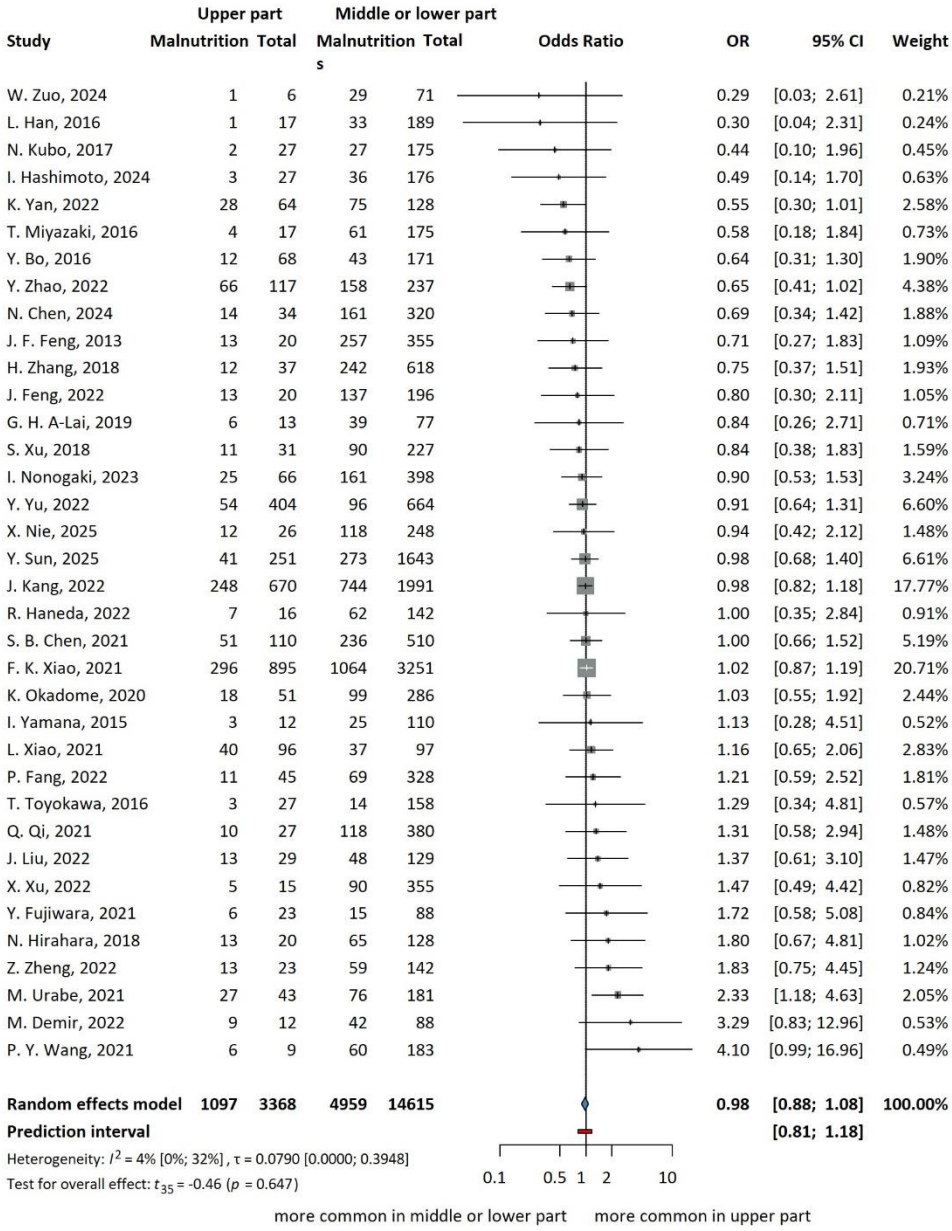
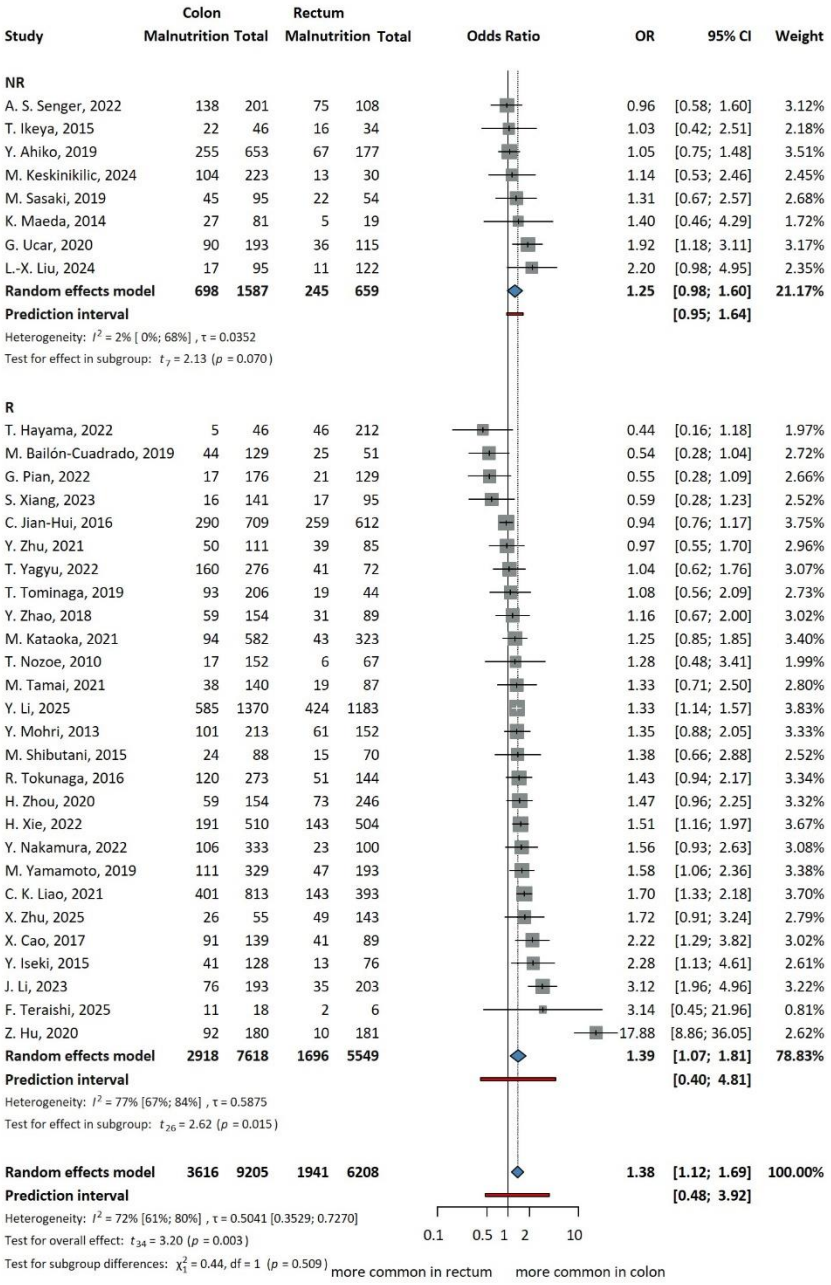


Figure S111.: Association between malnutrition-related complication risk and colorectal tumor location (Biological composite scores)



Abbreviations: R= resectable; NR= non-resectable

Figure S112.: Association between malnutrition-related complication risk and colon tumor location (Biological composite scores)

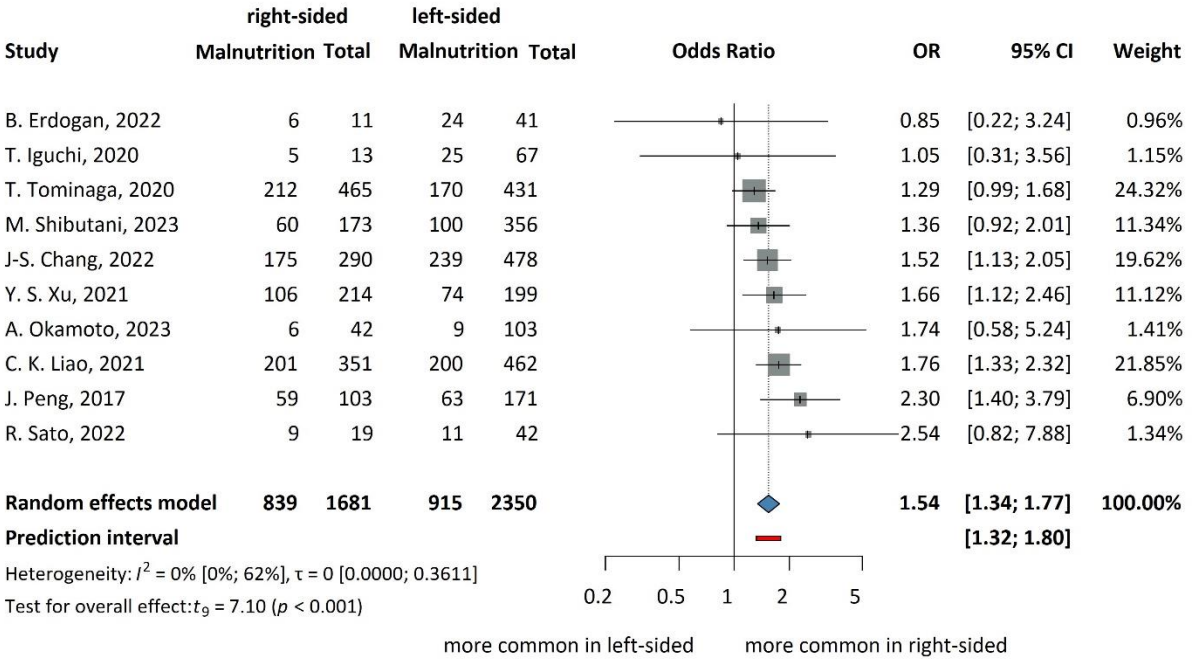


Figure S113.: Association between malnutrition-related complication risk and pancreatic tumour location (Biological composite scores)

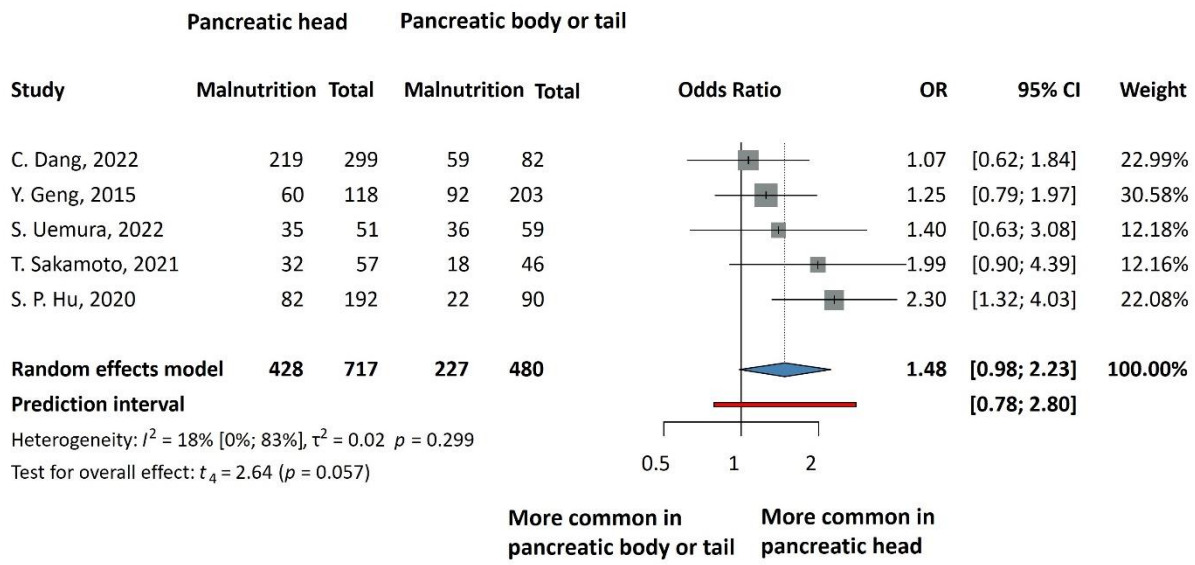


Figure S114.: Association between cachexia and gastric tumor location

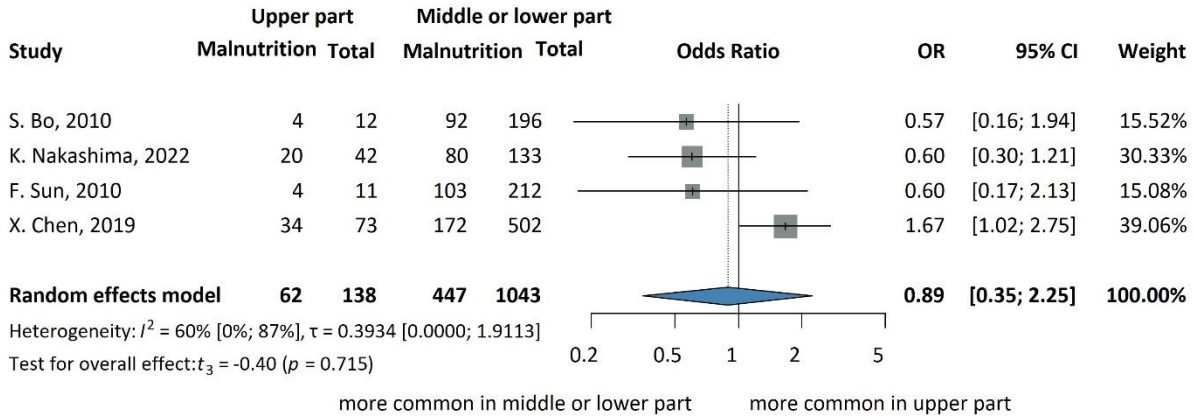


Figure S115.: Association between cachexia and pancreatic tumor location

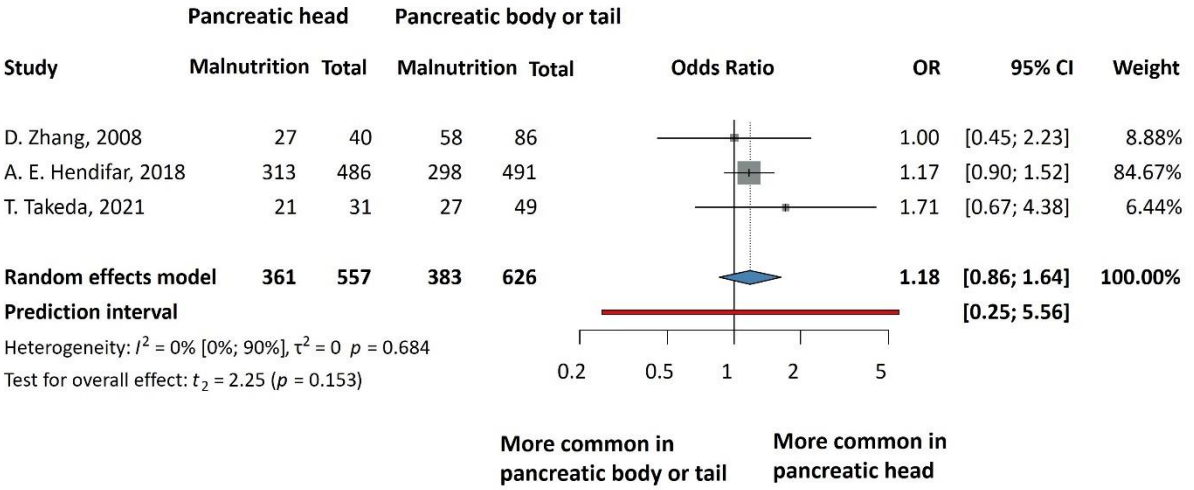


Figure S116.: Association between malnutrition-related complication risk and etiology in hepatocellular carcinoma (Biological composite scores)

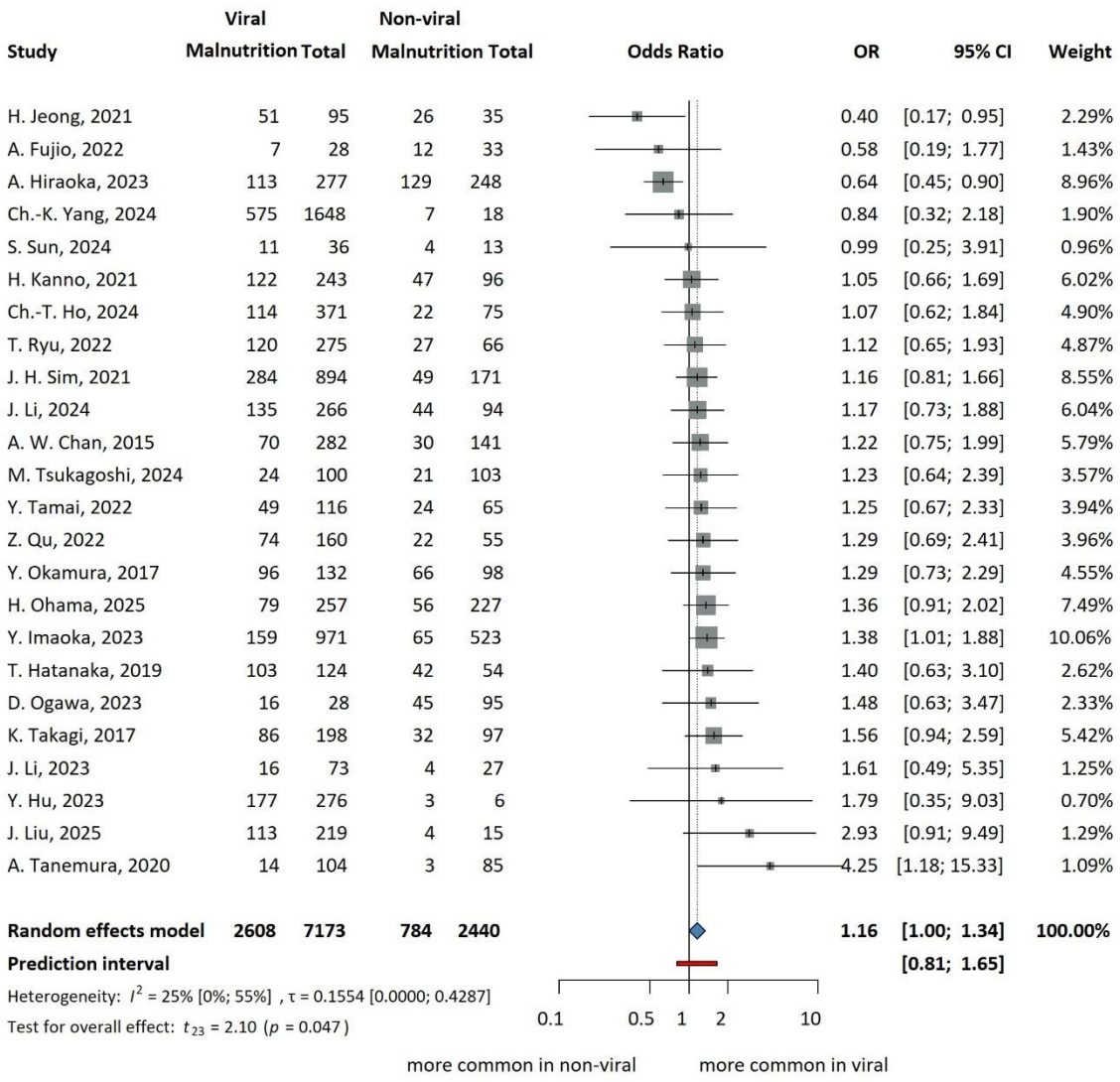


Figure S117.: Association between malnutrition-related complication risk and macrovascular invasion in esophageal cancer (Biological composite scores)

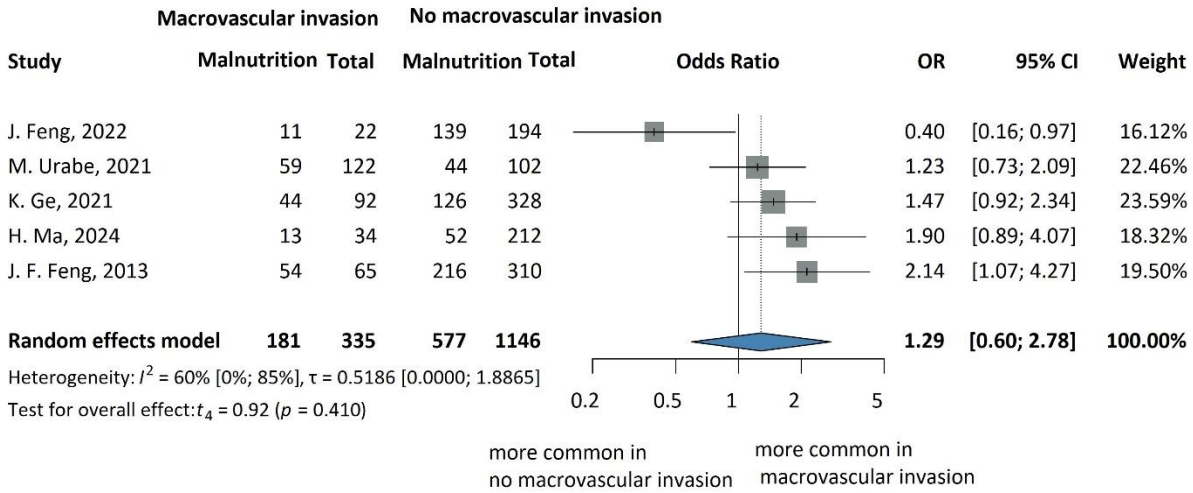


Figure S118.: Association between malnutrition-related complication risk and macrovascular invasion in gastric cancer (Biological composite scores)

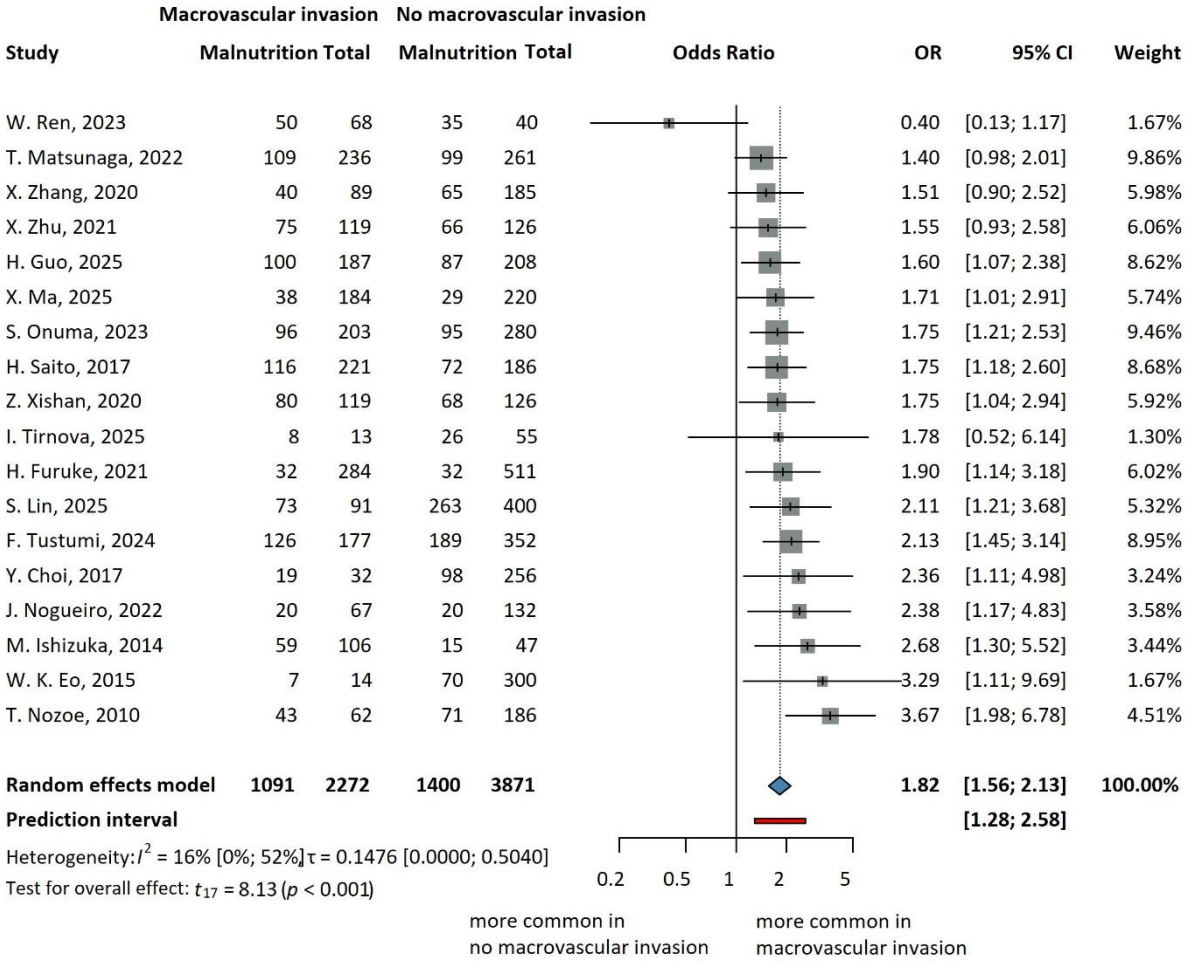
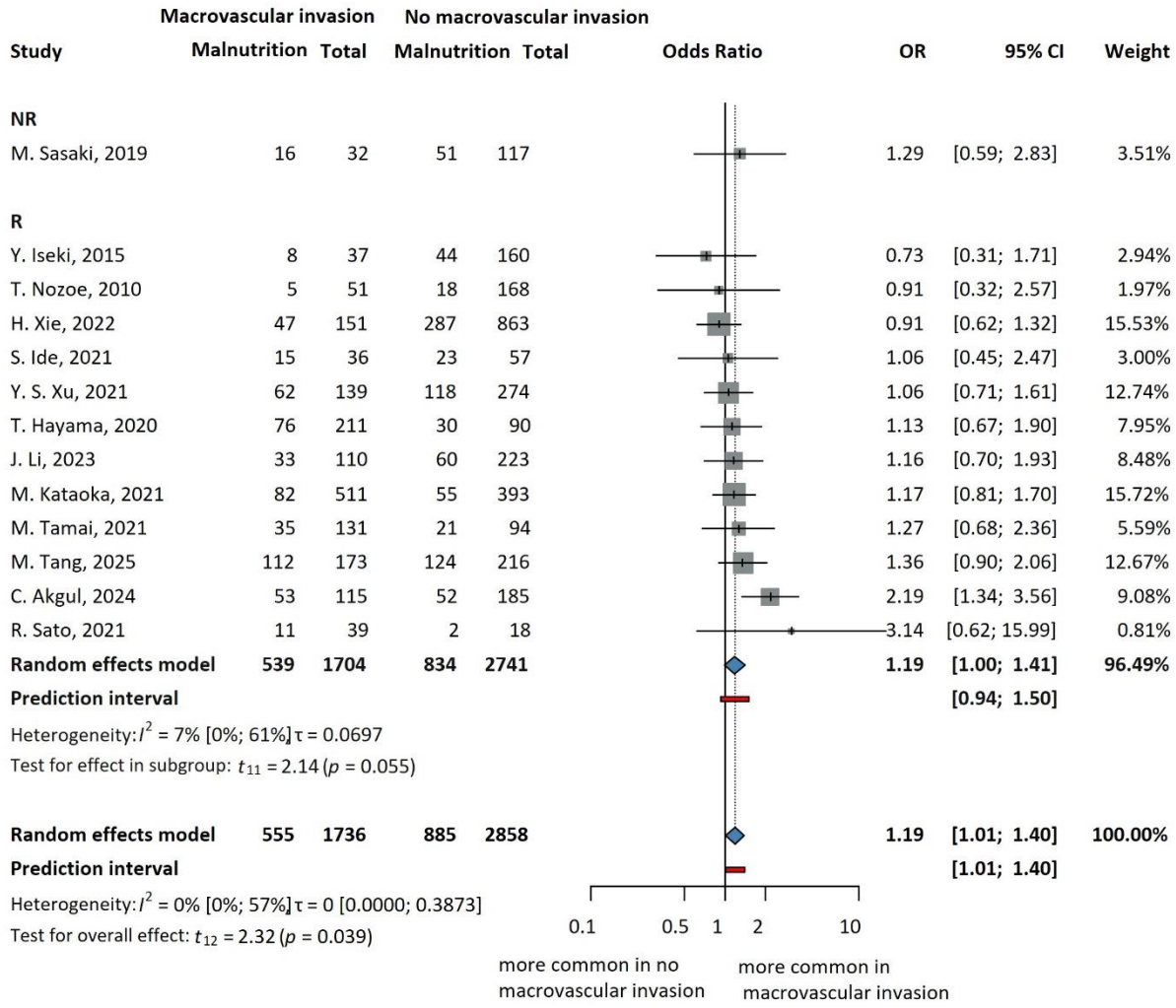


Figure S119.: Association between malnutrition-related complication risk and macrovascular invasion in colorectal carcinoma (Biological composite scores)



Abbreviations: R= resectable; NR= non-resectable

Figure S120.: Association between malnutrition-related complication risk and macrovascular invasion in hepatocellular carcinoma (Biological composite scores)

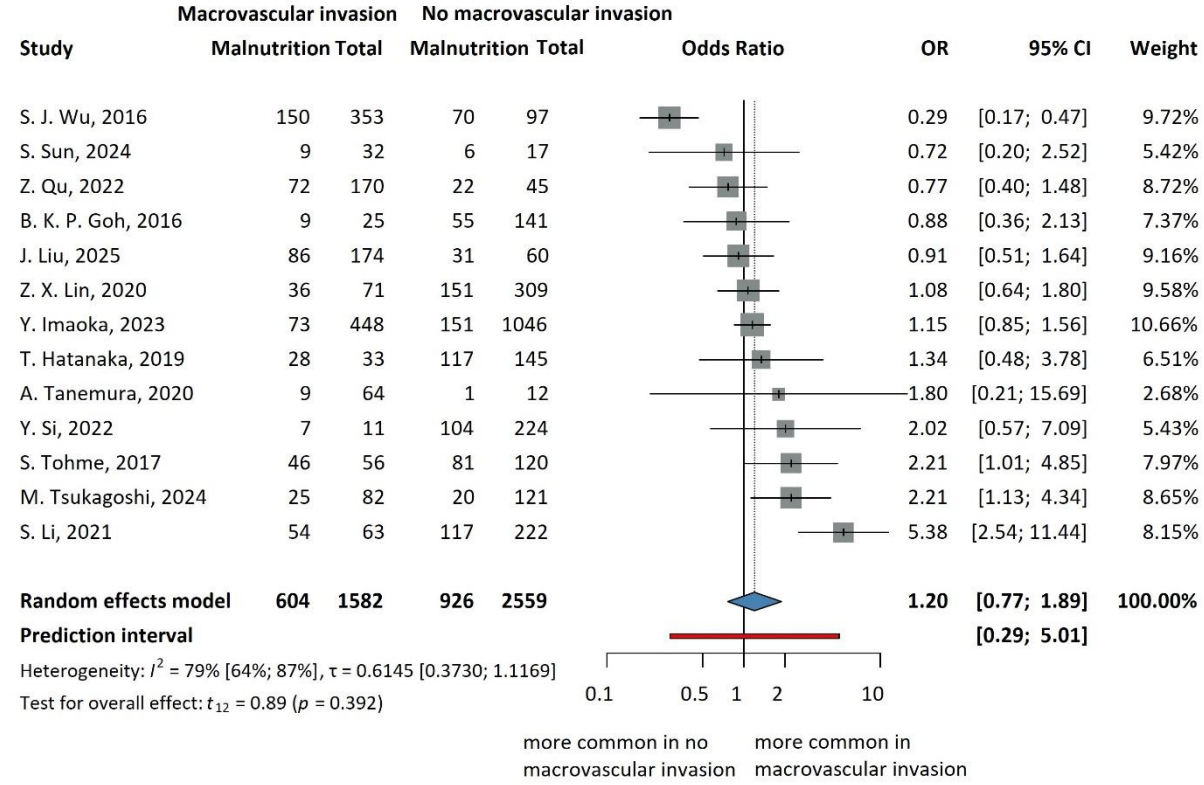
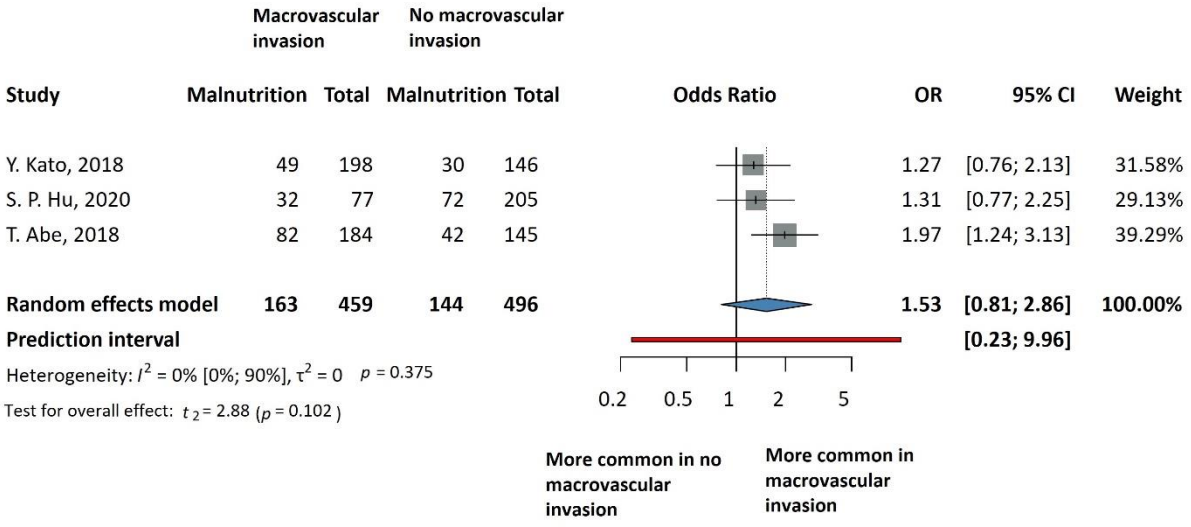


Figure S121.: Association between malnutrition-related complication risk and macrovascular invasion in pancreatic ductal adenocarcinoma (Biological composite scores)



Supplementary Document S13: Individual forest plots for neoadjuvant therapy: Figures S122-S125.

Figure S122.: Association between malnutrition-related complication risk and neoadjuvant chemotherapy in upper gastrointestinal cancer (Biological composite scores)

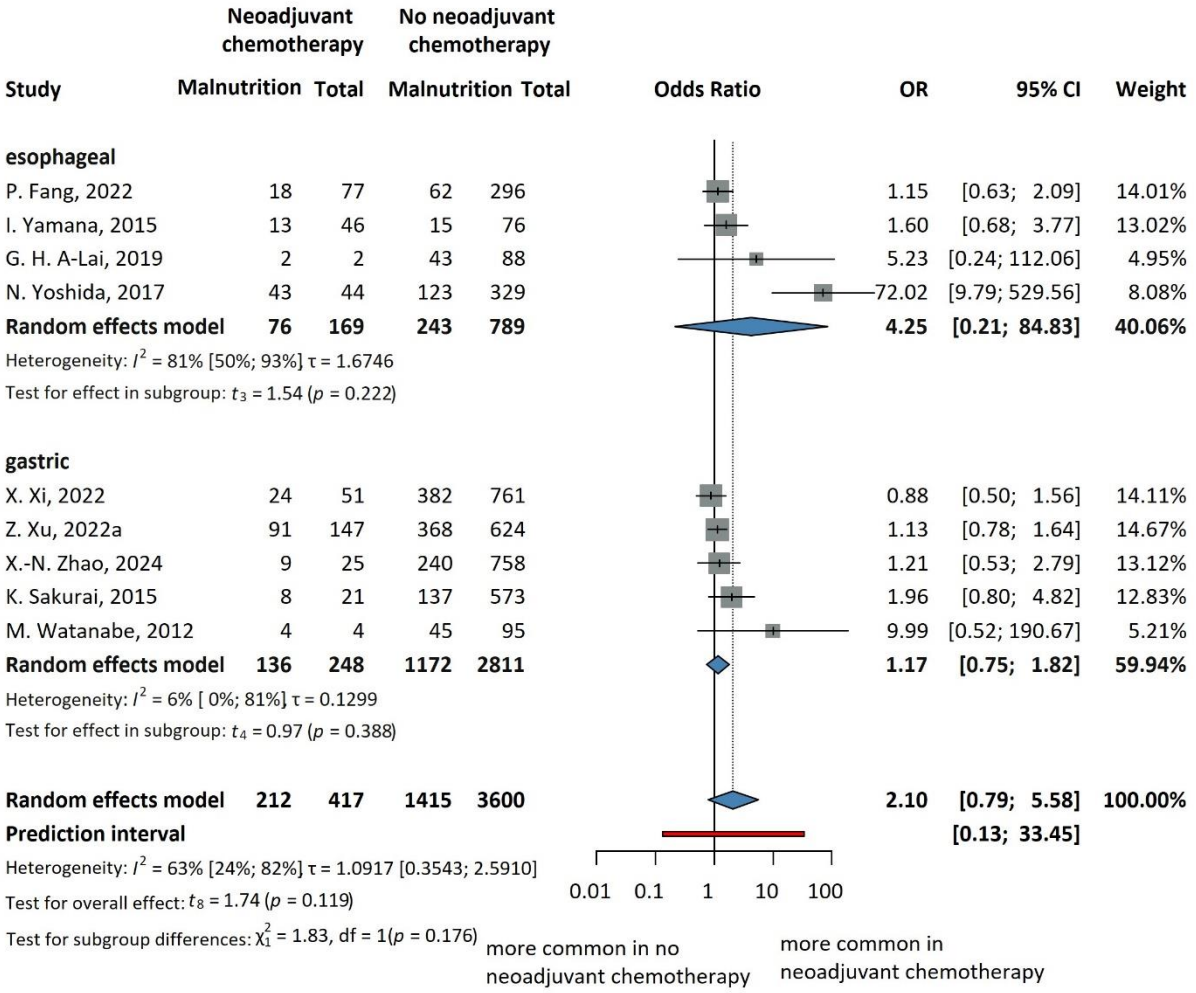


Figure S123.: Association between malnutrition risk and neoadjuvant chemo or radiotherapy in esophageal and in colorectal carcinoma (Symptom-based risk assessment tool)

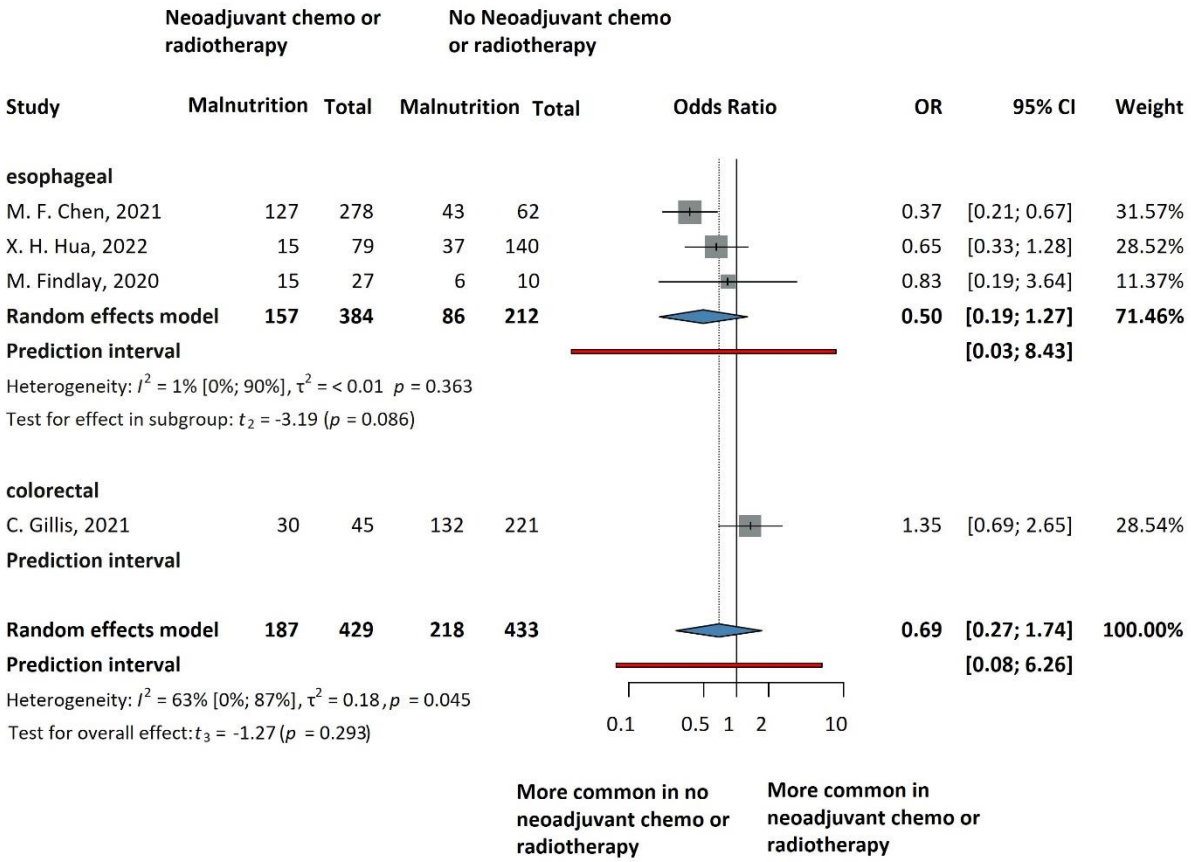


Figure S124.: Association between malnutrition-related complication risk and neoadjuvant chemo or radiotherapy in upper gastrointestinal cancer (Biological composite scores)

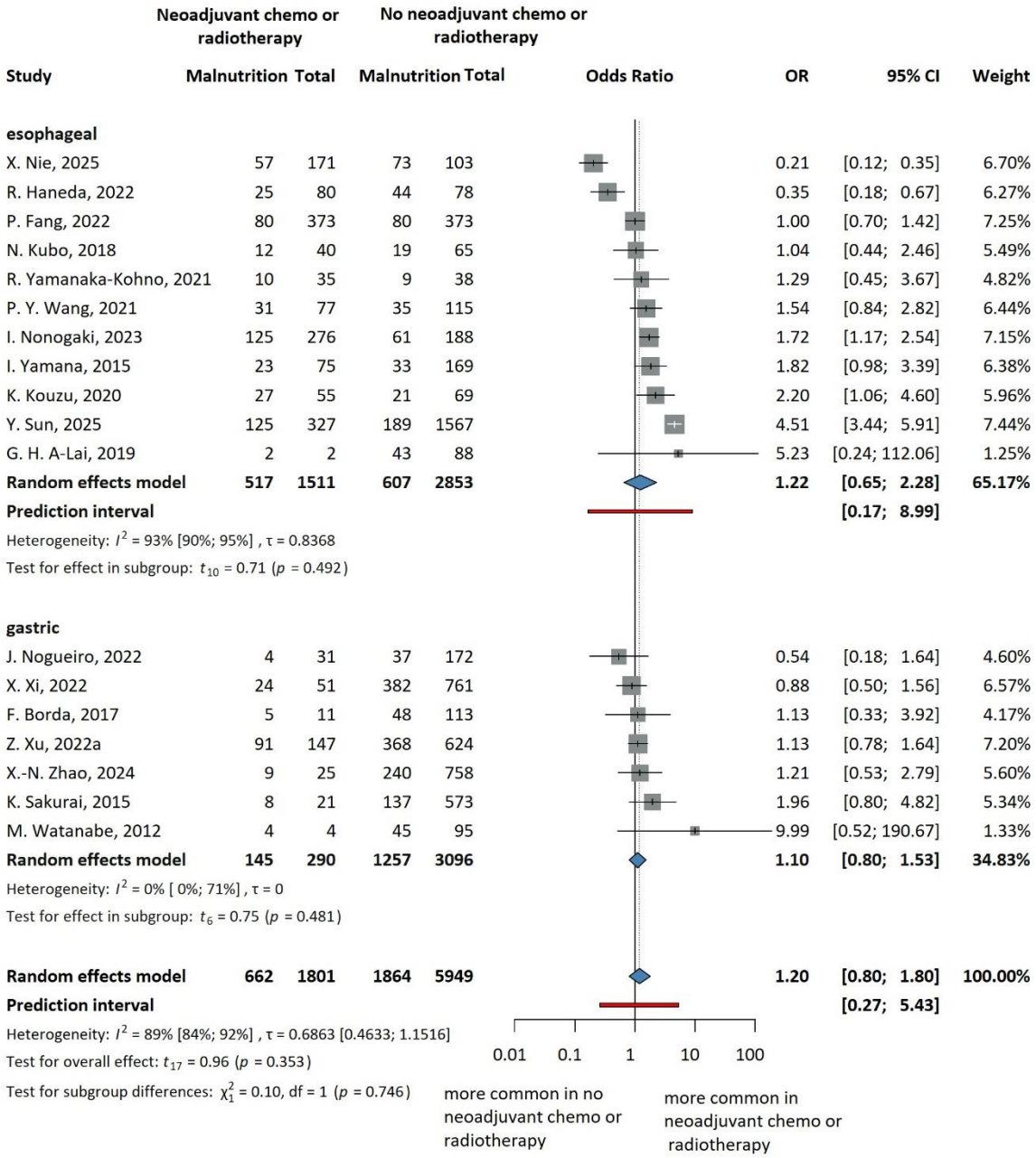
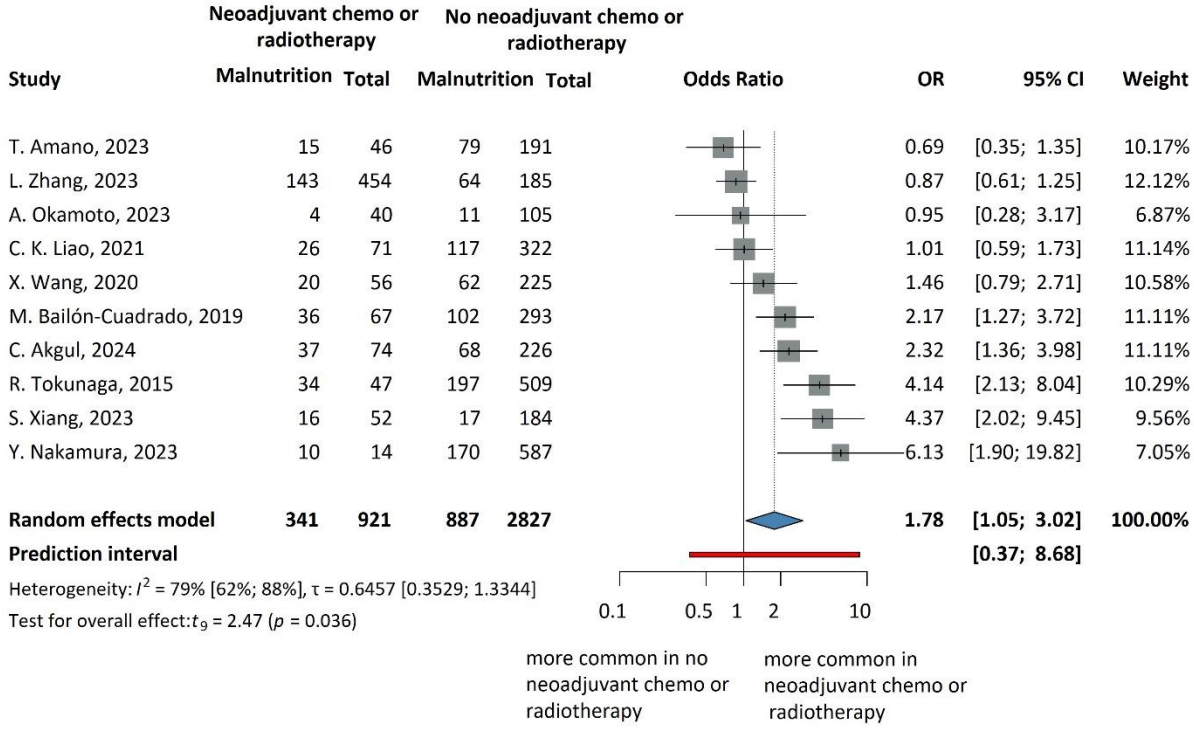


Figure S125.: Association between malnutrition-related complication risk and neoadjuvant chemo or radiotherapy in colorectal cancer (Biological composite scores)



Supplementary Document S14: Moderator analysis: Figures S126-S172

For age categories, we assumed a normal distribution of age, allowing us to treat mean and median values equivalently; therefore, studies were categorized using an age cut off of <70 vs. ≥70, regardless of whether the reported value was a mean or median. However, moderator analysis based on categorized continuous variables may introduce ecological bias.

Figure S126. Cancer type moderator analysis for the association between malnutrition-related complication risk and age >65 vs. <65 in gastrointestinal cancer (Biological composite scores)

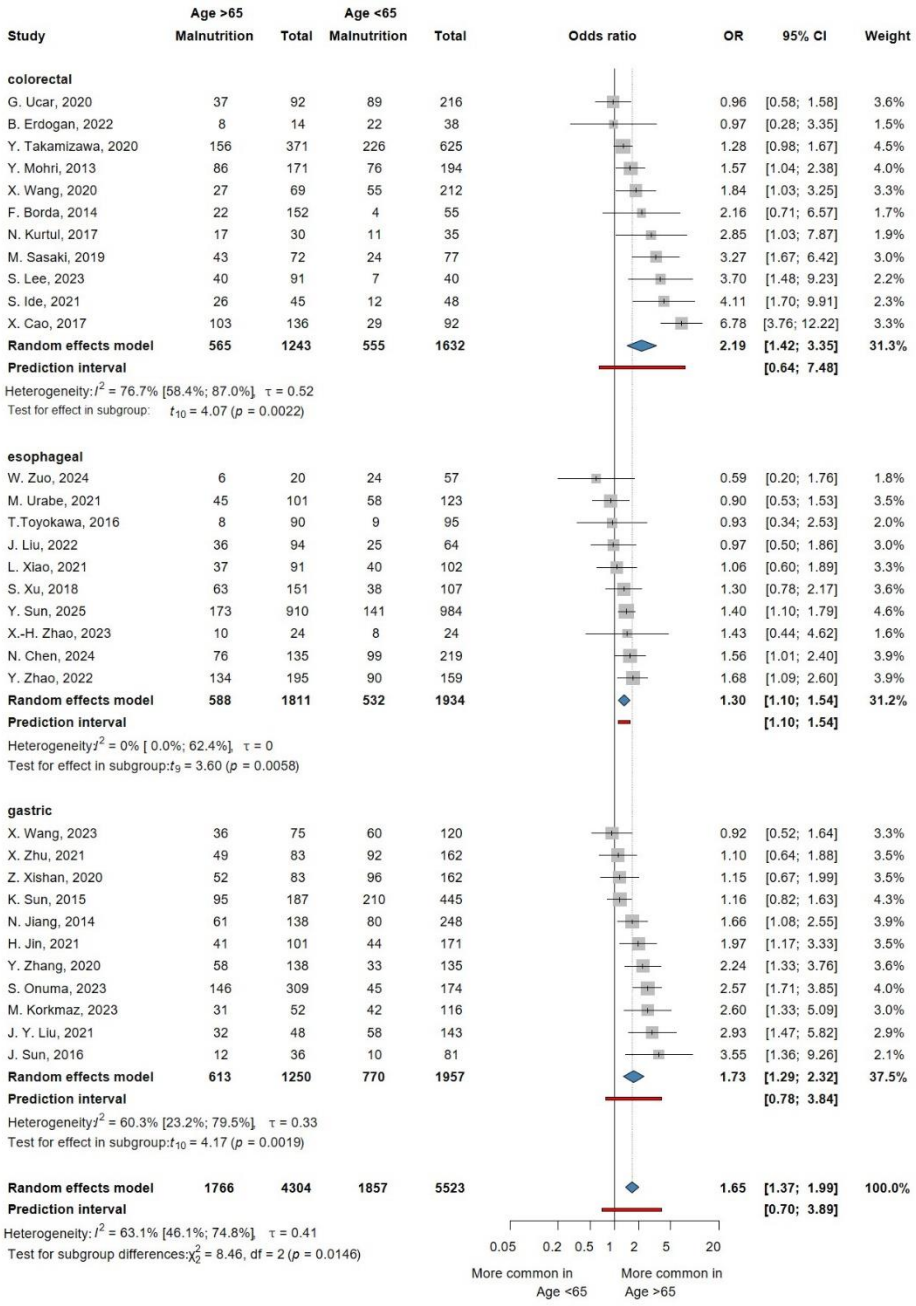
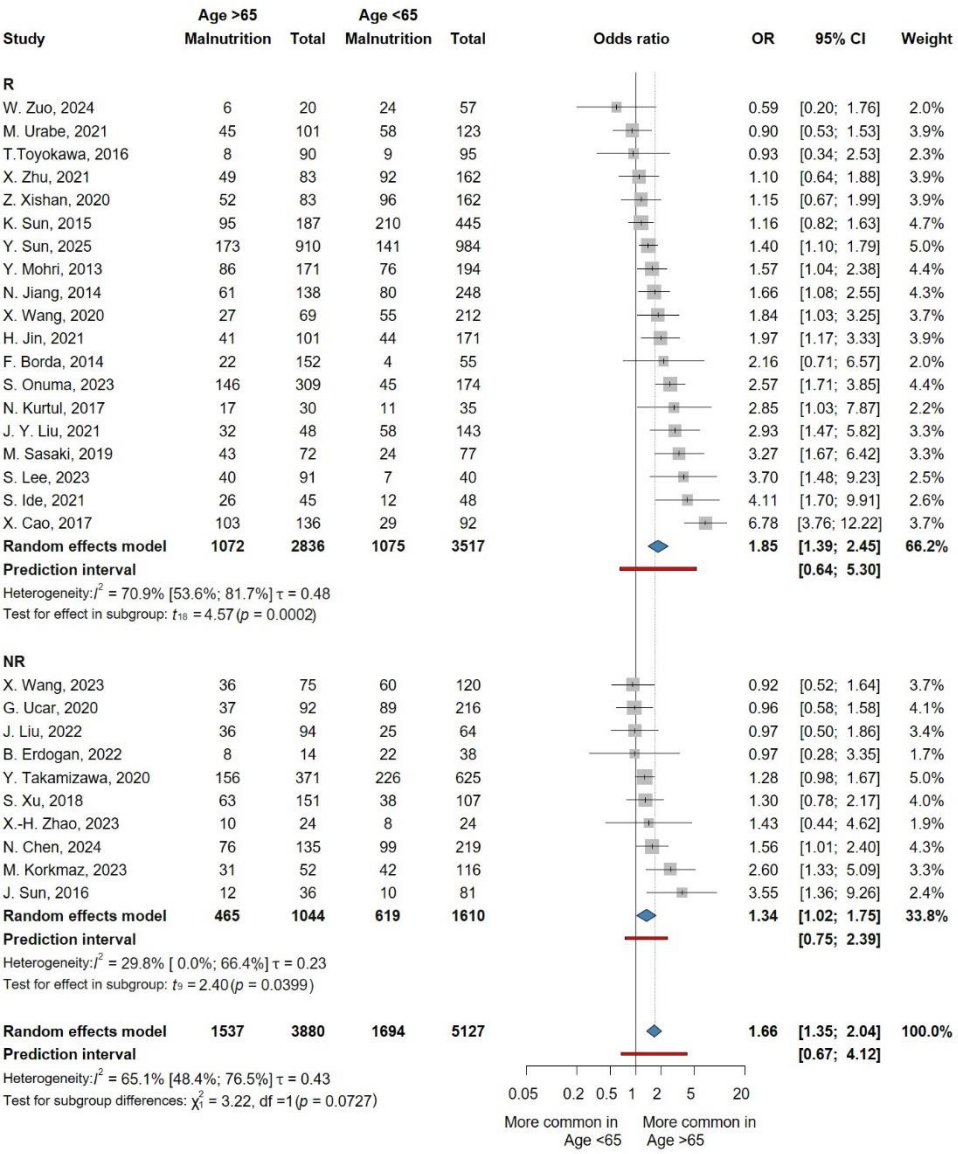
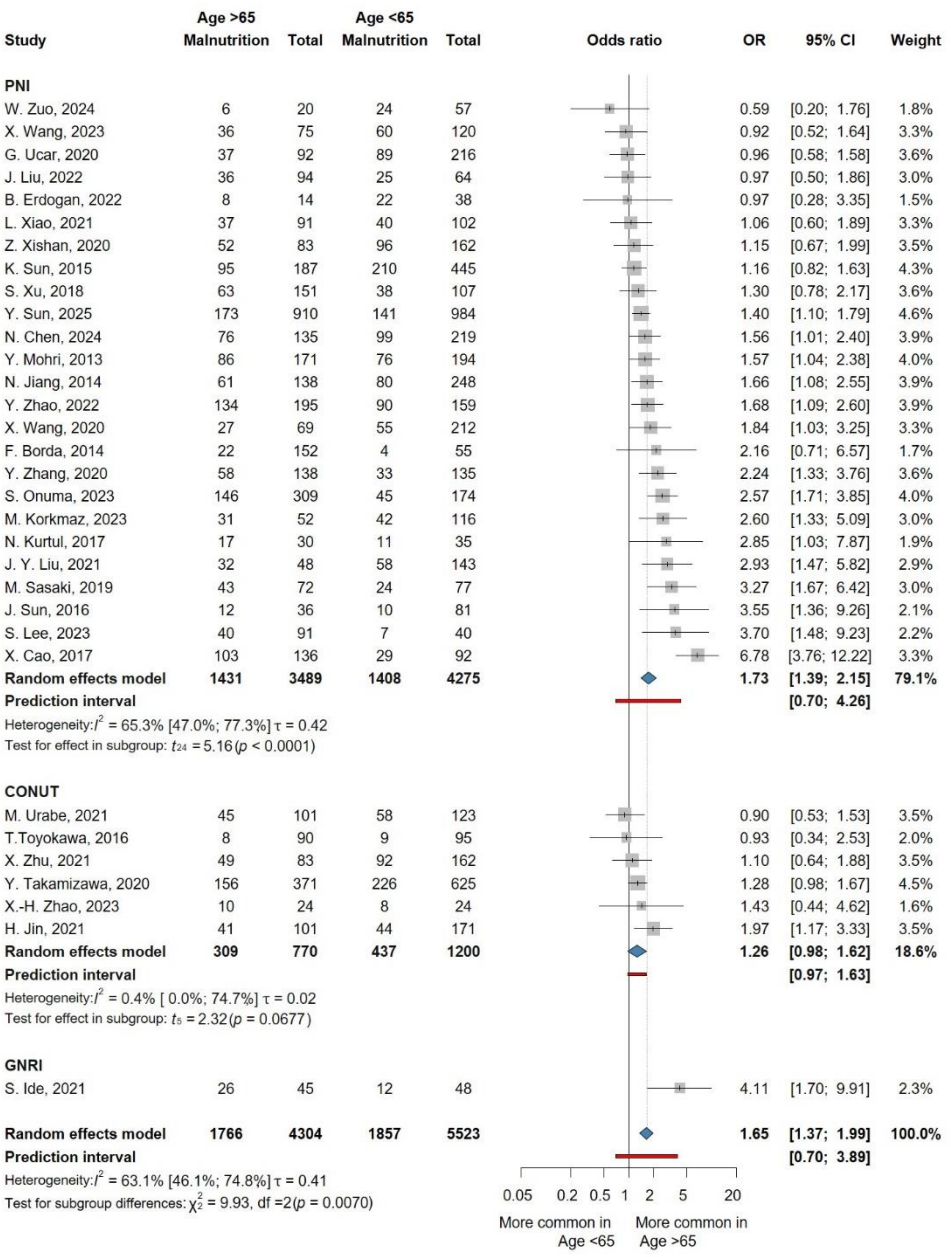


Figure S127. Resectability moderator analysis for the association between malnutrition-related complication risk and age >65 vs. <65 in gastrointestinal cancer (Biological composite scores)



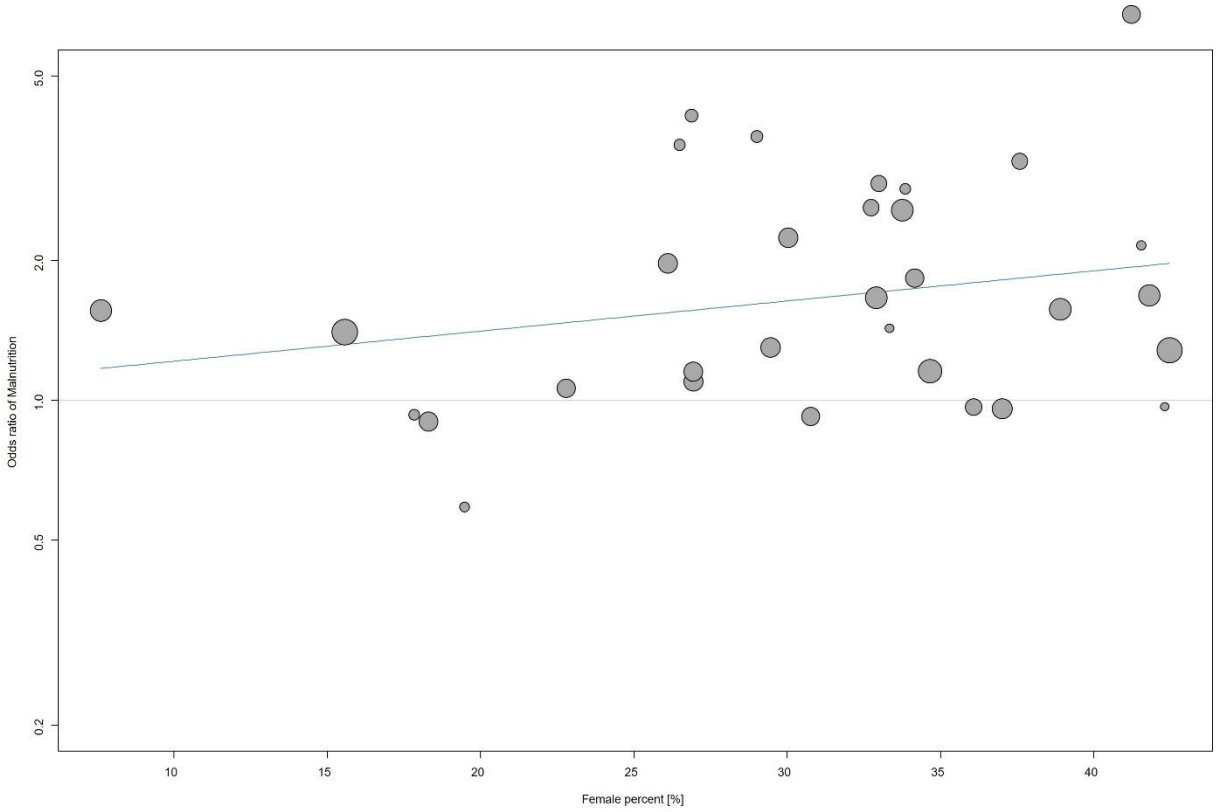
Abbreviations: R= resectable, NR= non-resectable

Figure S128. Assessment tool moderator analysis for the association between malnutrition-related complication risk and age >65 vs. <65 in gastrointestinal cancer (Biological composite scores)



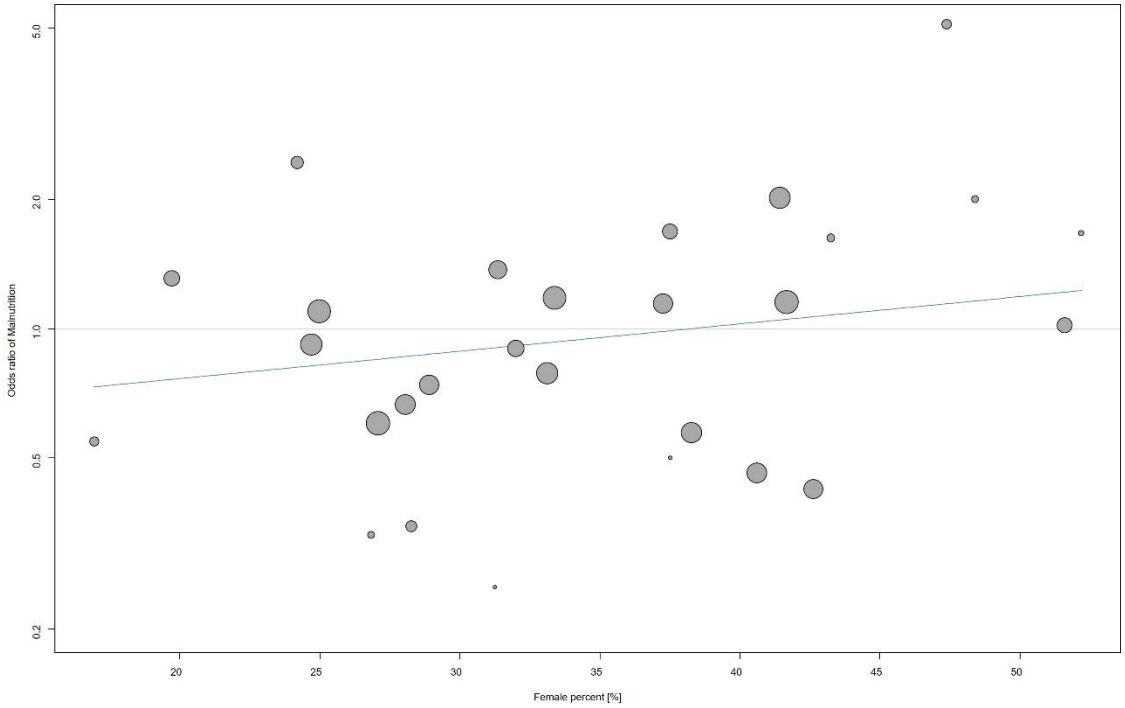
Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S129. Female proportion meta regression analysis for the association between malnutrition-related complication risk and age >65 vs. <65 in gastrointestinal cancer (Biological composite scores)



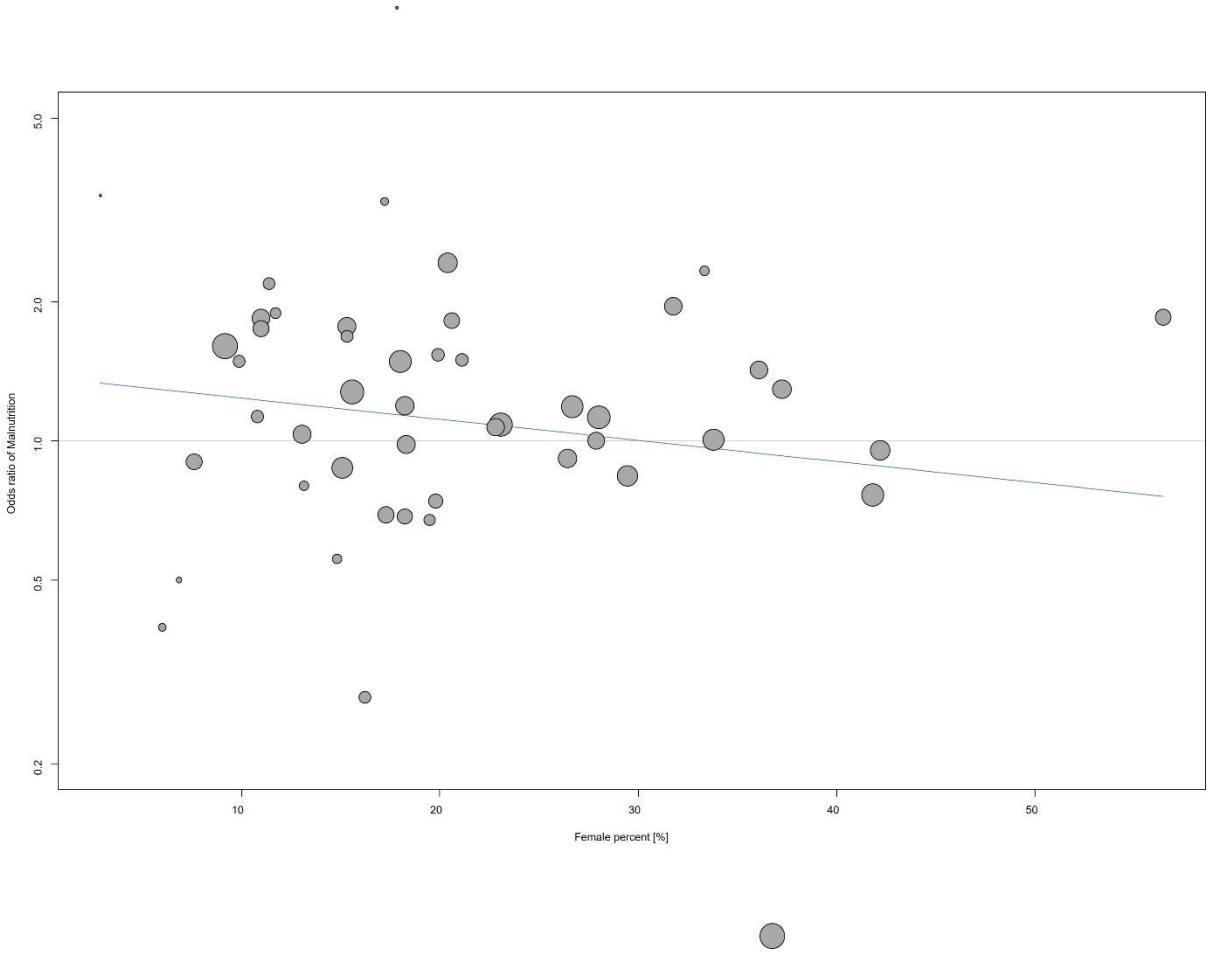
Assuming a linear relation, the estimated slope is 0.015 [95% CI: -0.0064 - 0.0363] [log(OR of Malnutrition) / female %] (p-value: 0.1624). NOTE: it is given in the log scale!

Figure S130. Female proportion meta regression analysis for the association between malnutrition risk and sex in colorectal cancer (symptom-based tools)



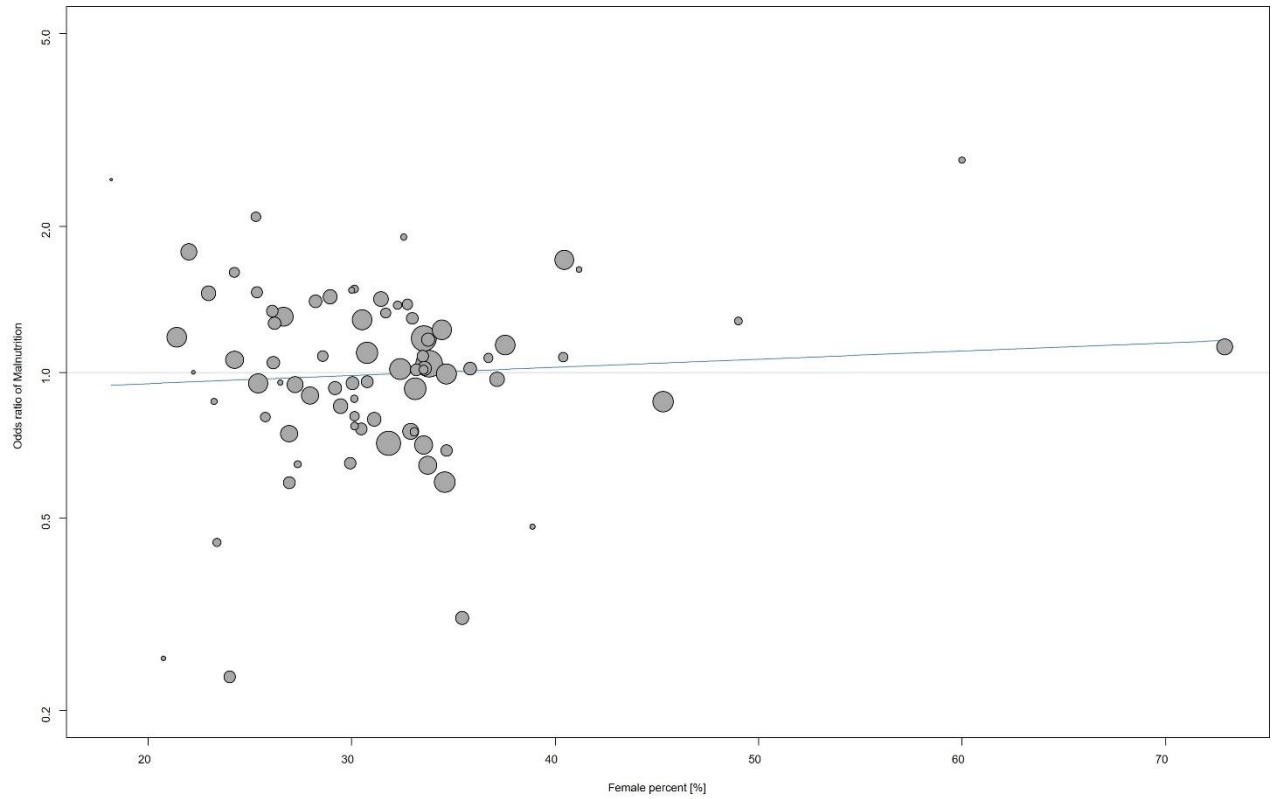
Assuming a linear relation, the estimated slope is -0.0231 [95% CI: -0.0553 - 0.0091] [log(OR of Malnutrition) / female %] (p-value: 0.1502). NOTE: it is given in the log scale!

Figure S131. Female proportion meta regression analysis for the association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



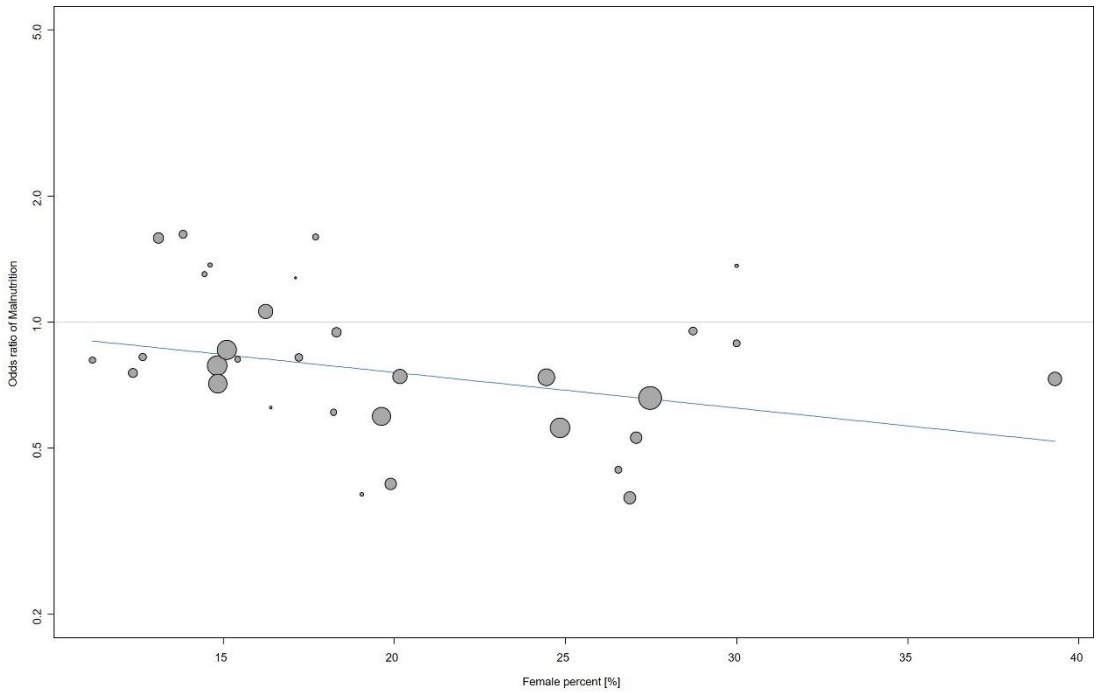
Assuming a linear relation, the estimated slope is -0.0105 [95% CI: -0.028 - 0.0069] [log(OR of Malnutrition) / female %] (p-value: 0.2305). NOTE: it is given in the log scale!

Figure S132. Female proportion meta regression analysis for the association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)



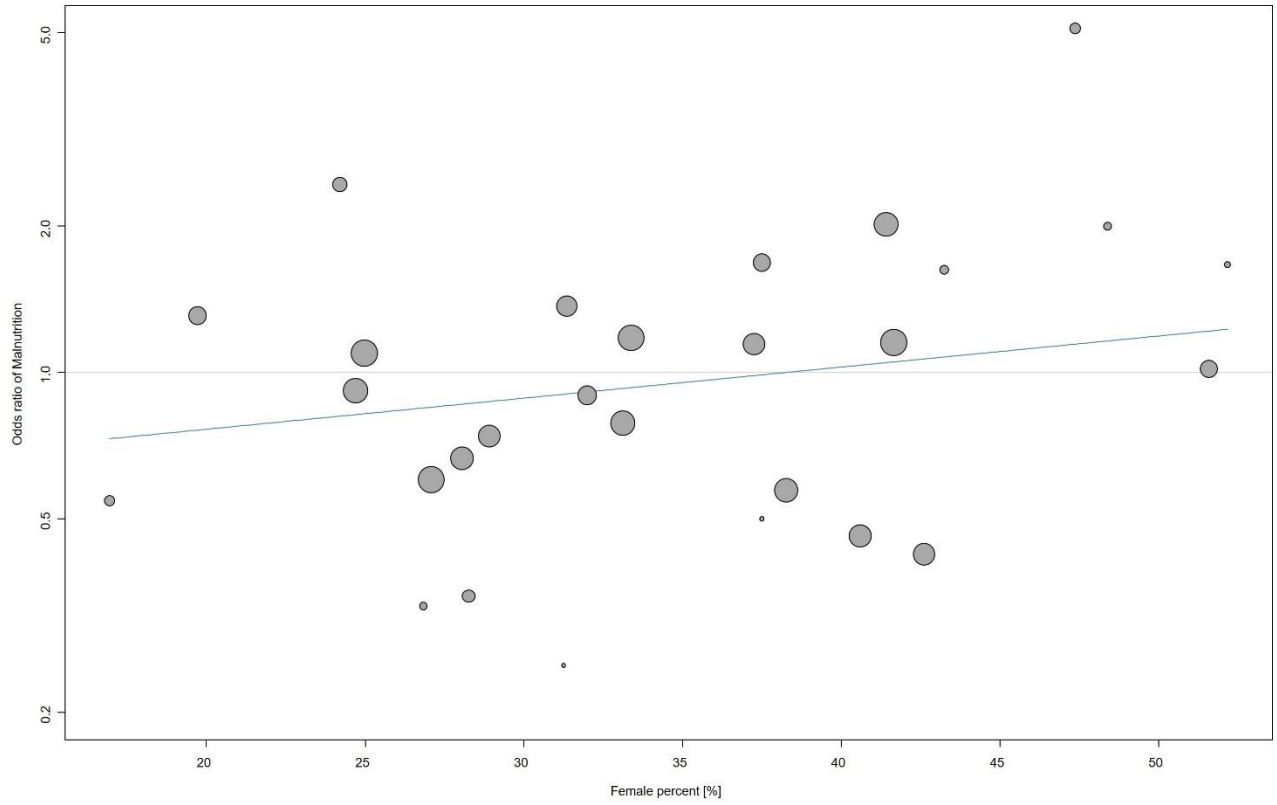
Assuming a linear relation, the estimated slope is 0.0038 [95% CI: -0.0072 - 0.0149] [log(OR of Malnutrition) / female %] (p-value: 0.4914). NOTE: it is given in the log scale!

Figure S133. Female proportion meta regression analysis for the association between malnutrition-related complication risk and sex in resectable hepatocellular carcinoma (Biological composite scores)



Assuming a linear relation, the estimated slope is -0.0197 [95% CI: -0.0374 - -0.0019] [log(OR of Malnutrition) / female %] (p-value: 0.0308). NOTE: it is given in the log scale!

Figure S134. Female proportion meta regression analysis for the association between cachexia and sex in gastrointestinal cancer



Assuming a linear relation, the estimated slope is 0.0147 [95% CI: -0.0119 - 0.0413] [log(OR of Malnutrition) / female %] (p-value: 0.2671). NOTE: it is given in the log scale!

Figure S135. Cancer type moderator analysis for the association between cachexia and sex in gastrointestinal cancer

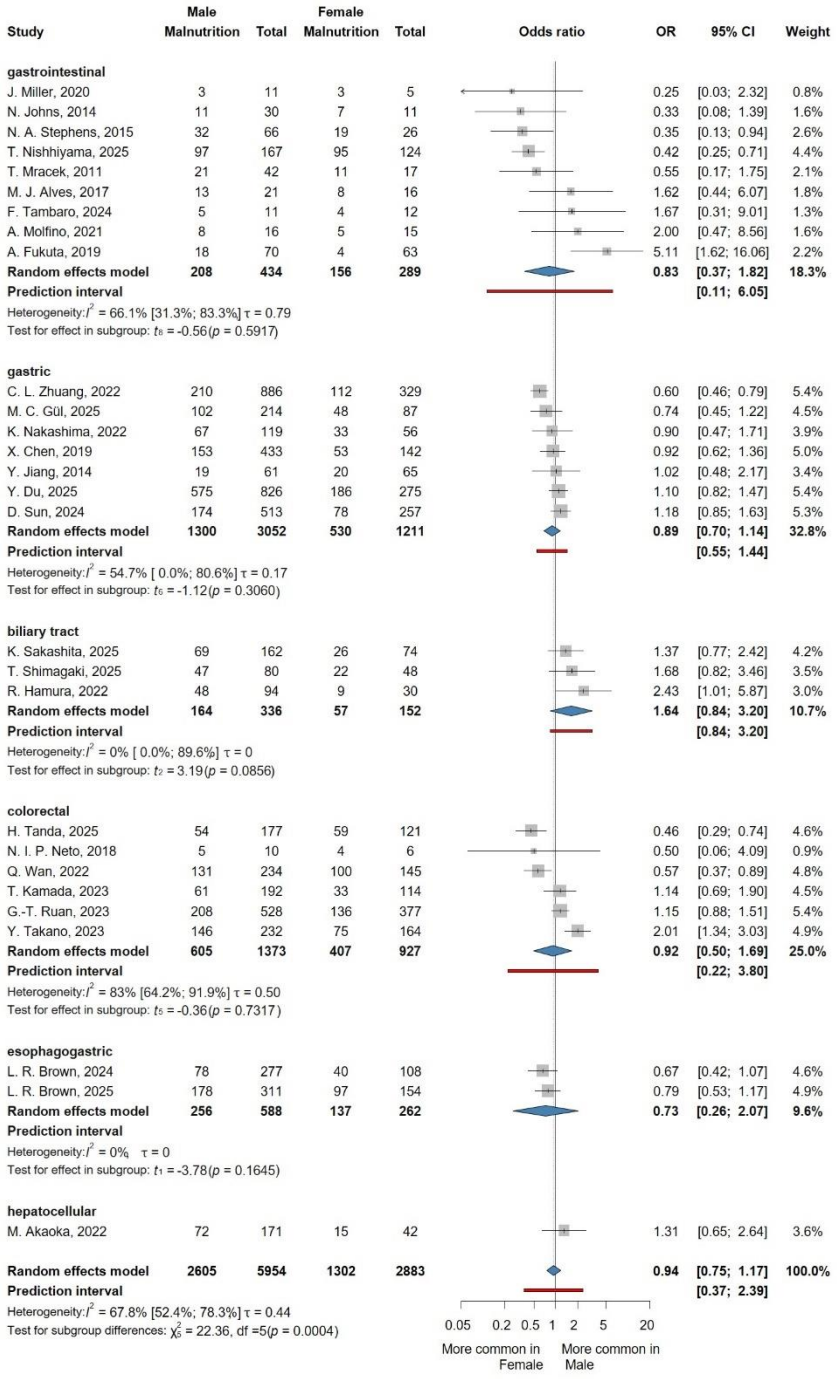


Figure S136. Assessment tool moderator analysis for the association between cachexia and sex in gastrointestinal cancer

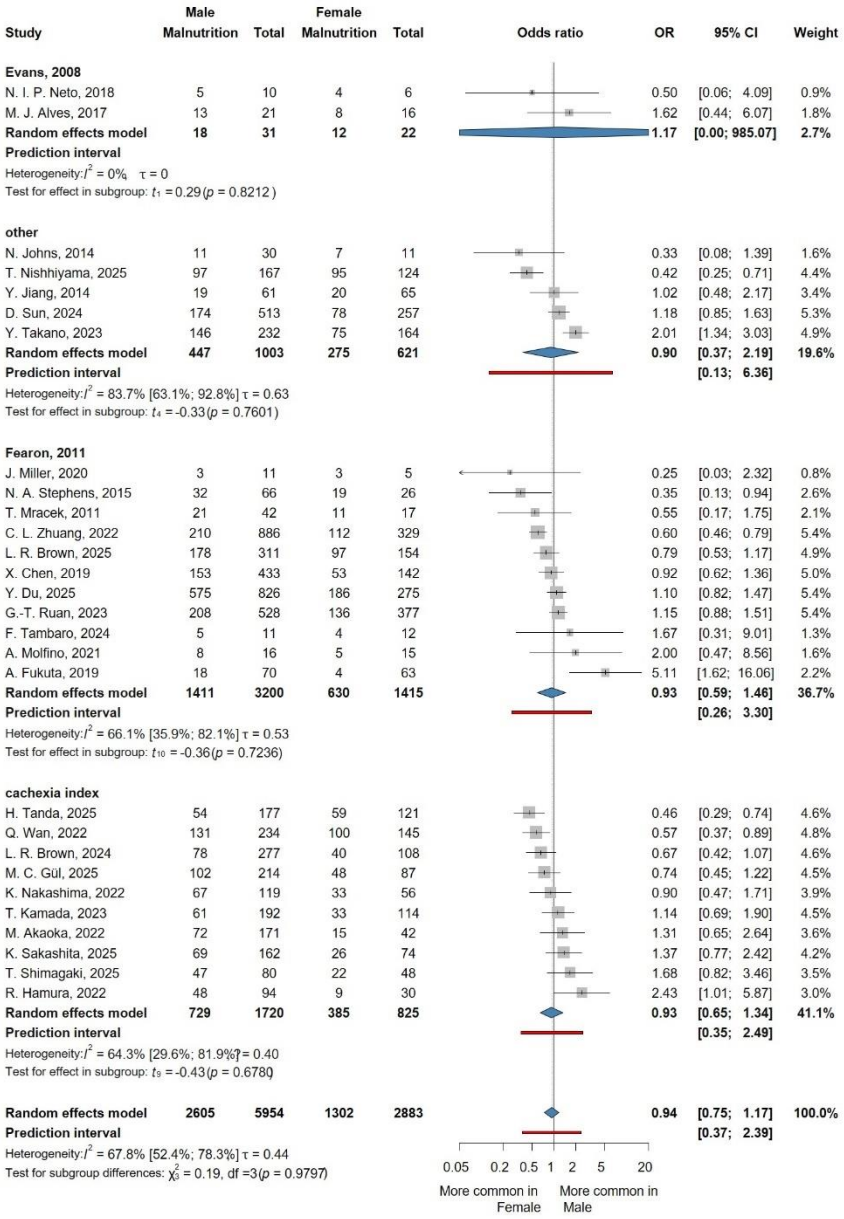
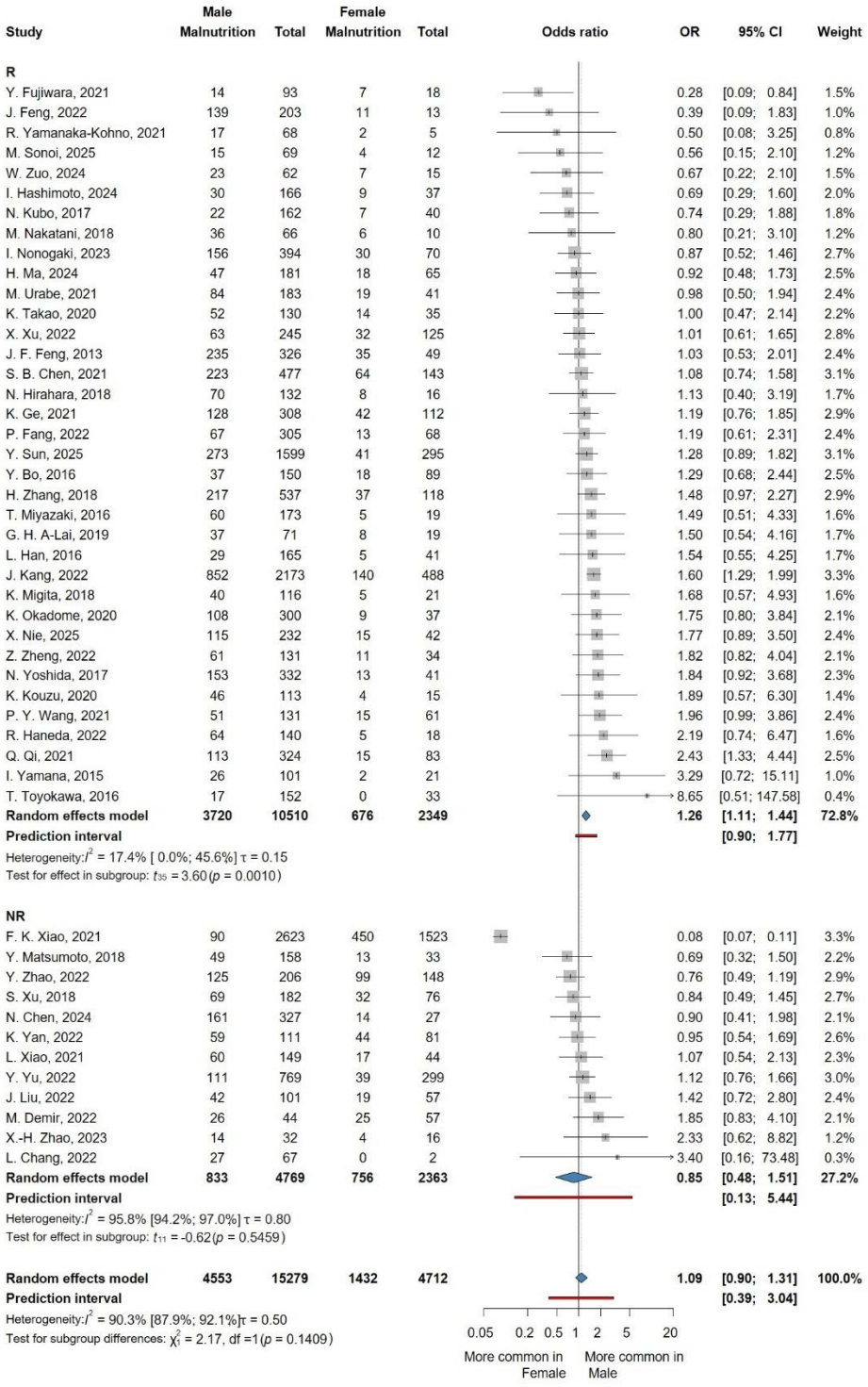


Figure S137. Resectability moderator analysis for the association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



Abbreviations: R= resectable, NR= non-resectable

Figure S138. Cancer type moderator analysis for the association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)

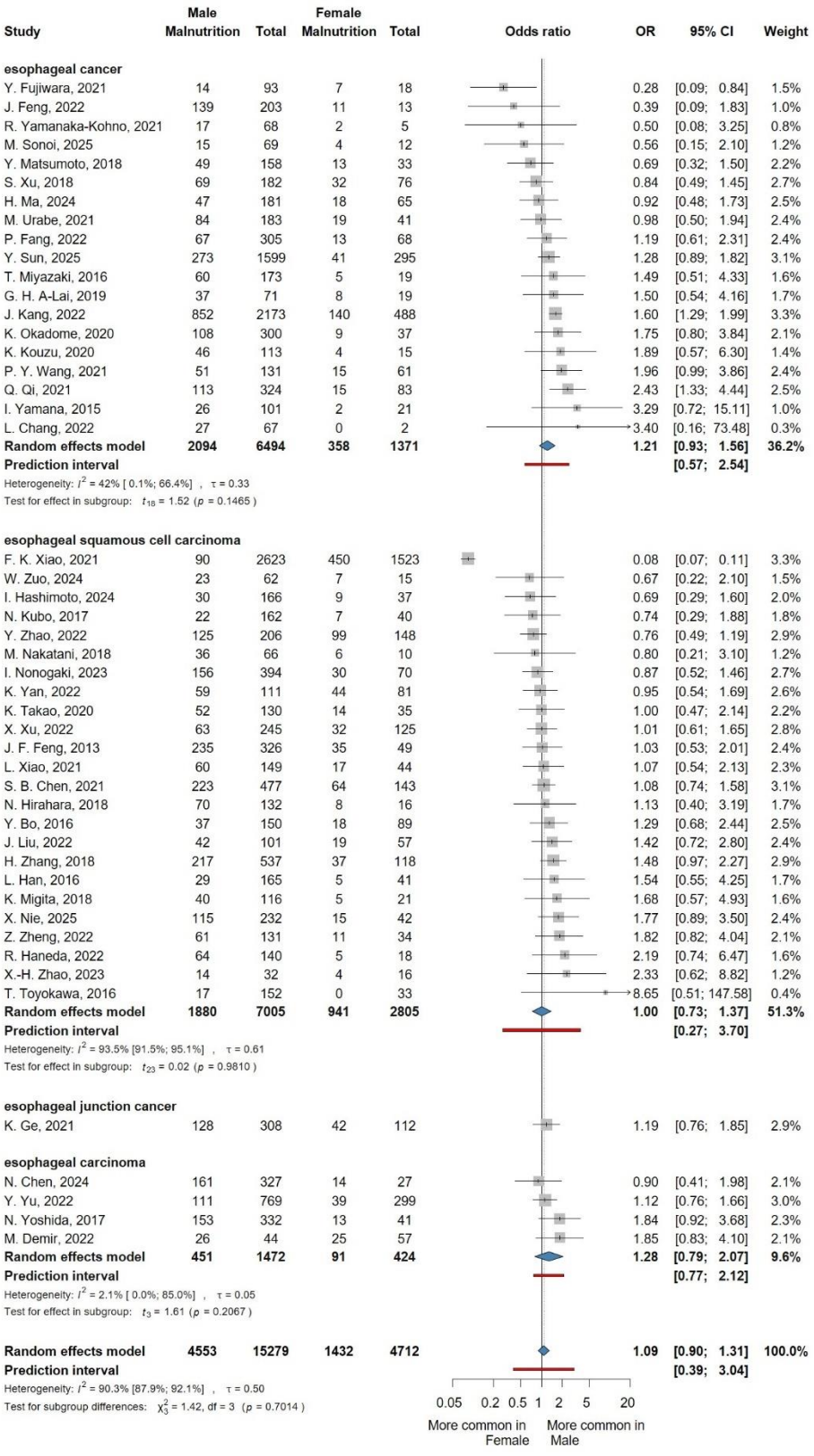
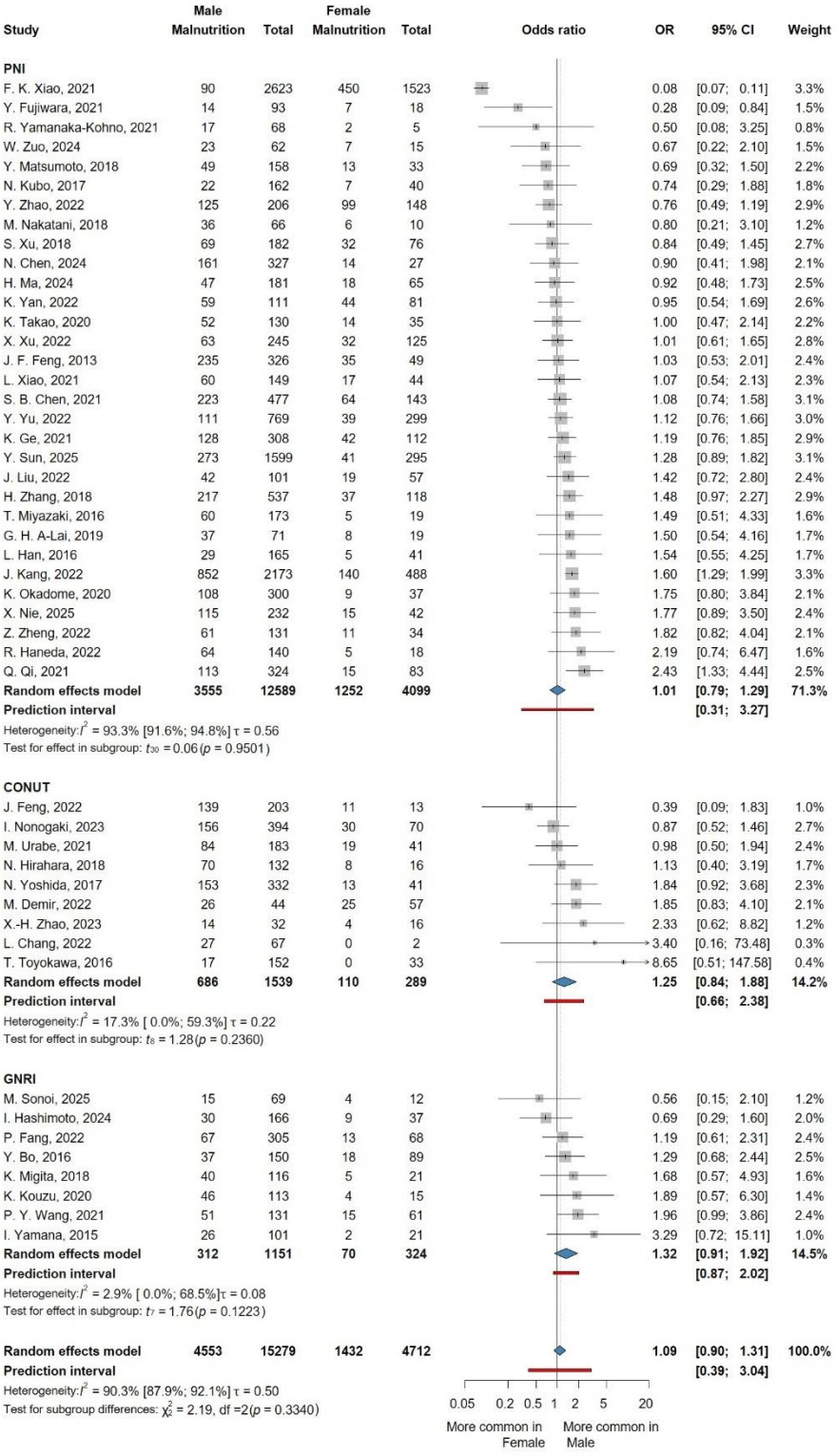


Figure S139. Assessment tool moderator analysis for the association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S140. Cancer type moderator analysis for the association between malnutrition risk and sex in colorectal cancer (symptom-based tools)

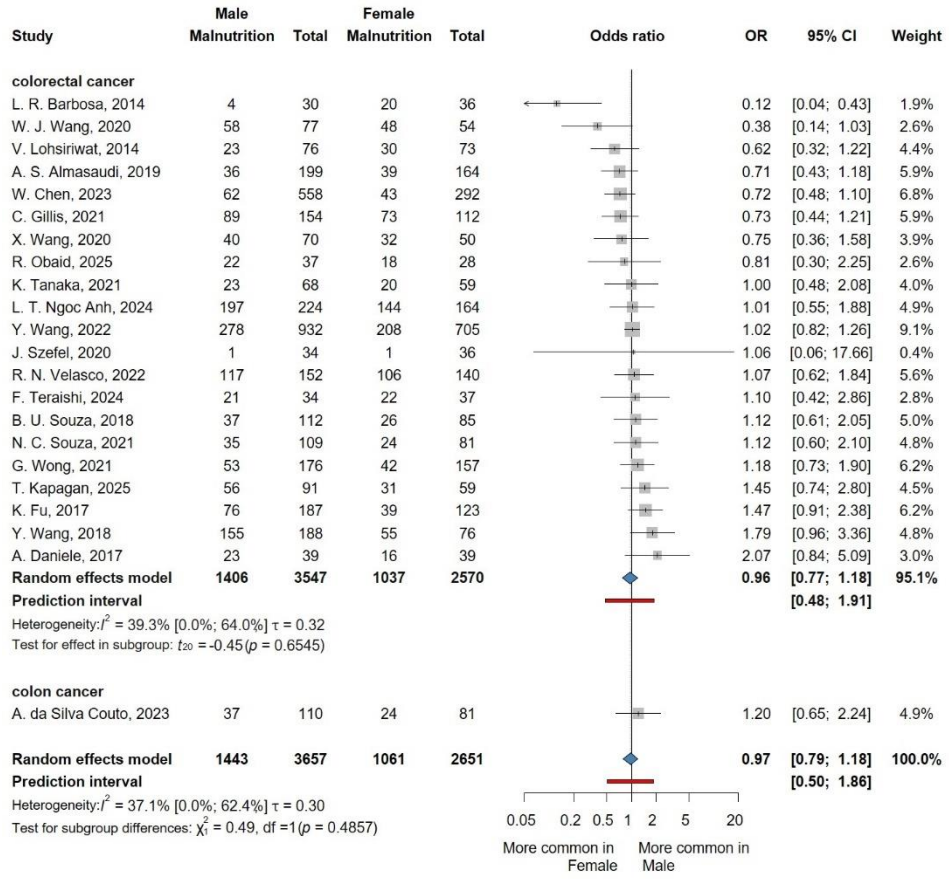
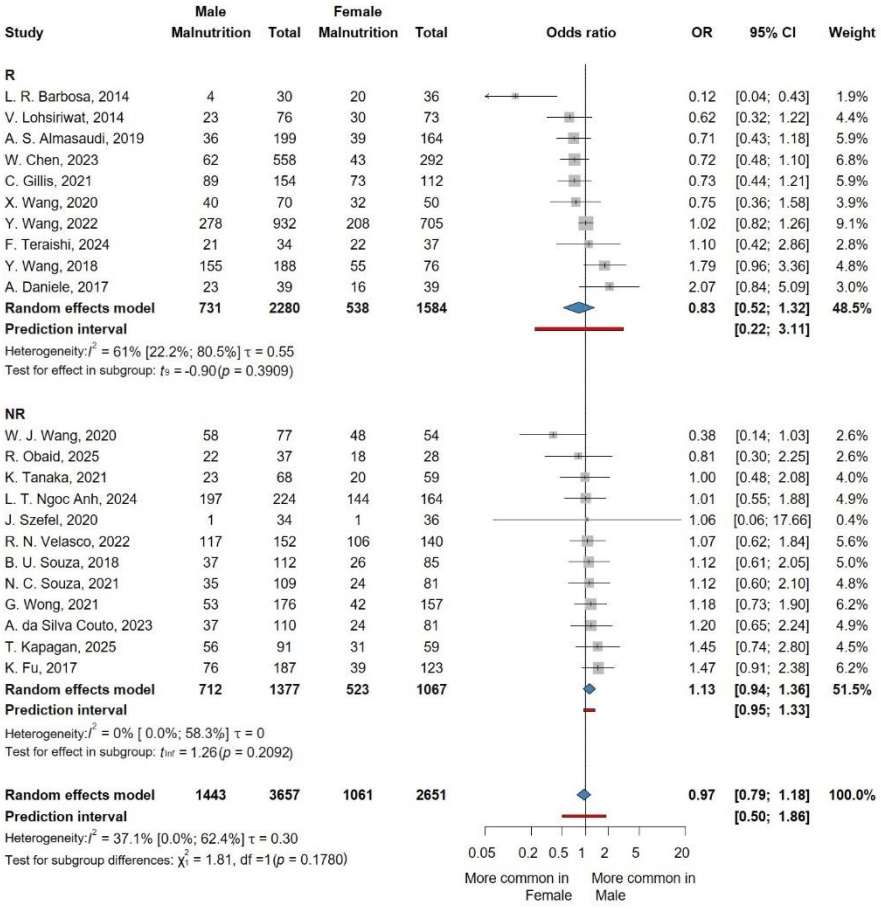
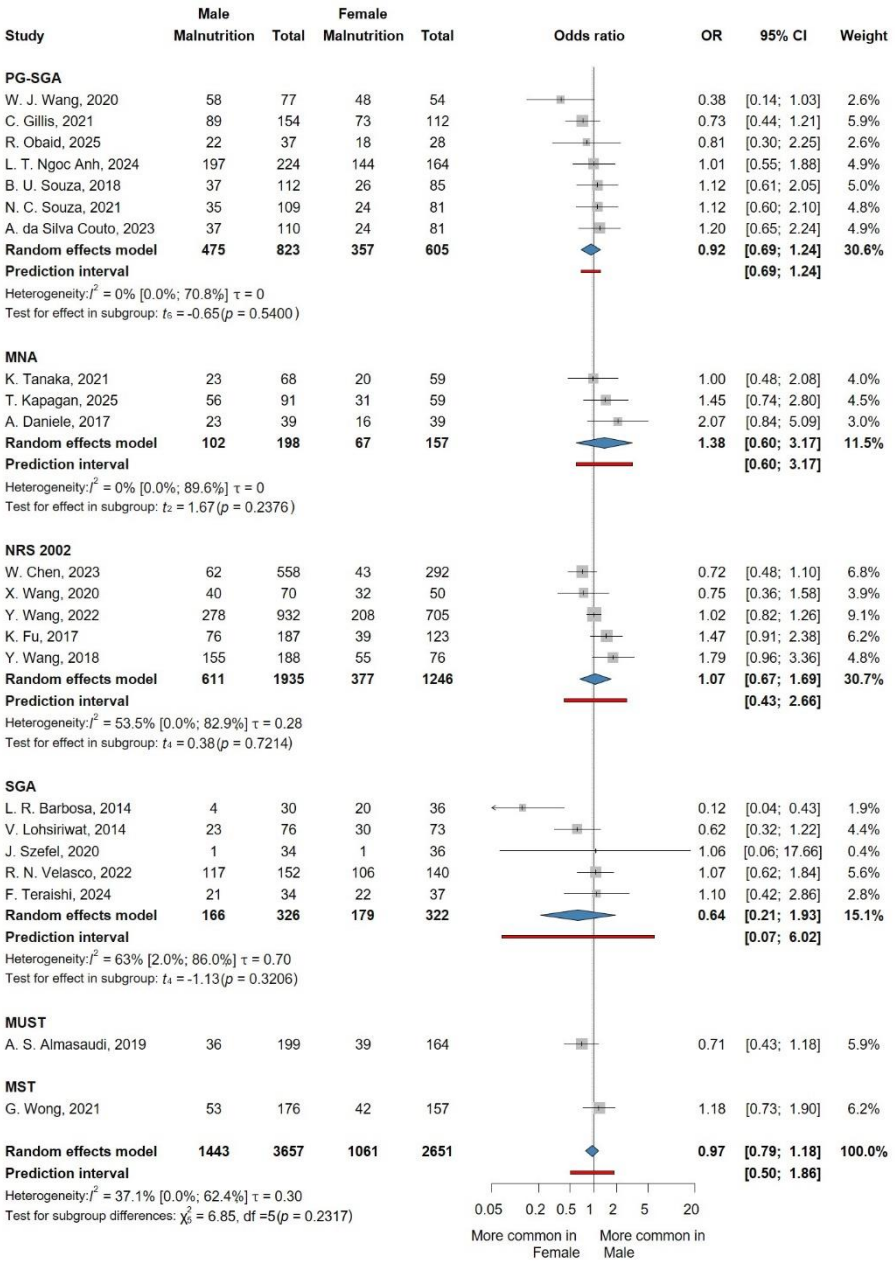


Figure S141. Resectability moderator analysis for the association between malnutrition risk and sex in colorectal cancer (symptom-based tools)



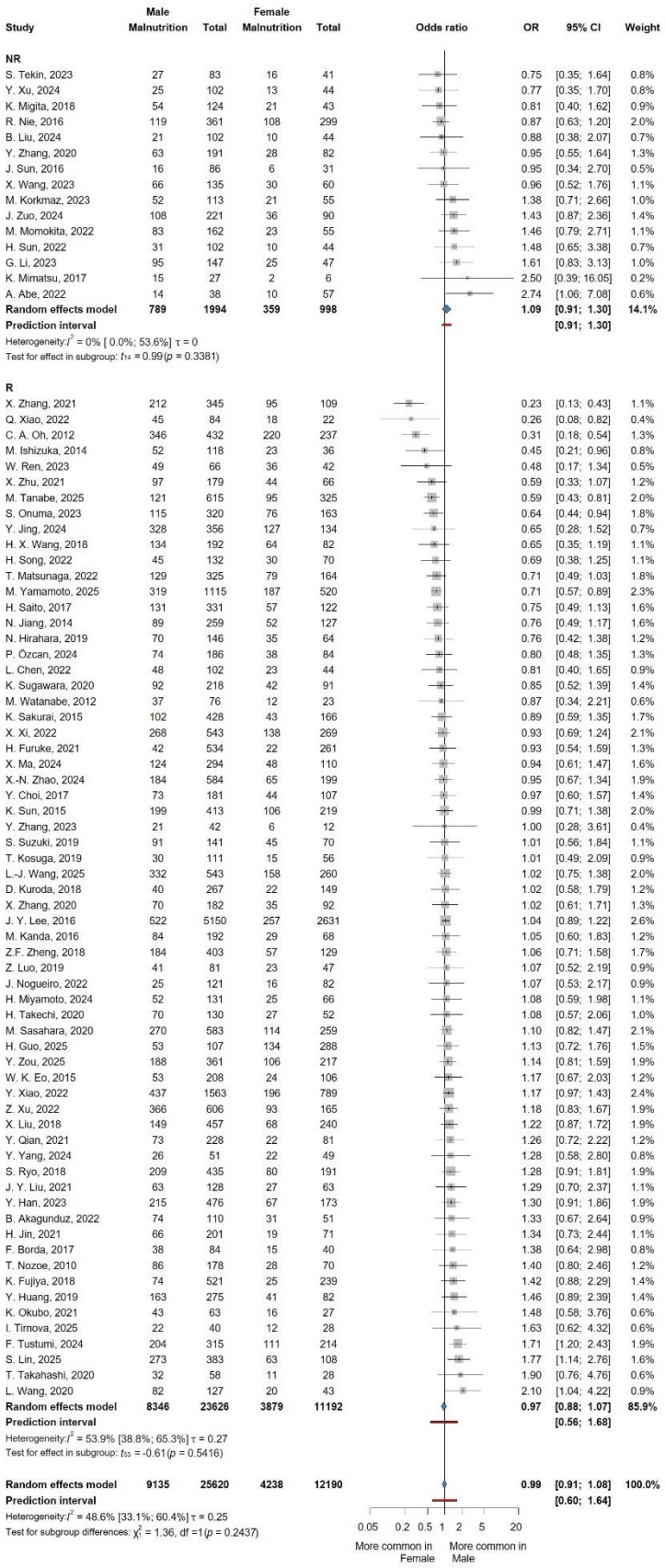
Abbreviations: R= resectable, NR= non-resectable

Figure S142. Assessment tool moderator analysis for the association between malnutrition risk and sex in colorectal cancer (symptom-based tools)



Abbreviations: PG-SGA= Patient-Generated Subjective Global Assessment, MNA= Mini Nutritional Assessment, NRS 2002= Nutrition Risk Screening 2002, SGA= Subjective Global Assessment, MUST= Malnutrition Universal Screening Tool, MST= Malnutrition Screening Tool

Figure S143. Resectability moderator analysis for the association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)



Abbreviations: R= resectable, NR= non-resectable

Figure S144. Age group moderator analysis for the association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)

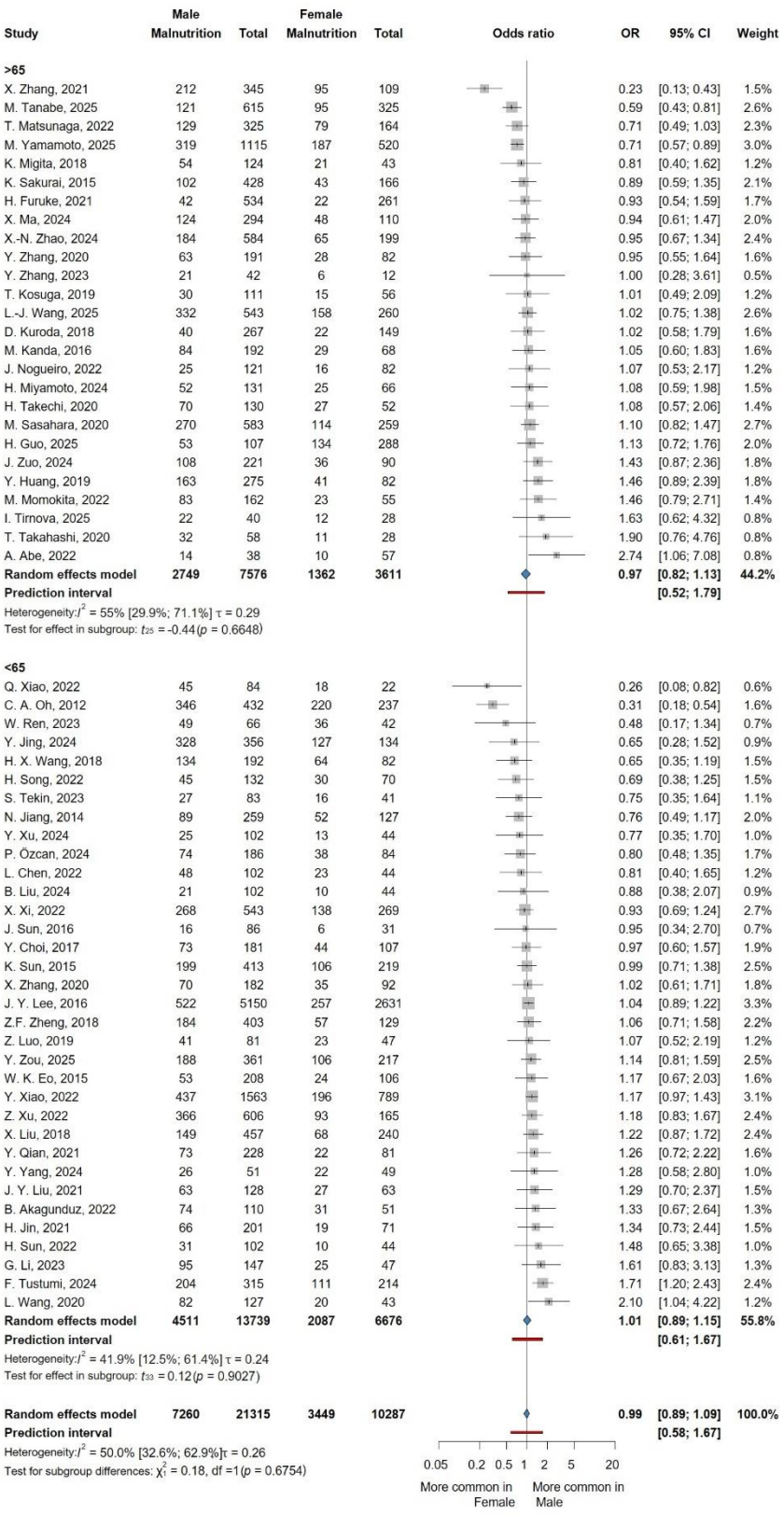
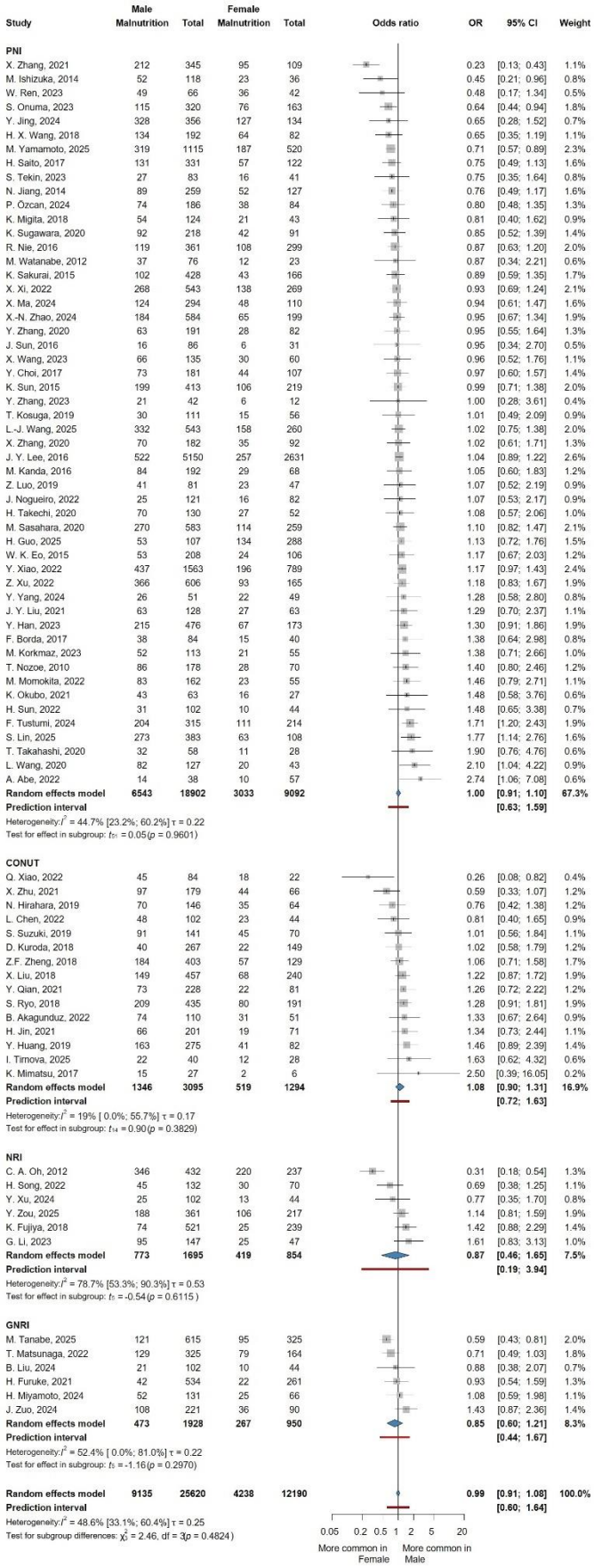


Figure S145. Assessment tool moderator analysis for the association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index, NRI = Nutritional Risk Index

Figure S146. Age group moderator analysis for the association between malnutrition-related complication risk and sex in resectable hepatocellular carcinoma (Biological composite scores)

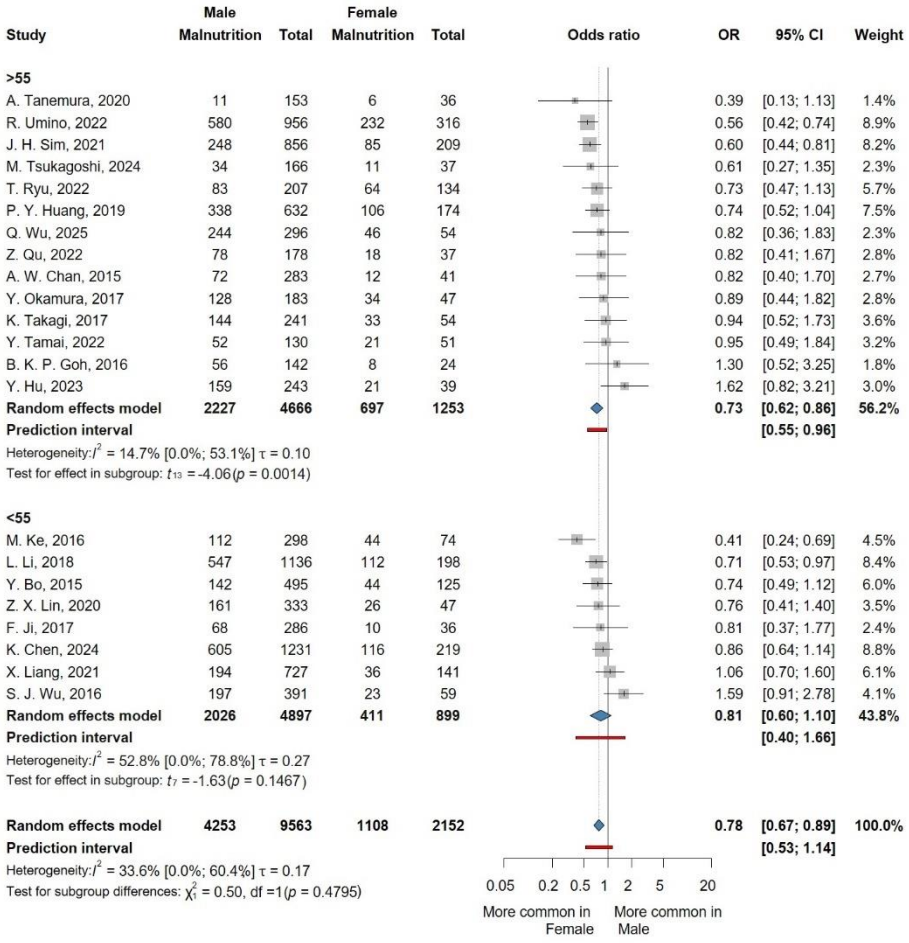
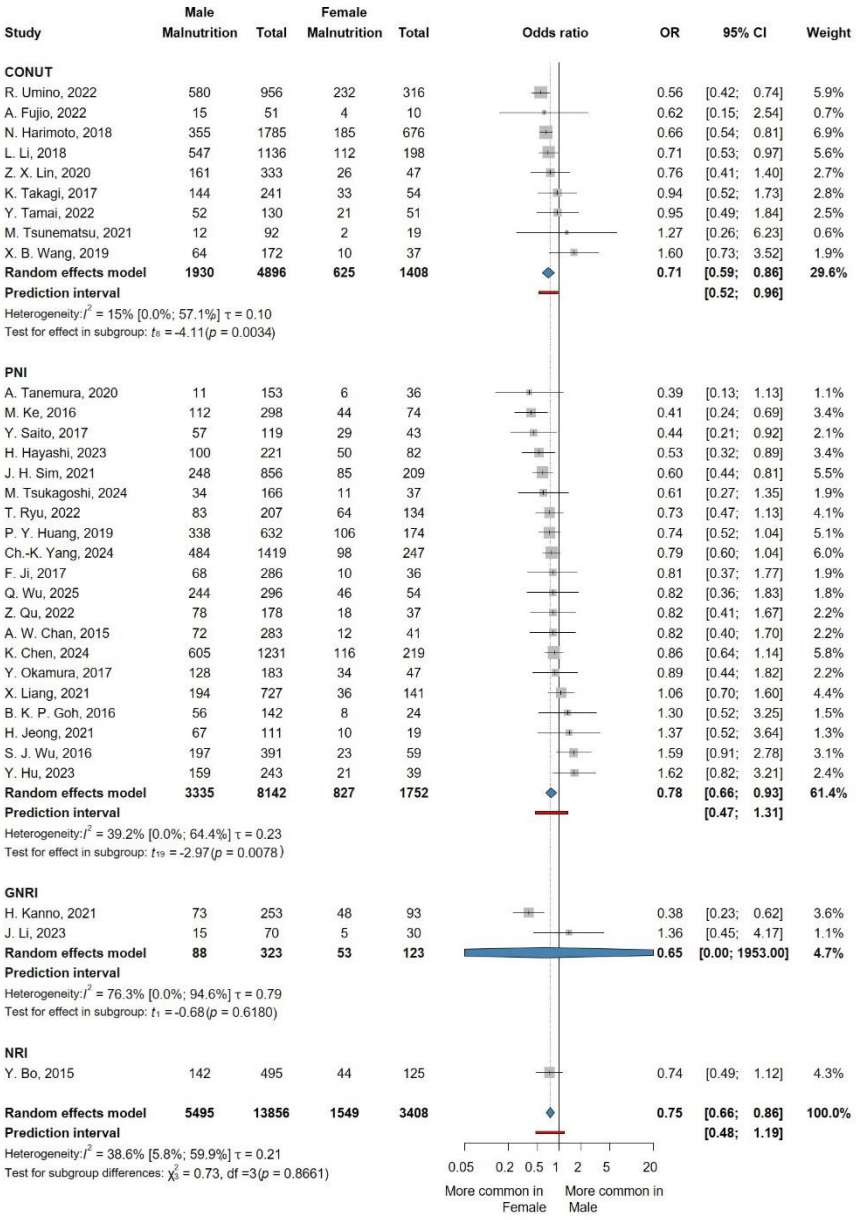
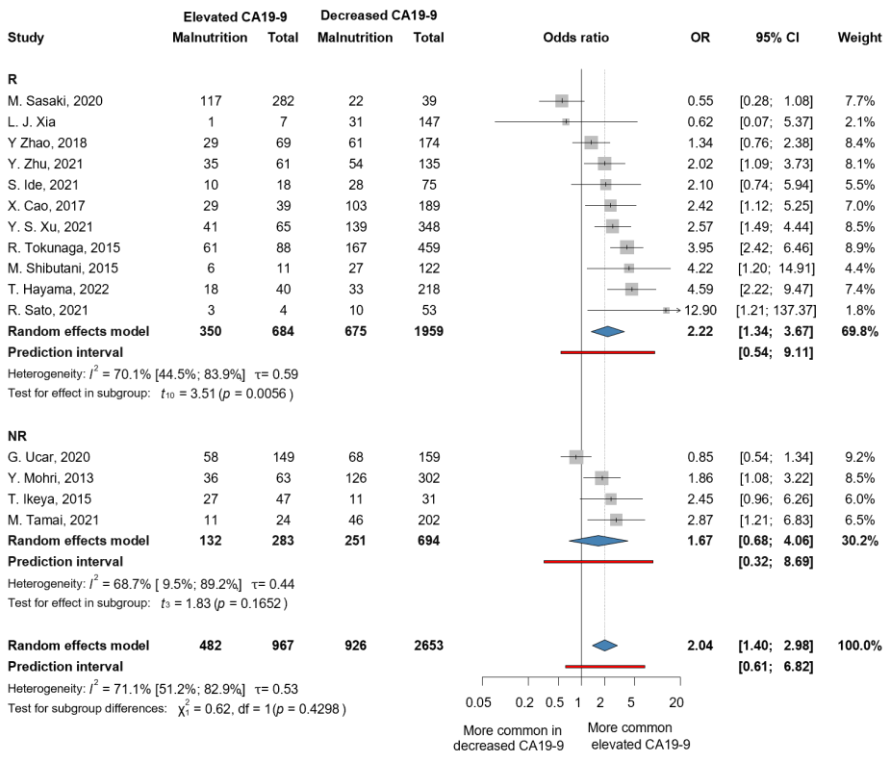


Figure S147. Assessment tool moderator analysis for the association between malnutrition-related complication risk and sex in resectable hepatocellular carcinoma (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index, NRI = Nutritional Risk Index

Figure S148. Resectability moderator analysis for the association between malnutrition-related complication risk and serum CA19-9 level in colorectal cancer (Biological composite scores)



Abbreviations: R= resectable, NR= non-resectable

Figure S149. Cancer type moderator analysis for the association between malnutrition-related complication risk and serum CA19-9 level in colorectal cancer (Biological composite scores)

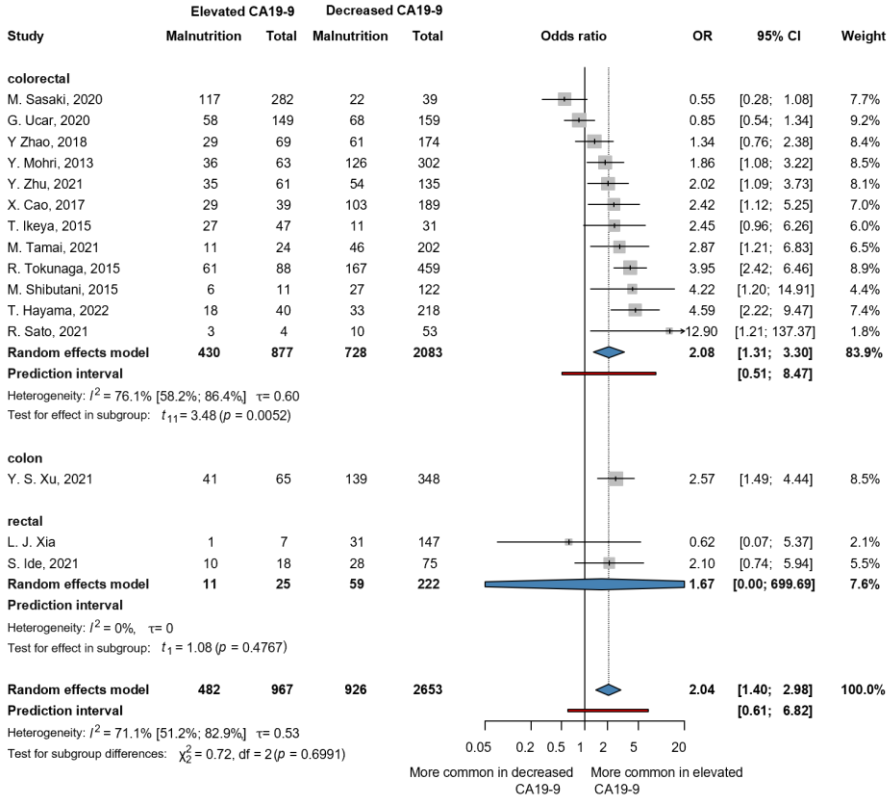
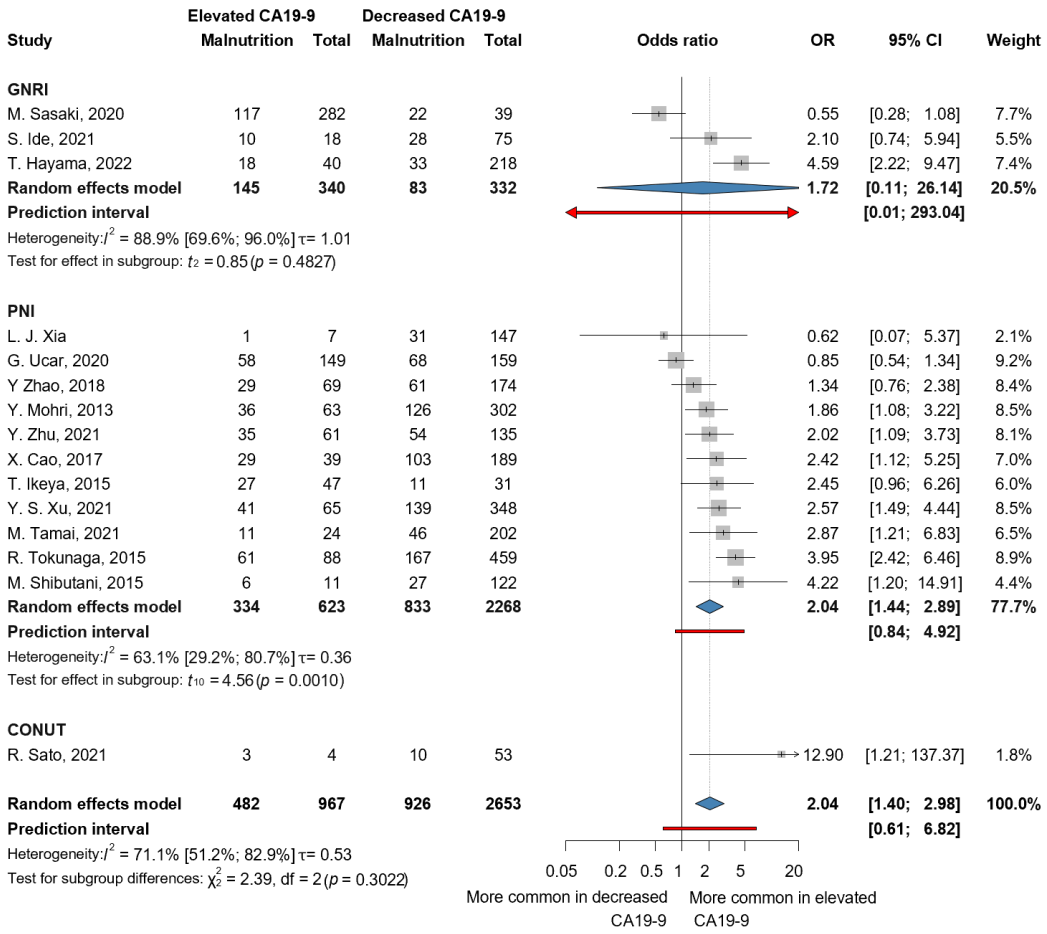
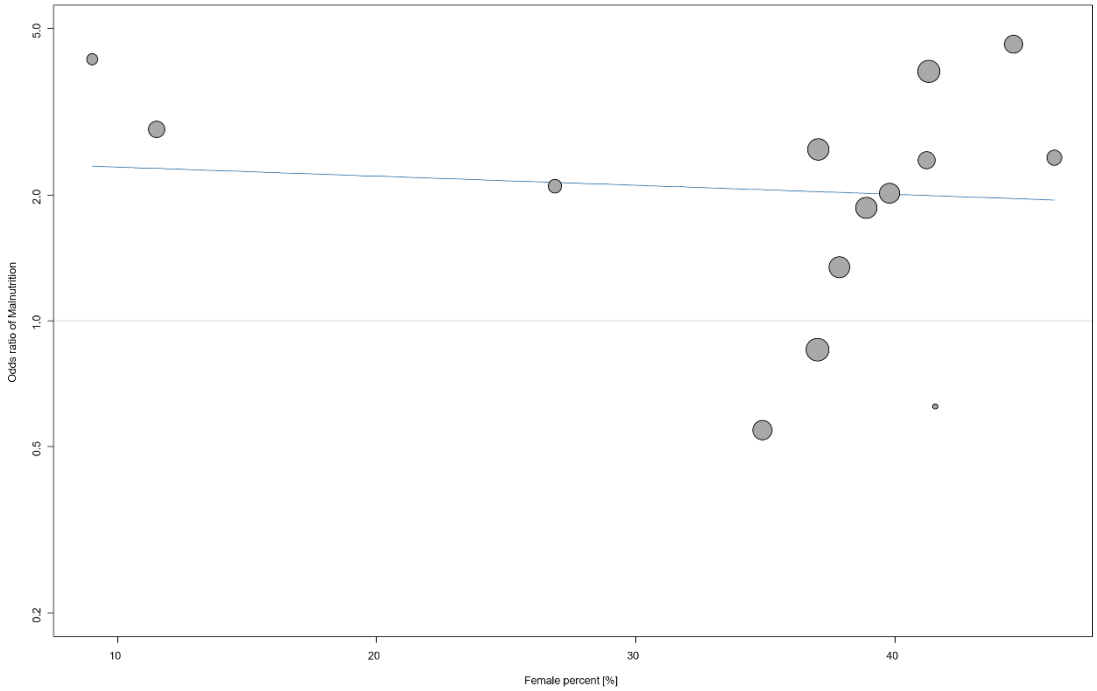


Figure S150. Assessment tool moderator analysis for the association between malnutrition-related complication risk and serum CA19-9 level in colorectal cancer (Biological composite scores)



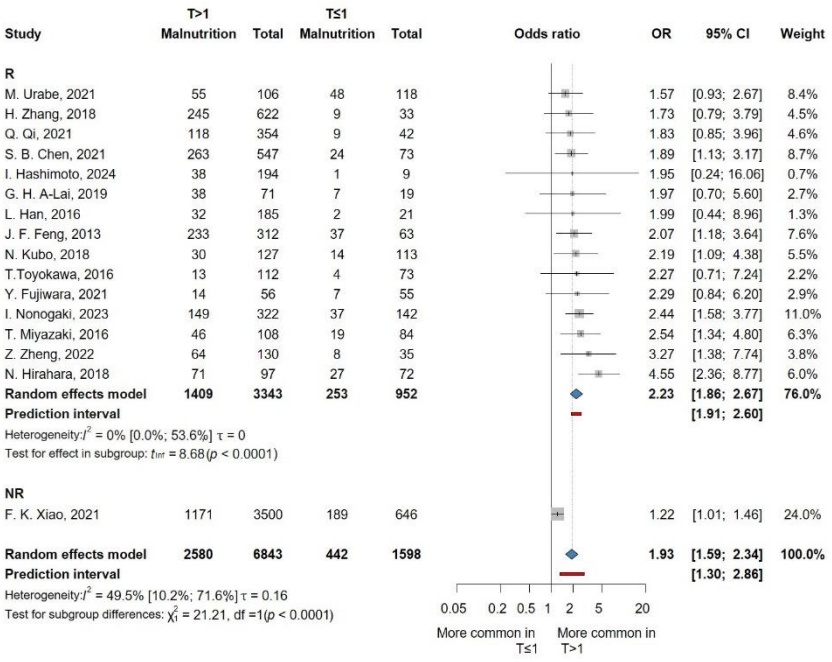
Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S151. Female proportion meta regression analysis for the association between malnutrition-related complication risk and serum CA19-9 level in colorectal cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is -0.005 [95% CI: -0.0453 - 0.0352] [log(OR of Malnutrition) / female %] (p-value: 0.7907). NOTE: it is given in the log scale!

Figure S152. Resectability moderator analysis for the association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)



Abbreviations: R= resectable, NR= non-resectable

Figure S153. Cancer type moderator analysis for the association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)

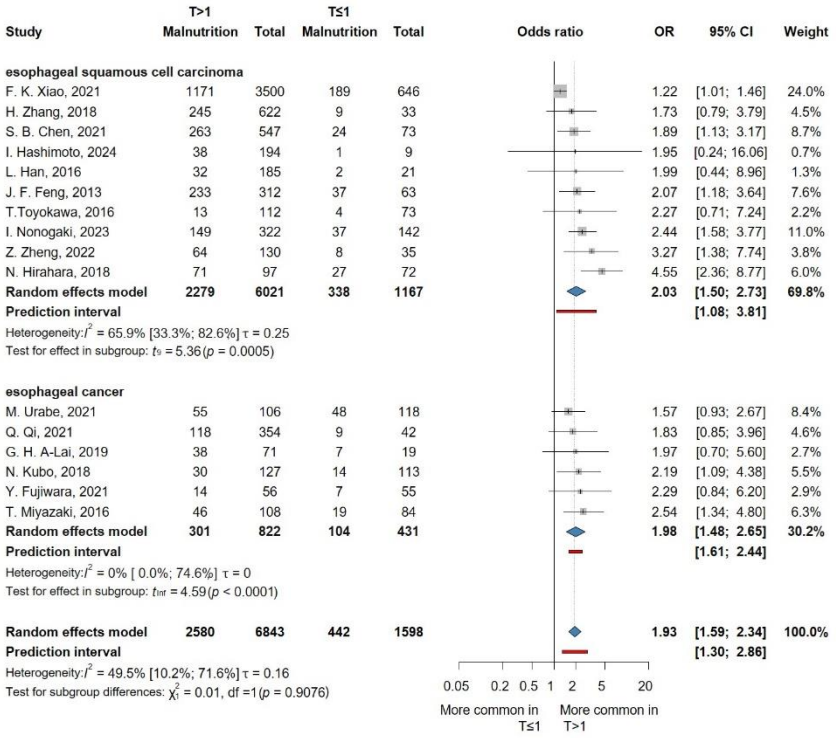
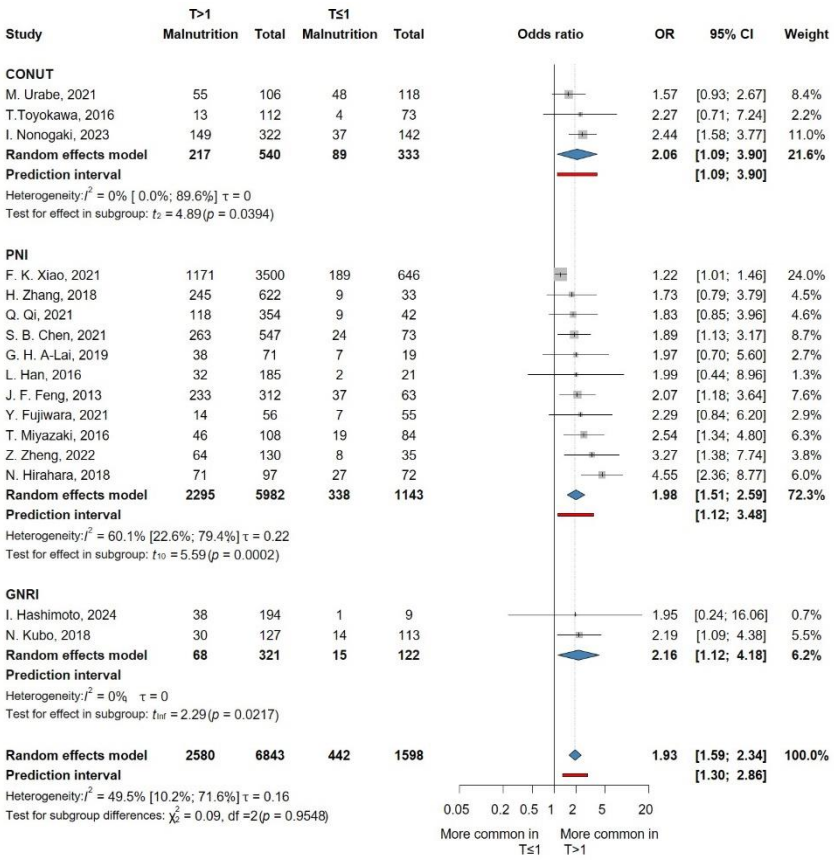


Figure S154. Assessment tool moderator analysis for the association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S155. TNM staging edition moderator analysis for association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)

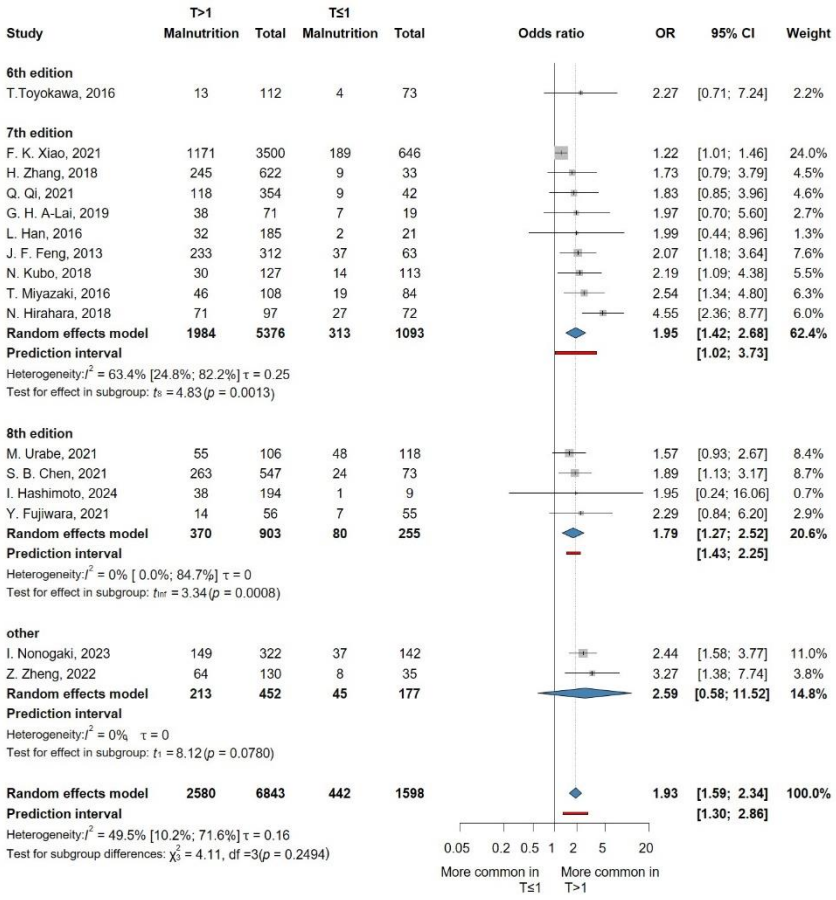
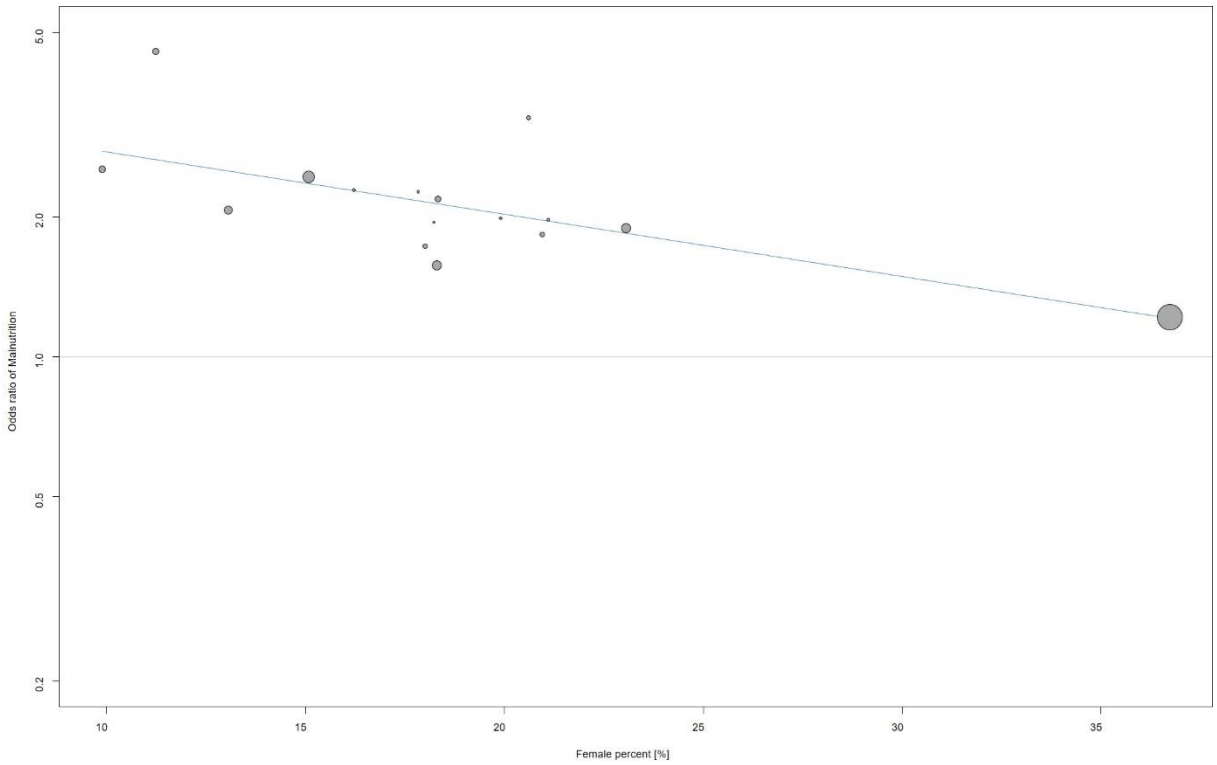
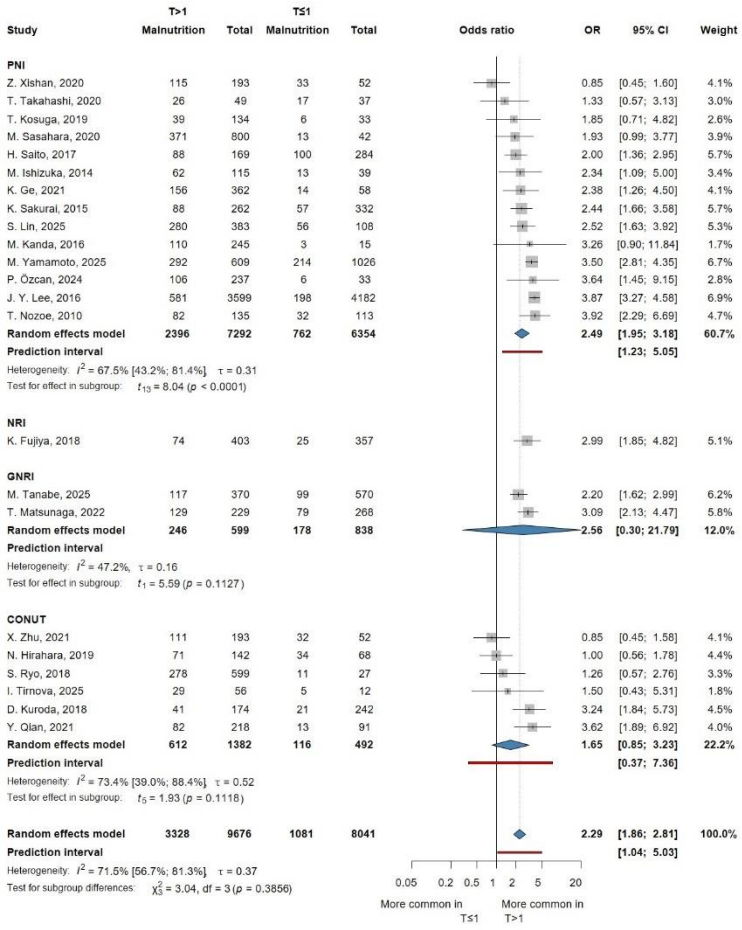


Figure S156. Female proportion meta regression analysis for the association between malnutrition-related complication risk and T stage in esophageal cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is -0.0309 [95% CI: -0.0399 - -0.0219] [log(OR of Malnutrition) / female %] (p-value: <0.0001). NOTE: it is given in the log scale!

Figure S157. Assessment tool moderator analysis for association between malnutrition-related complication risk and T stage in gastric cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index, NRI= Nutritional Risk Index

Figure S158. TNM staging edition moderator analysis for association between malnutrition-related complication risk and T stage in gastric cancer (Biological composite scores)

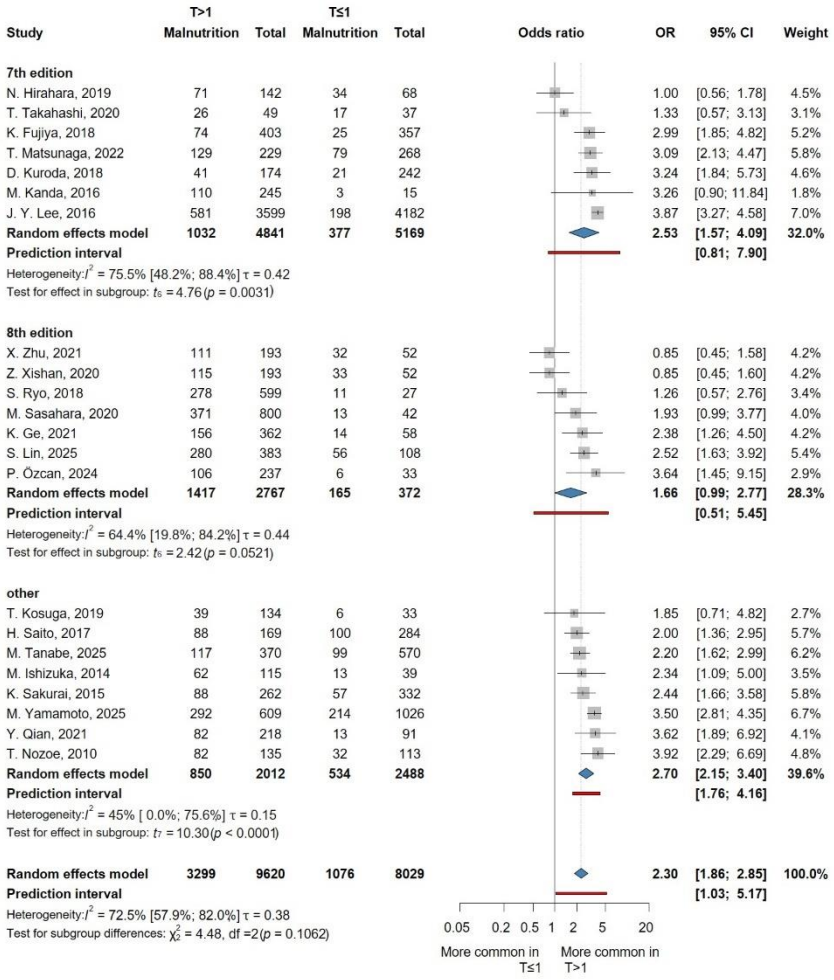
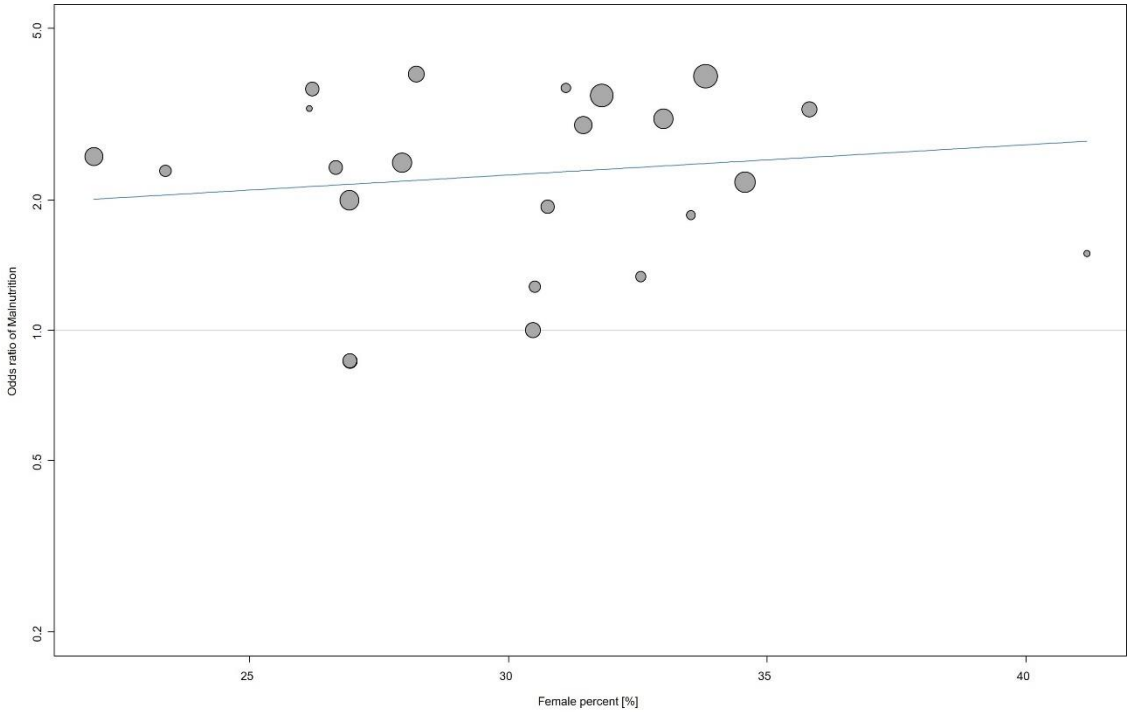
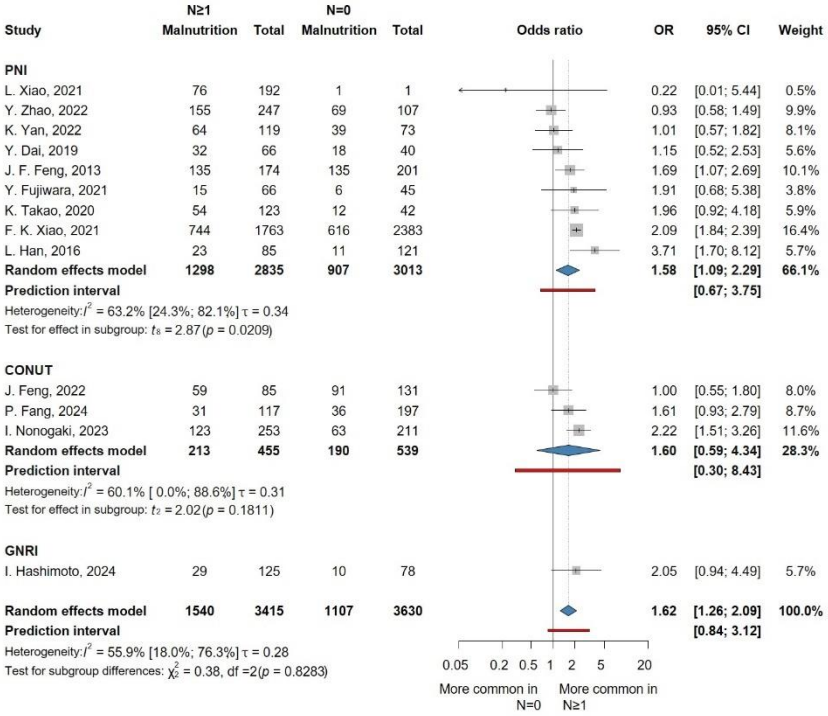


Figure S159. Female proportion meta regression analysis for association between malnutrition-related complication risk and T stage in gastric cancer (Biological composite scores)



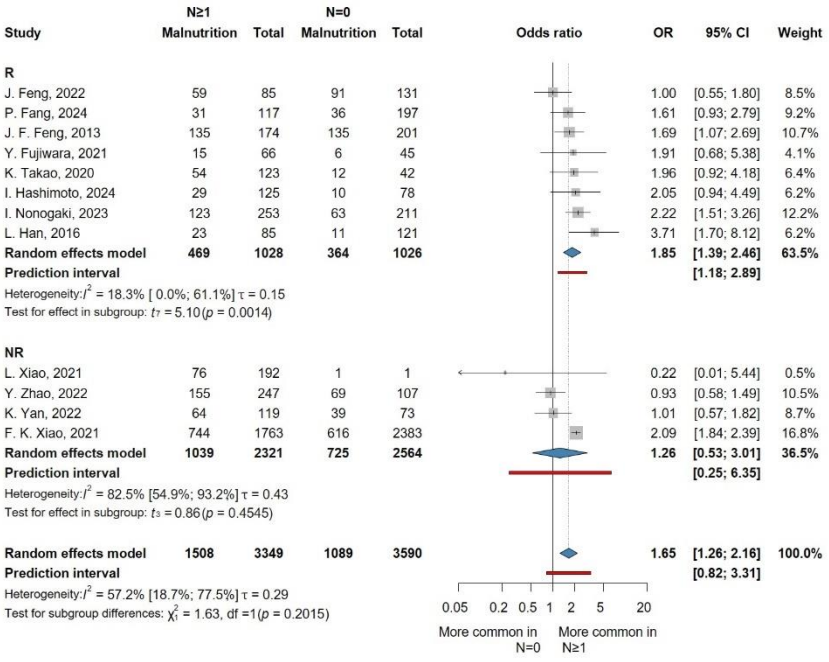
Assuming a linear relation, the estimated slope is 0.0162 [95% CI: -0.037 - 0.0694] [log(OR of Malnutrition) / female %] (p-value: 0.5335). NOTE: it is given in the log scale!

Figure S160. Assessment tool moderator analysis for association between malnutrition-related complication risk and N stage in esophageal cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status,

Figure S161. Resectability moderator analysis for association between malnutrition-related complication risk and N stage in esophageal cancer (Biological composite scores)



Abbreviations: R= resectable, NR= non-resectable

Figure S162. TNM staging edition moderator analysis for association between malnutrition-related complication risk and N stage in esophageal cancer (Biological composite scores)

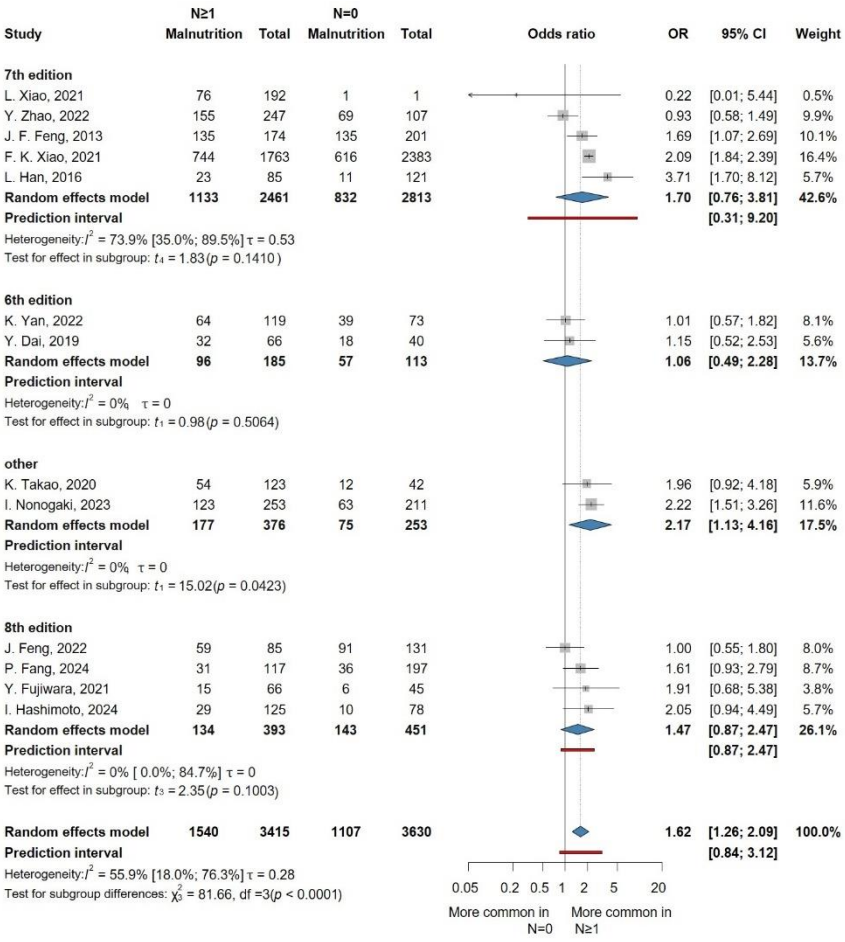
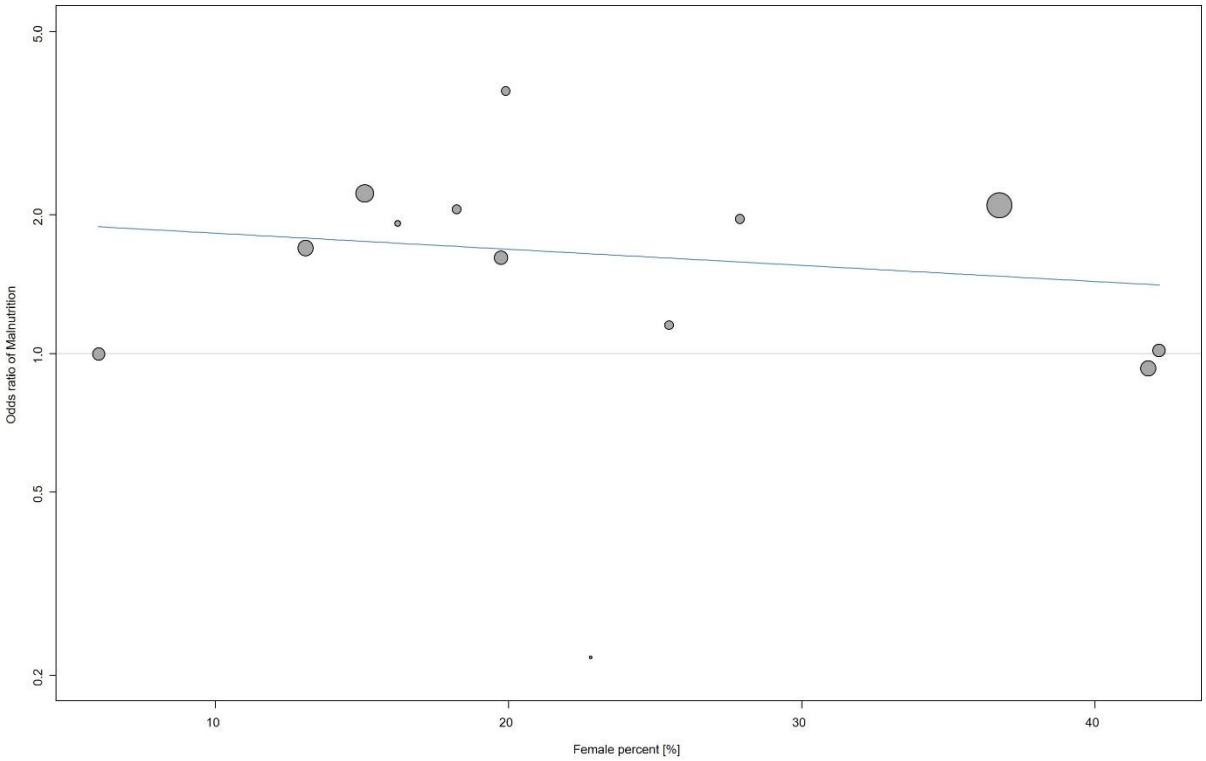
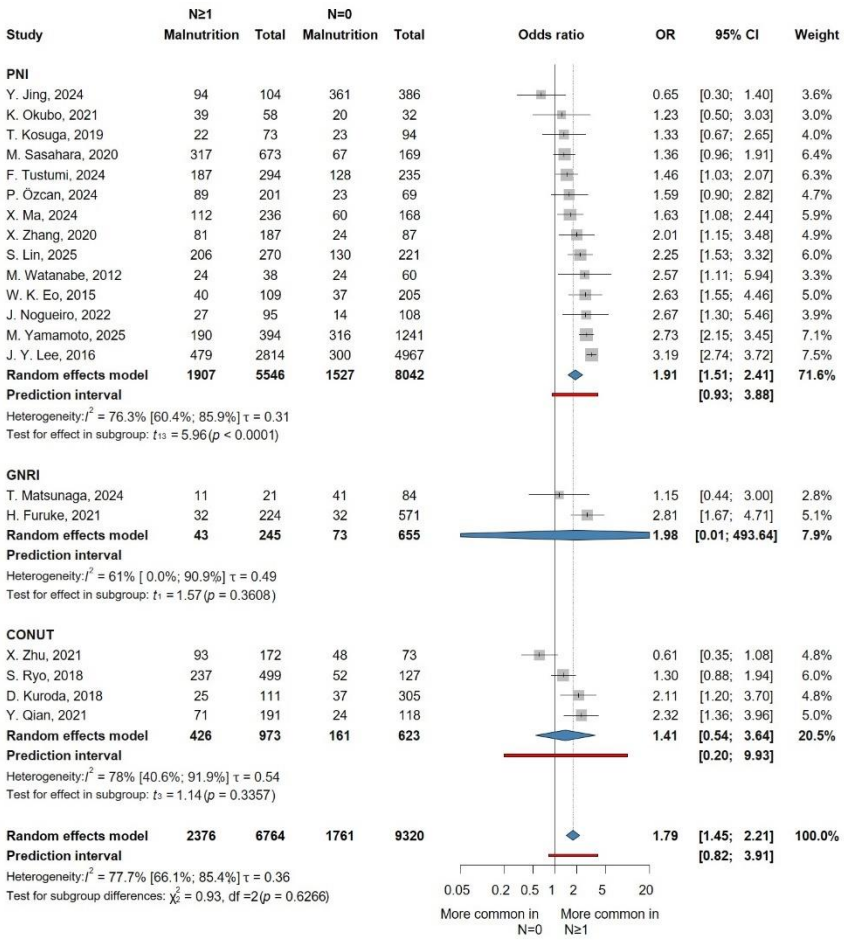


Figure S163. Female proportion meta regression analysis for association between malnutrition-related complication risk and N stage in esophageal cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is -0.0081 [95% CI: -0.0302 - 0.014] [log(OR of Malnutrition) / female %] (p-value: 0.4374). NOTE: it is given in the log scale!

Figure S164. Assessment tool moderator analysis for association between malnutrition-related complication risk and N stage in gastric cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S165. TNM staging edition moderator analysis for association between malnutrition-related complication risk and N stage in gastric cancer (Biological composite scores)

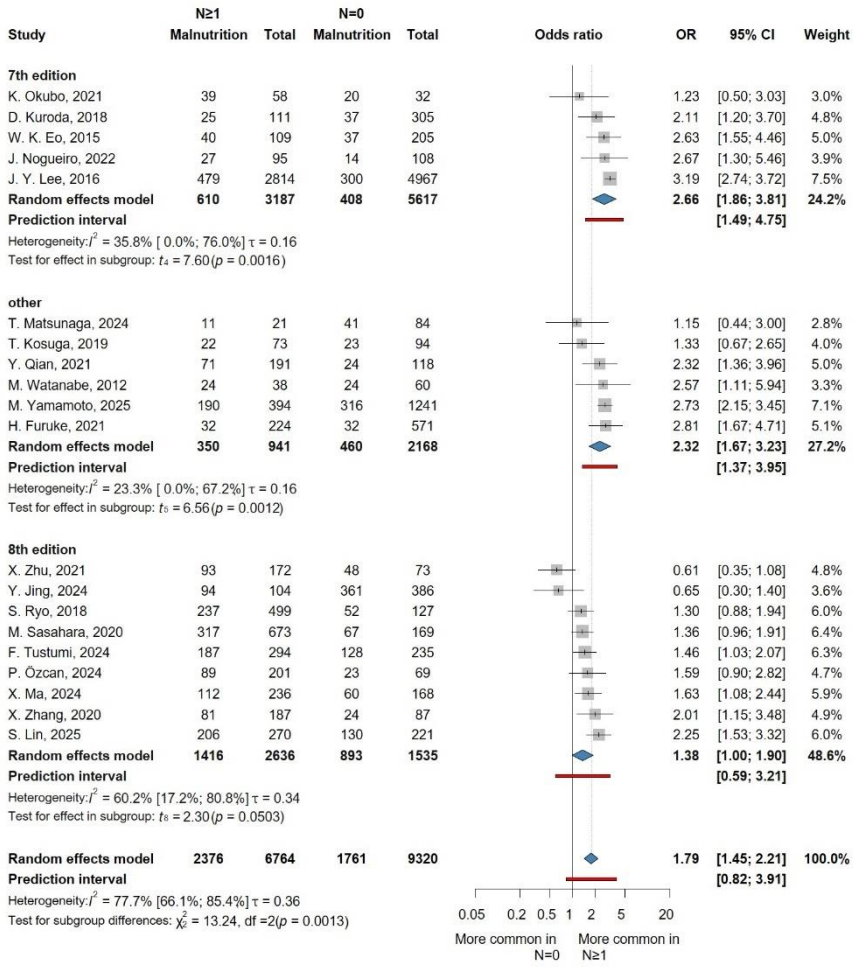
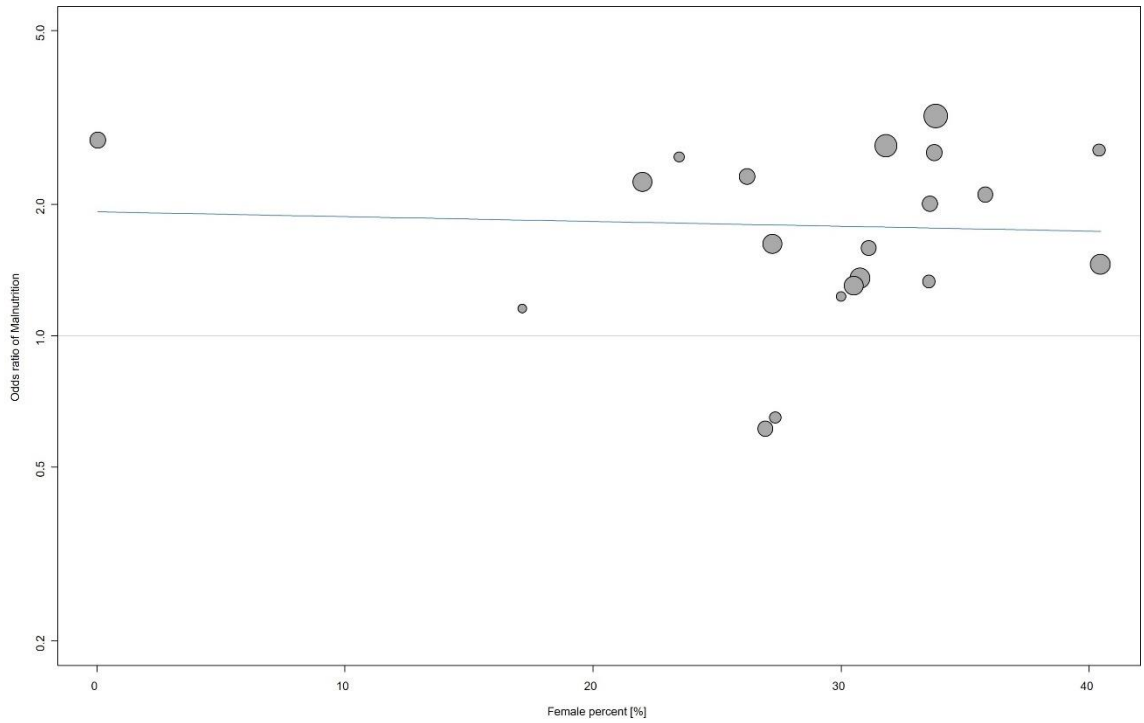
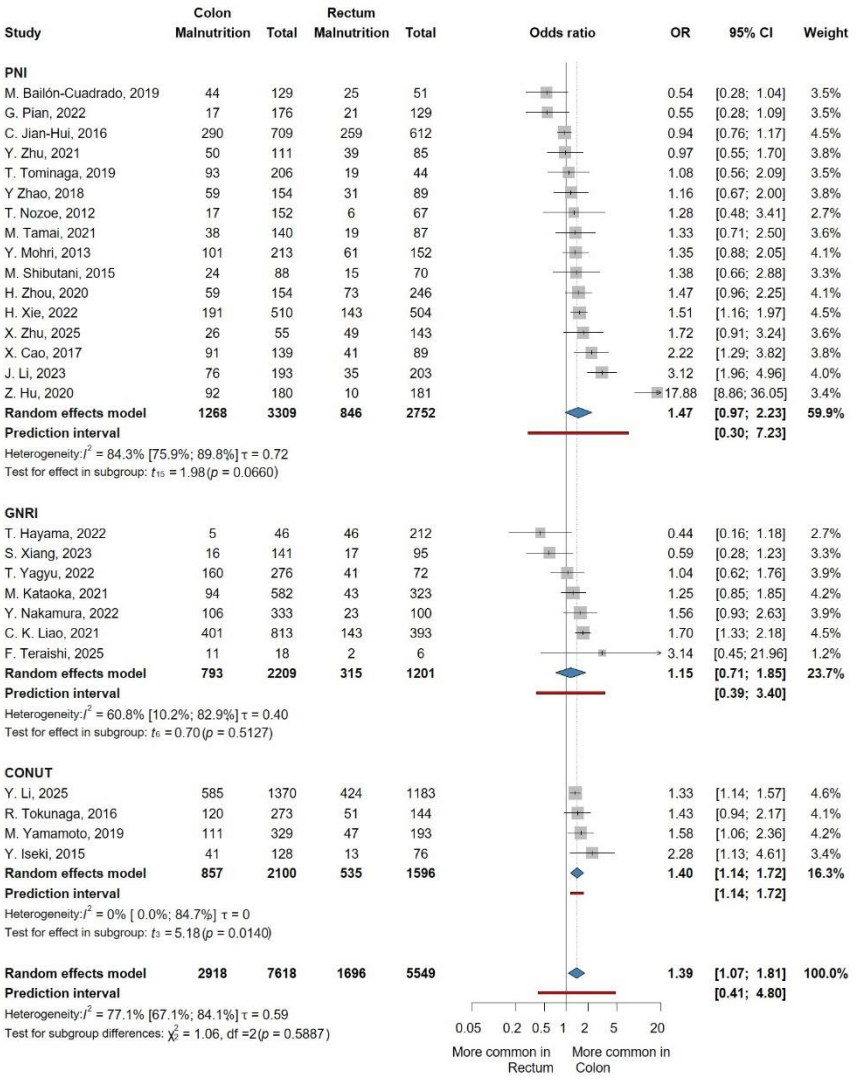


Figure S166. Female proportion meta regression analysis for association between malnutrition-related complication risk and N stage in gastric cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is -0.0026 [95% CI: -0.0281 - 0.0229] [log(OR of Malnutrition) / female %] (p-value: 0.8344). NOTE: it is given in the log scale!

Figure S167. Assessment tool moderator analysis for association between malnutrition-related complication risk and tumor location in colorectal cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S168. Age group moderator analysis for association between malnutrition-related complication risk and tumor location in colorectal cancer (Biological composite scores)

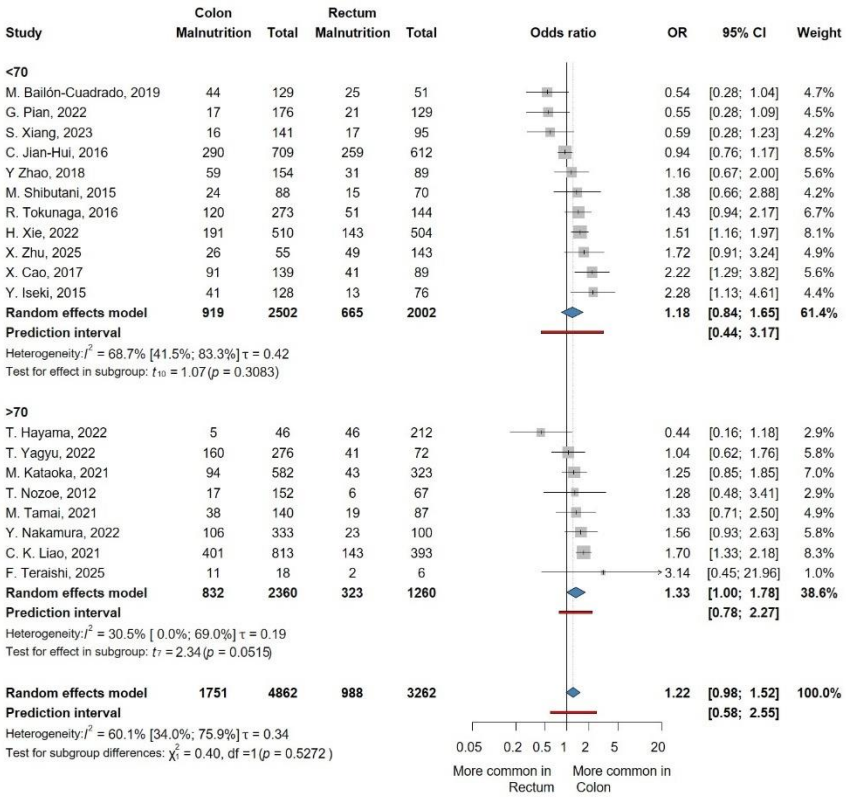
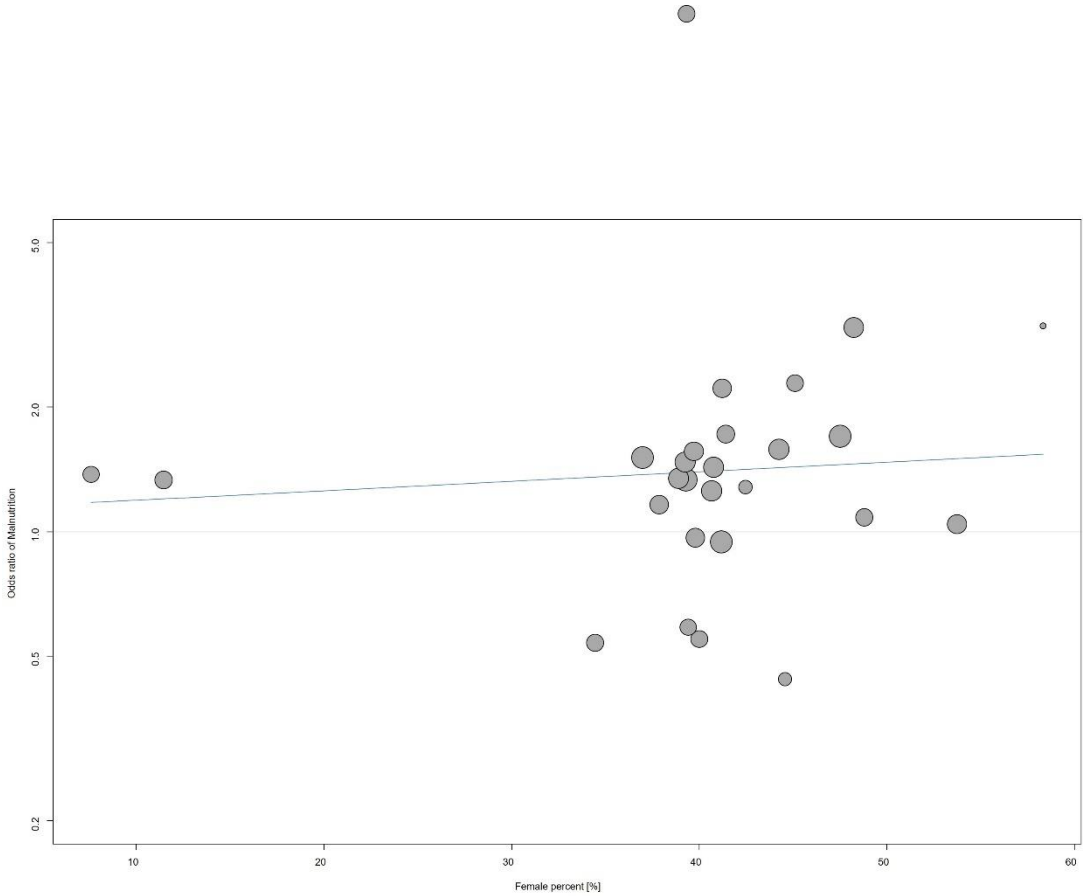
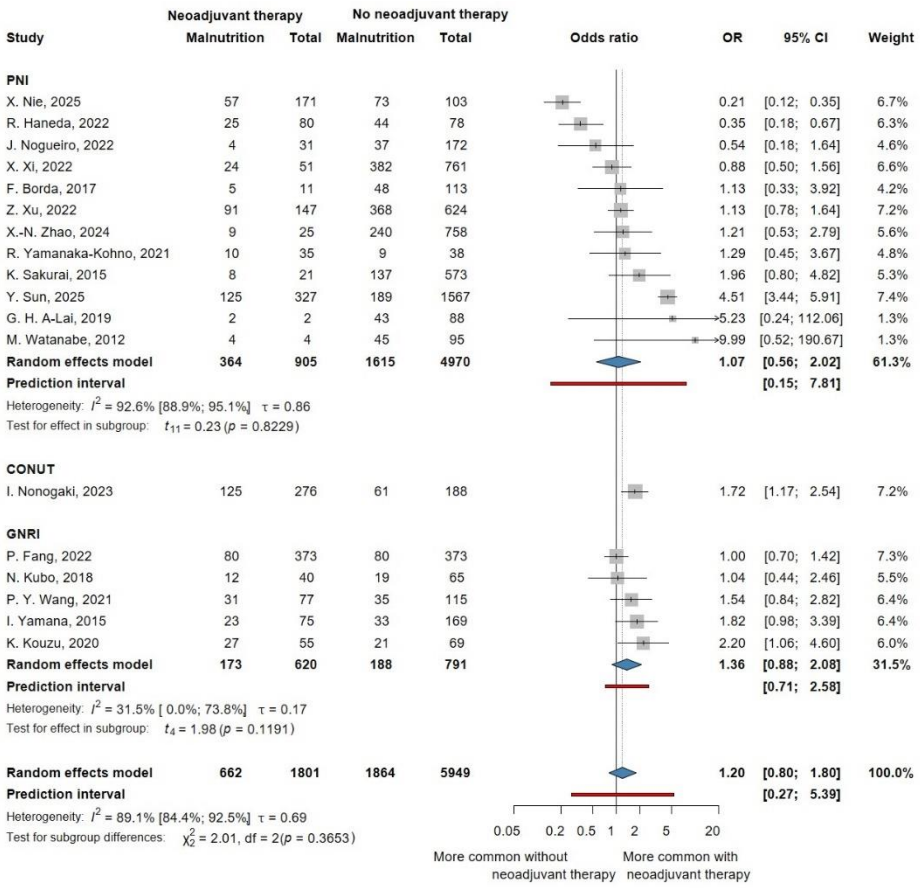


Figure S169. Female proportion meta regression analysis for association between malnutrition-related complication risk and tumor location in colorectal cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is 0.0053 [95% CI: -0.0231 - 0.0337] [log(OR of Malnutrition) / female %] (p-value: 0.704). NOTE: it is given in the log scale!

Figure S170. Assessment tool moderator analysis for association between malnutrition-related complication risk and neoadjuvant therapy in upper gastrointestinal cancer (Biological composite scores)



Abbreviations: PNI= Prognostic Nutritional Index, CONUT= Controlling Nutritional Status, GNRI= Geriatric Nutritional Risk Index

Figure S171. Cancer type moderator analysis for association between malnutrition-related complication risk and neoadjuvant therapy in upper gastrointestinal cancer (Biological composite scores)

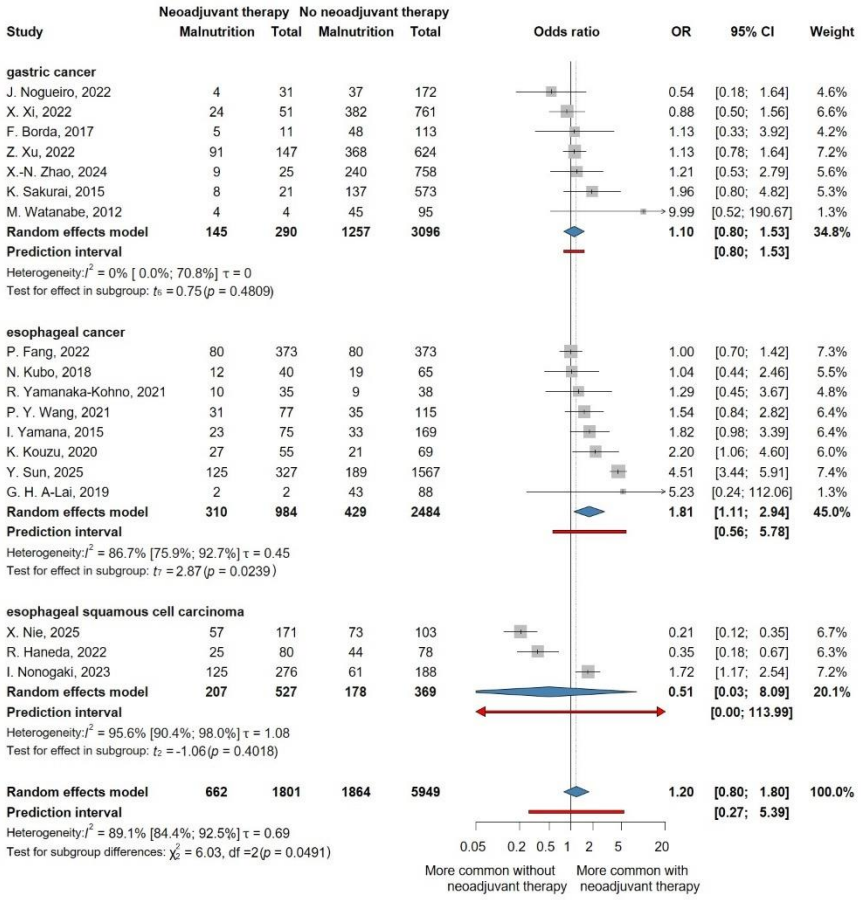
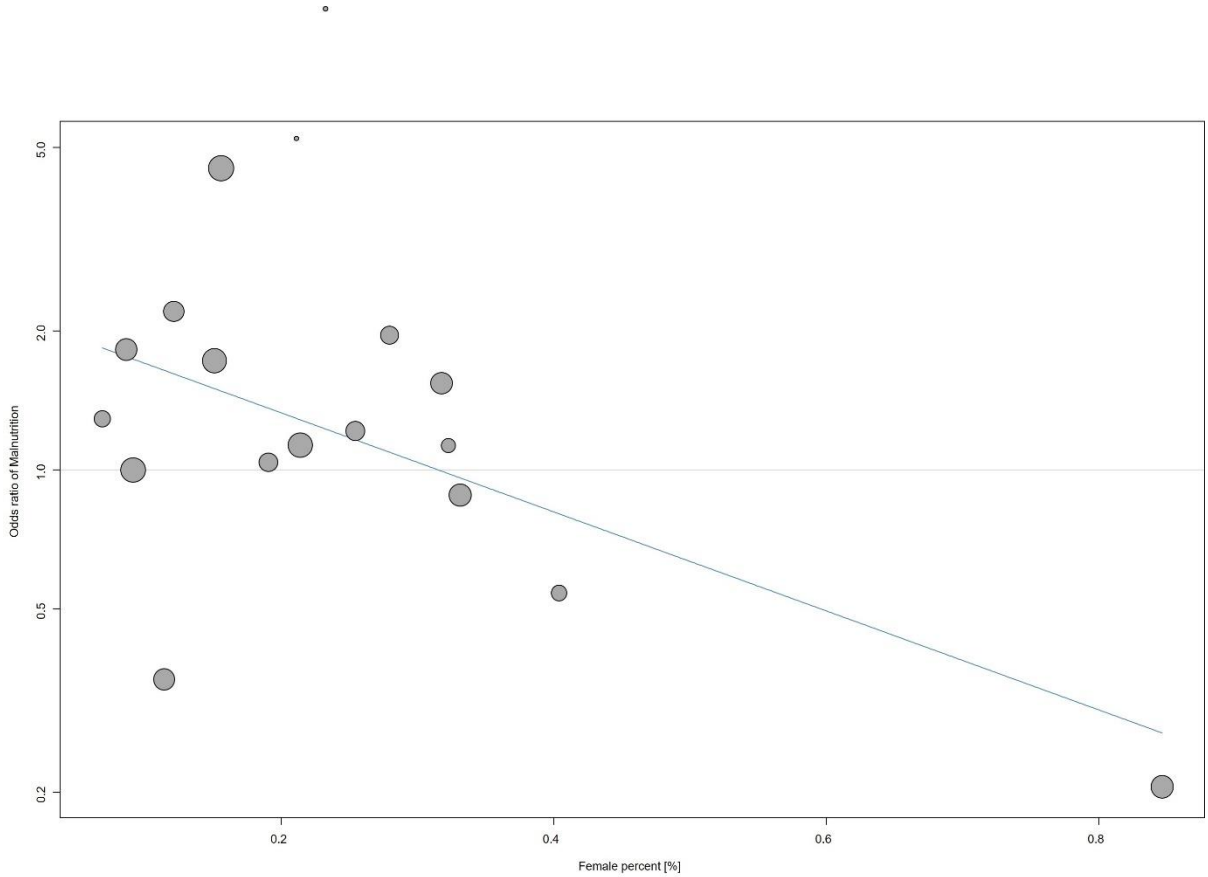


Figure S172. Female proportion meta regression analysis for association between malnutrition-related complication risk and neoadjuvant therapy in upper gastrointestinal cancer (Biological composite scores)



Assuming a linear relation, the estimated slope is -2.4711 [95% CI: -4.2362 - -0.706] [log(OR of Malnutrition) / female %] (p-value: 0.0091). NOTE: it is given in the log scale!

Supplementary Document S15: Publication bias

Publication bias was assessed by visual inspection of the funnel plots and Egger's test. Publication bias is judged to be meaningful if at least 10 articles are in the analysis.
The Egger's test indicated potential publication bias in the following cases (see figures in Document S10):

- **Figure 182**: Association between malnutrition-related complication risk and hypertension in gastrointestinal cancer (Biological composite scores) [Egger test: t = -2.06, df = 15, p-value = 0.0568]
- **Figure 184**: Association between malnutrition-related complication risk and N stage (N0 vs. N≥1) in gastric cancer (Biological composite scores) [Egger test: t = -2.32, df = 18, p-value = 0.0320]
- **Figure 194**: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in esophageal cancer (Biological composite scores) [Egger test: t = 4.44, df = 14, p-value = 0.0006]
- **Figure 196**: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in gastric cancer (Biological composite scores) [Egger test: t = -2.51, df = 21, p-value = 0.0204]
- **Figure 197**: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in gastric cancer (Biological composite scores) [Egger test: t = -2.07, df = 20, p-value = 0.0520]
- **Figure 206**: Association between malnutrition risk and sex in esophageal cancer (Symptom-based risk assessment tools) [Egger test: t = -2.67, df = 9, p-value = 0.0254]

In case of **Figure 182,** we see that study with a large standard error (small sample size) tend to bias towards a lower OR. If articles were published with a small standard error (large sample size), this would tend to bias towards a higher OR.

In case of **Figure 184,** we see that studies with a large standard error (small sample size) appear lower or nonsignificant effects to be underrepresented, while studies with a small standard error (large sample size) tend to bias towards a higher OR.

In the case of **Figure 194**, The analyses rather indicate that there is an article with an extreme standard error and showing a different effect. In case of Figure 22 this article is F.K. Xiao, 2022. Also, studies with a small standard error (large sample size) tend to bias towards a higher OR.

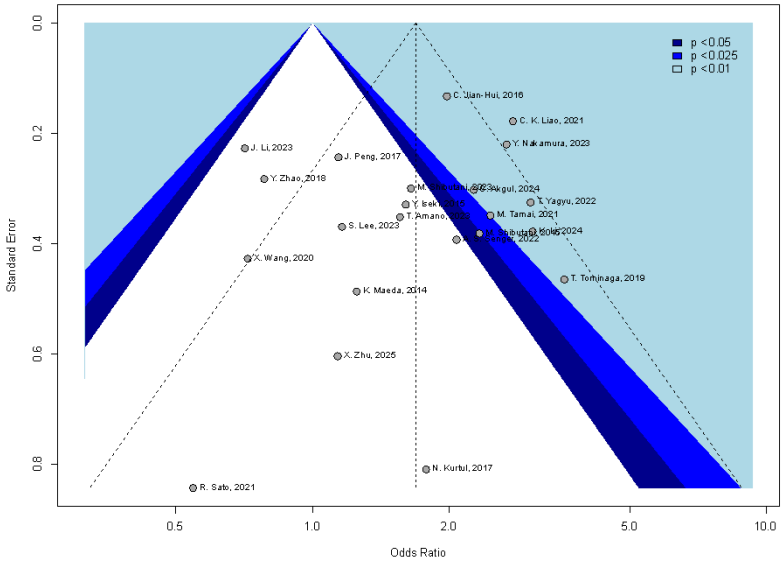
In the case of **Figure 196**, the analyses rather indicate that the effect differs between two different sets of articles (an unidentified subgroup), and this is why the p-value of the Egger test is small and not because of a possible publication bias.

In the case of **Figure 197** the suspicion of publication bias is indeed stronger, and in each instance, we see that studies with a large standard error (small sample size) tend to bias towards a higher OR. If articles were published with a small standard error (large sample size), this would tend to bias towards a lower OR.

In the case of **Figure 206,** we see that studies with a large standard error (small sample size) tend to bias towards a lower OR.

Supplementary Document S16: Funnel plots for the publication bias and leave-one-out plots: Figures S173-S227

Figure S173: Funnel plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in colorectal cancer (Biological composite scores)



Egger test: t = -1.81, df = 20, p-value = 0.0851

Figure S173.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in colorectal cancer (Biological composite scores)

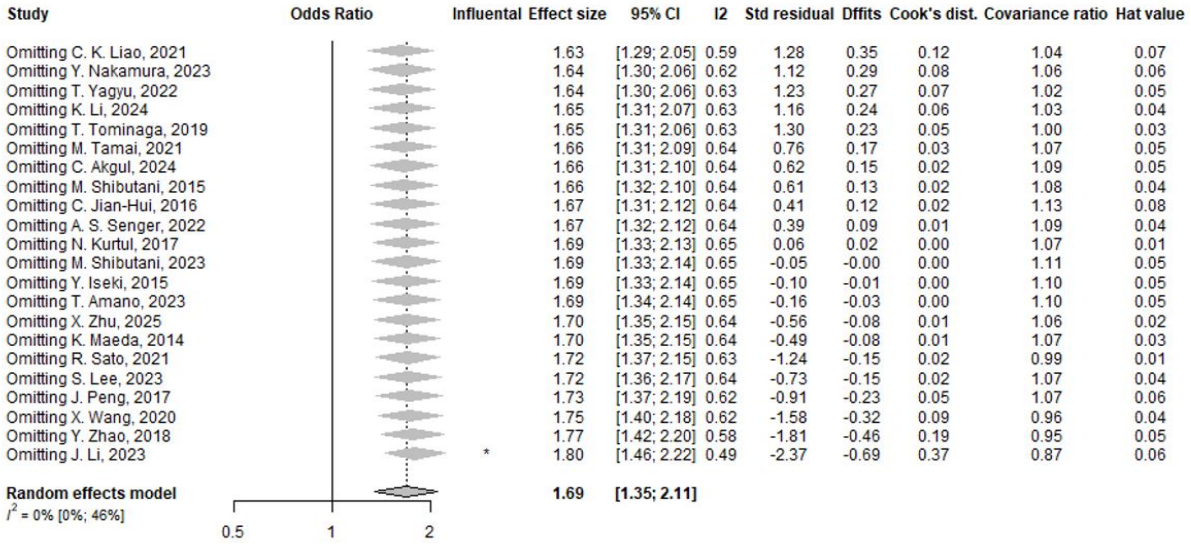
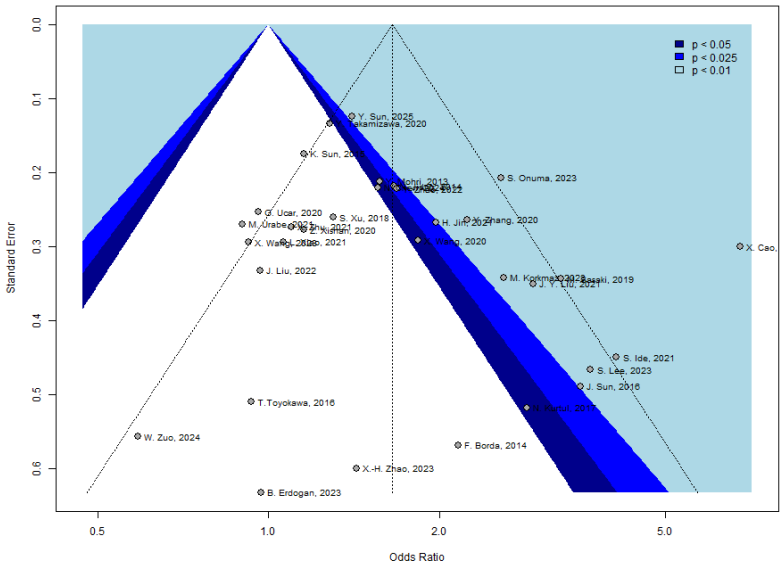


Figure S174: Funnel plot: Association between malnutrition-related complication risk and age (cut off 65) in gastrointestinal cancer (Biological composite scores)



Egger test: t = 0.94, df = 30, p-value = 0.3562

Figure S174.1: Leave-one-out plot: Association between malnutrition-related complication risk and age (cut off 65) in gastrointestinal cancer (Biological composite scores)

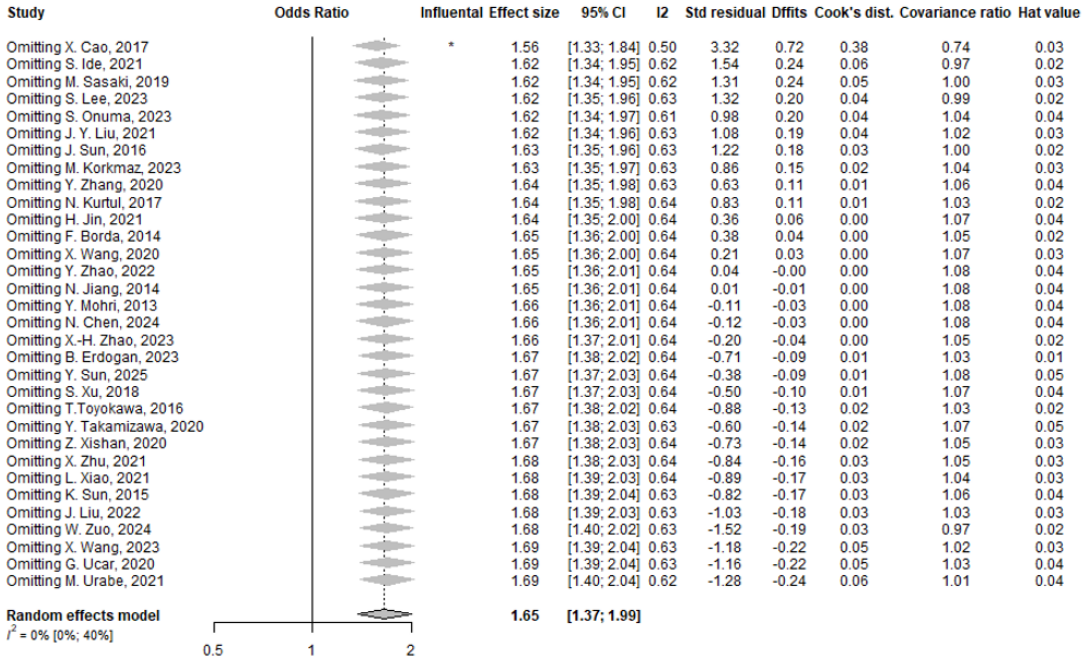
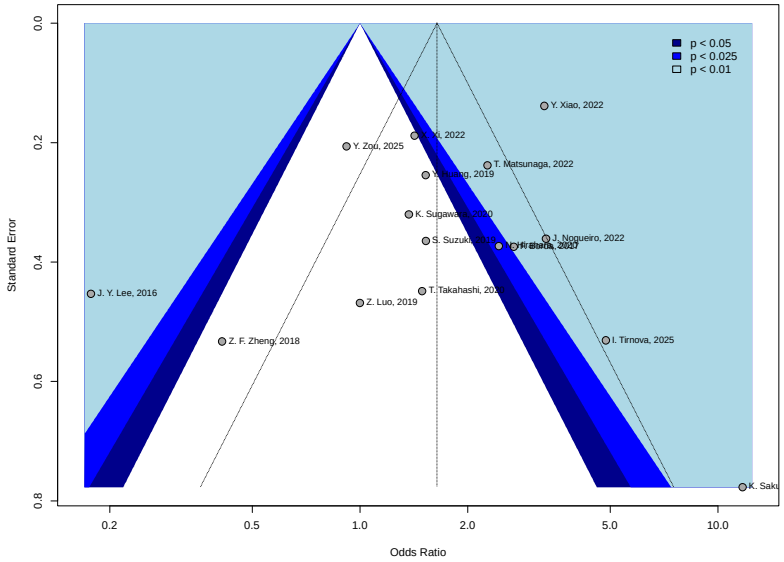
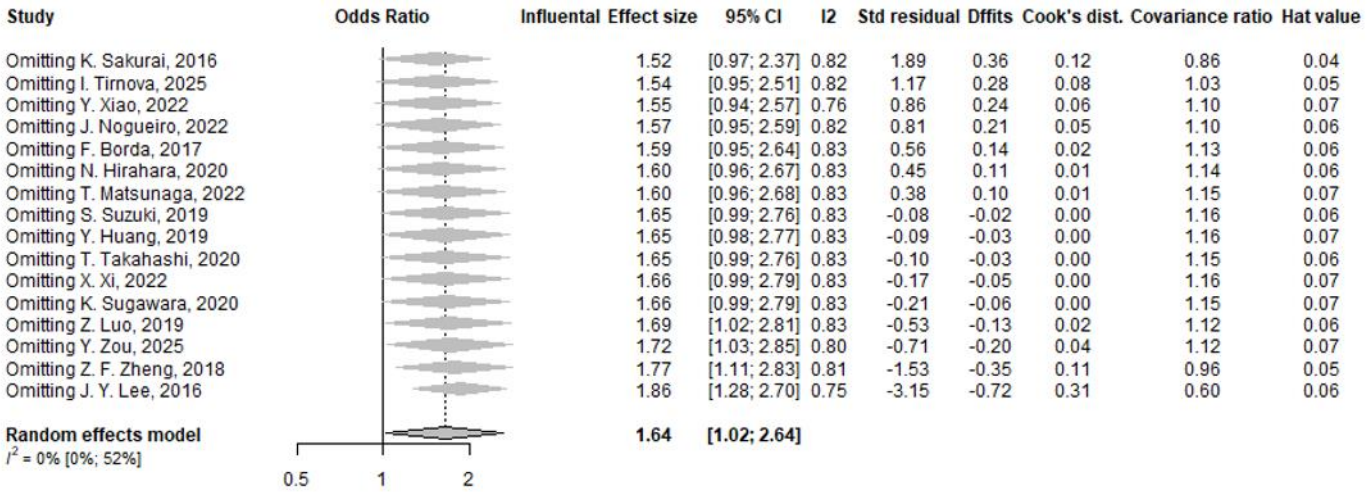


Figure S175: Funnel plot: Association between malnutrition-related complication risk and ASA score (≥3 vs. <3) in gastric cancer (Biological composite scores)



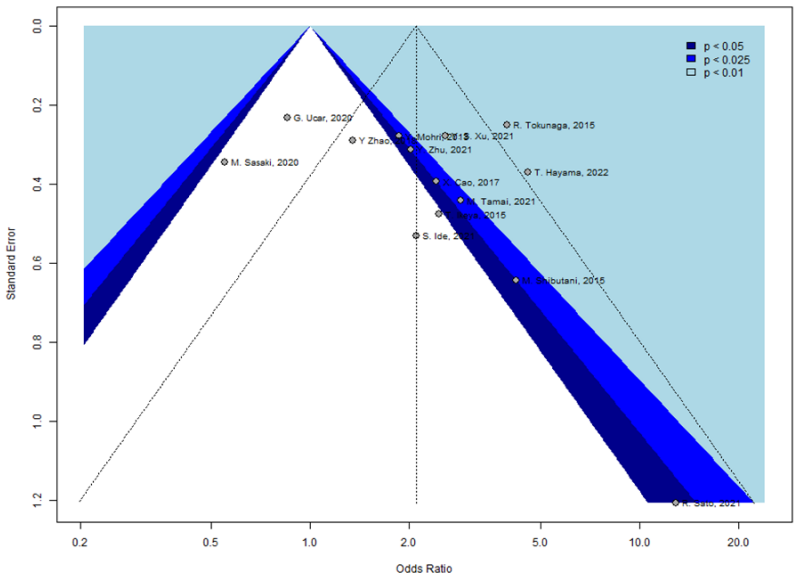
Egger test: t = 1.58, df = 14, p-value = 0.1358

Figure S175.1: Leave-one-out plot: Association between malnutrition-related complication risk and ASA score (≥3 vs. <3) in gastric cancer (Biological composite scores)



Study	Odds Ratio	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting K. Sakurai, 2016			1.52	[0.97; 2.37]	0.82	1.89	0.36	0.12	0.86	0.04
Omitting I. Tirnova, 2025			1.54	[0.95; 2.51]	0.82	1.17	0.28	0.08	1.03	0.05
Omitting Y. Xiao, 2022			1.55	[0.94; 2.57]	0.76	0.86	0.24	0.06	1.10	0.07
Omitting J. Nogueiro, 2022			1.57	[0.95; 2.59]	0.82	0.81	0.21	0.05	1.10	0.06
Omitting F. Borda, 2017			1.59	[0.95; 2.64]	0.83	0.56	0.14	0.02	1.13	0.06
Omitting N. Hirahara, 2020			1.60	[0.96; 2.67]	0.83	0.45	0.11	0.01	1.14	0.06
Omitting T. Matsunaga, 2022			1.60	[0.96; 2.68]	0.83	0.38	0.10	0.01	1.15	0.07
Omitting S. Suzuki, 2019			1.65	[0.99; 2.76]	0.83	-0.08	-0.02	0.00	1.16	0.06
Omitting Y. Huang, 2019			1.65	[0.98; 2.77]	0.83	-0.09	-0.03	0.00	1.16	0.07
Omitting T. Takahashi, 2020			1.65	[0.99; 2.76]	0.83	-0.10	-0.03	0.00	1.15	0.06
Omitting X. Xi, 2022			1.66	[0.99; 2.79]	0.83	-0.17	-0.05	0.00	1.16	0.07
Omitting K. Sugawara, 2020			1.66	[0.99; 2.79]	0.83	-0.21	-0.06	0.00	1.15	0.07
Omitting Z. Luo, 2019			1.69	[1.02; 2.81]	0.83	-0.53	-0.13	0.02	1.12	0.06
Omitting Y. Zou, 2025			1.72	[1.03; 2.85]	0.80	-0.71	-0.20	0.04	1.12	0.07
Omitting Z. F. Zheng, 2018			1.77	[1.11; 2.83]	0.81	-1.53	-0.35	0.11	0.96	0.05
Omitting J. Y. Lee, 2016			1.86	[1.28; 2.70]	0.75	-3.15	-0.72	0.31	0.60	0.06
Random effects model			**1.64**	**[1.02; 2.64]**						
I^2 = 0% [0%; 52%]										

Figure S176: Funnel plot: Association between malnutrition-related complication risk and serum CA 19-9 level in colorectal cancer (Biological composite scores)



Egger test: t = 0.68, df = 12, p-value = 0.5087

Figure S176.1: Leave-one-out plot: Association between malnutrition-related complication riskand serum CA 19-9 level in colorectal cancer (Biological composite scores)

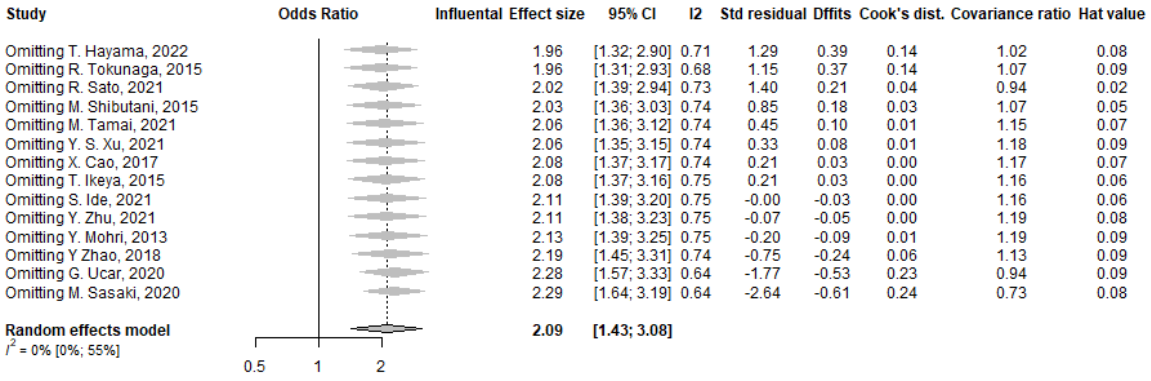
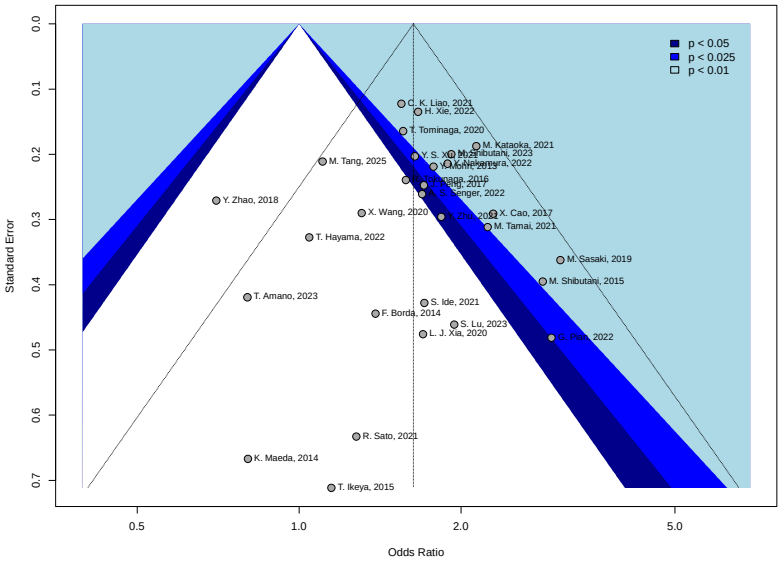


Figure S177: Funnel plot: Association between malnutrition-related complication risk and serum CEA level in colorectal cancer (Biological composite scores)



Egger test: t = -0.58, df = 27, p-value = 0.5653

Figure S177.1: Leave-one-out plot: Association between malnutrition-related complication risk and serum CEA level in colorectal cancer (Biological composite scores)

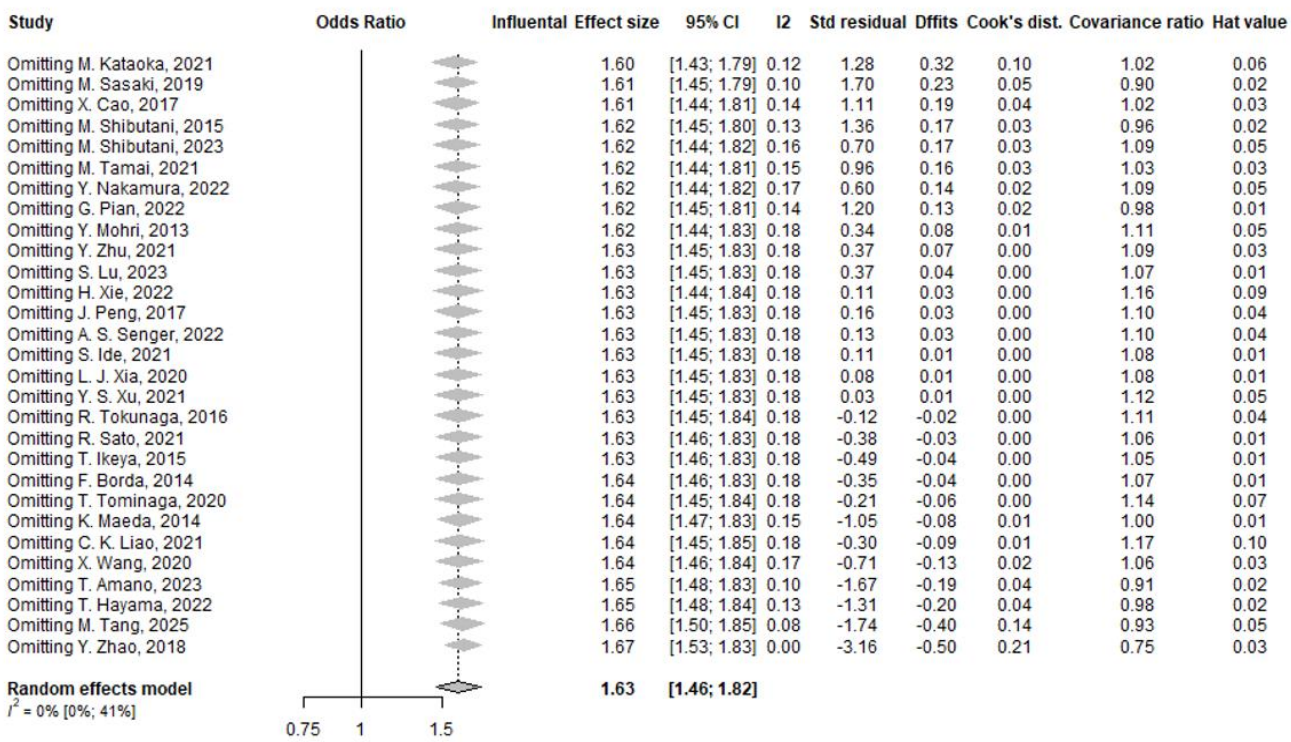
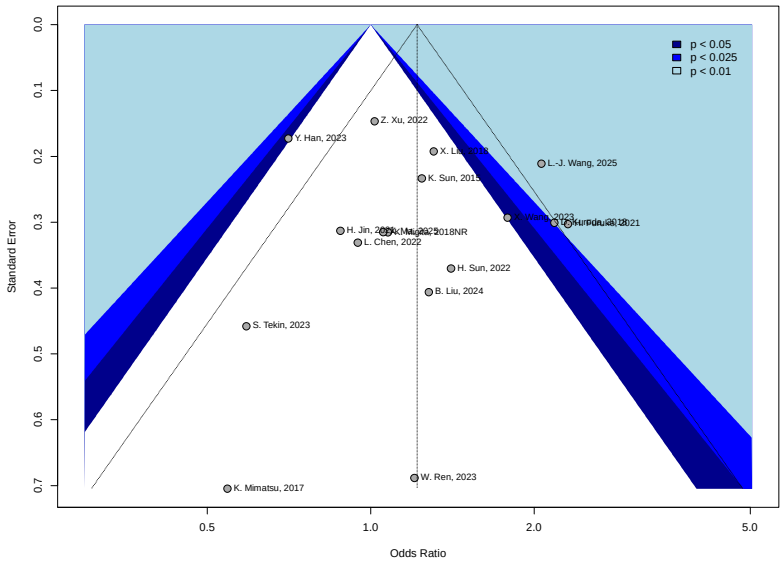


Figure S178: Funnel plot: Association between malnutrition-related complication risk and serum CEA level in gastric cancer (Biological composite scores)



Egger test: t = -1.20, df = 15, p-value = 0.2479

Figure S178.1: Leave-one-out plot: Association between malnutrition-related complication risk and serum CEA level in gastric cancer (Biological composite scores)

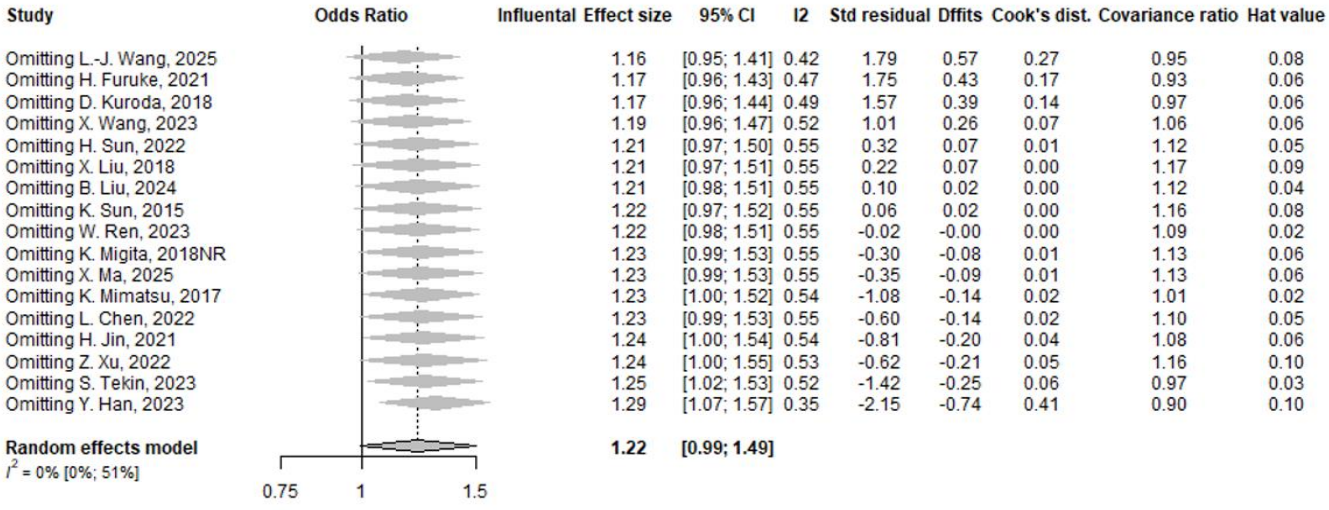
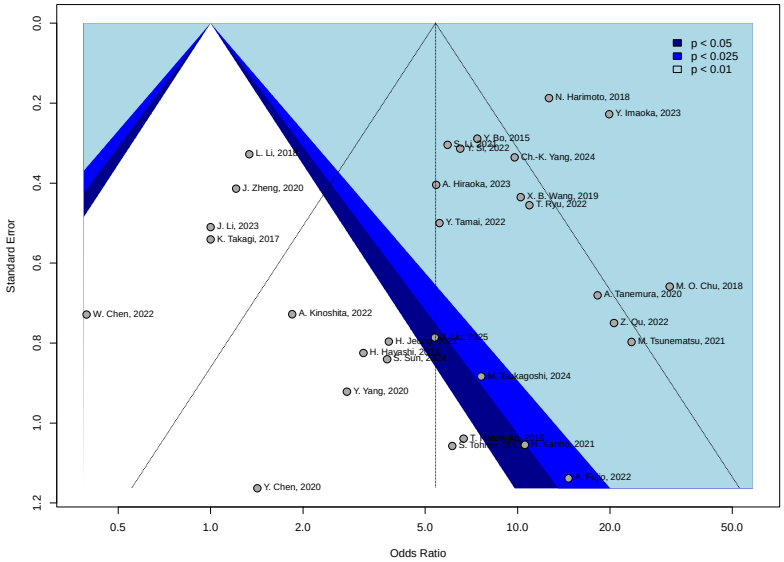


Figure S179: Funnel plot: Association between malnutrition-related complication risk and Child-Pugh class (B, C vs. A) in hepatocellular carcinoma (Biological composite scores)

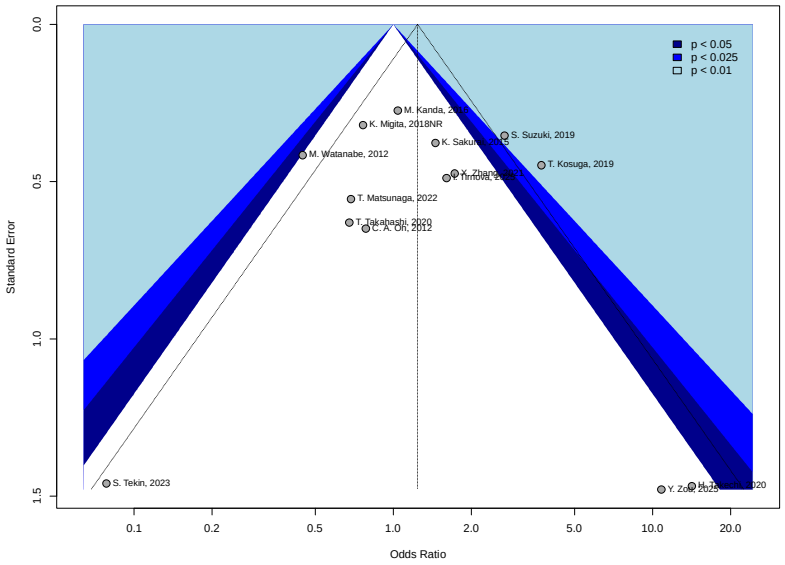


Egger test: t = -0.50, df = 29, p-value = 0.6215

Figure S179.1: Leave-one-out plot: Association between malnutrition-related complication risk and Child-Pugh class (B, C vs. A) in hepatocellular carcinoma (Biological composite scores)

Study	Odds Ratio	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Y. Imaoka, 2023			5.07	[3.42; 7.53]	0.75	1.53	0.34	0.11	1.00	0.05
Omitting M. O. Chu, 2018			5.12	[3.47; 7.54]	0.79	1.68	0.29	0.08	0.97	0.03
Omitting N. Harimoto, 2018			5.18	[3.46; 7.76]	0.77	0.98	0.22	0.05	1.05	0.05
Omitting M. Tsunematsu, 2021			5.19	[3.50; 7.71]	0.79	1.27	0.21	0.04	1.01	0.03
Omitting Z. Qu, 2022			5.20	[3.50; 7.73]	0.79	1.19	0.20	0.04	1.01	0.03
Omitting A. Tanemura, 2020			5.20	[3.49; 7.75]	0.79	1.12	0.20	0.04	1.02	0.03
Omitting T. Ryu, 2022			5.25	[3.50; 7.87]	0.79	0.73	0.15	0.02	1.06	0.04
Omitting Ch.-K. Yang, 2024			5.26	[3.50; 7.90]	0.79	0.64	0.14	0.02	1.07	0.04
Omitting X. B. Wang, 2019			5.26	[3.51; 7.90]	0.79	0.66	0.14	0.02	1.06	0.04
Omitting A. Fujio, 2022			5.30	[3.55; 7.92]	0.79	0.70	0.10	0.01	1.04	0.02
Omitting Y. Bo, 2015			5.32	[3.53; 8.01]	0.80	0.34	0.08	0.01	1.08	0.04
Omitting H. Kanno, 2021			5.33	[3.56; 7.97]	0.79	0.49	0.07	0.01	1.05	0.02
Omitting M. Tsukagoshi, 2024			5.35	[3.57; 8.03]	0.80	0.28	0.05	0.00	1.06	0.02
Omitting Y. Si, 2022			5.35	[3.55; 8.07]	0.80	0.20	0.05	0.00	1.08	0.04
Omitting T. Hatanaka, 2019			5.38	[3.59; 8.06]	0.80	0.16	0.03	0.00	1.06	0.02
Omitting S. Li, 2021			5.38	[3.57; 8.10]	0.79	0.10	0.02	0.00	1.08	0.04
Omitting S. Tohme, 2017			5.39	[3.59; 8.07]	0.80	0.09	0.02	0.00	1.06	0.02
Omitting Y. Tamai, 2022			5.39	[3.58; 8.12]	0.79	0.03	0.01	0.00	1.07	0.04
Omitting A. Hiraoka, 2023			5.40	[3.58; 8.13]	0.79	0.01	0.00	0.00	1.08	0.04
Omitting J. Liu, 2025			5.40	[3.60; 8.11]	0.80	-0.00	0.00	0.00	1.06	0.03
Omitting S. Sun, 2024			5.45	[3.63; 8.18]	0.79	-0.30	-0.05	0.00	1.06	0.03
Omitting H. Jeong, 2021			5.45	[3.63; 8.18]	0.79	-0.30	-0.05	0.00	1.06	0.03
Omitting H. Hayashi, 2023			5.48	[3.65; 8.21]	0.79	-0.45	-0.07	0.01	1.06	0.03
Omitting Y. Yang, 2020			5.49	[3.66; 8.22]	0.79	-0.53	-0.08	0.01	1.05	0.02
Omitting Y. Chen, 2020			5.53	[3.71; 8.24]	0.79	-0.93	-0.12	0.02	1.02	0.02
Omitting A. Kinoshita, 2022			5.58	[3.74; 8.33]	0.79	-0.96	-0.17	0.03	1.03	0.03
Omitting K. Takagi, 2017			5.76	[3.91; 8.49]	0.77	-1.74	-0.34	0.11	0.97	0.04
Omitting J. Zheng, 2020			5.76	[3.90; 8.52]	0.77	-1.64	-0.34	0.11	0.99	0.04
Omitting L. Li, 2018			5.77	[3.89; 8.54]	0.75	-1.59	-0.35	0.11	0.99	0.04
Omitting J. Li, 2023			5.77	[3.92; 8.50]	0.77	-1.77	-0.36	0.12	0.97	0.04
Omitting W. Chen, 2022			5.85	[4.05; 8.45]	0.77	-2.51	-0.44	0.17	0.87	0.03
Random effects model			**5.40**	**[3.65; 8.01]**						
I^2 = 0% [0%; 40%]										

Figure S180: Funnel plot: Association between malnutrition-related complication risk and cardiovascular disease in gastric cancer (Biological composite scores)



Egger test: t = -0.86, df = 12, p-value = 0.4060

Figure S180.1: Leave-one-out plot: Association between malnutrition-related complication risk and cardiovascular disease in gastric cancer (Biological composite scores)

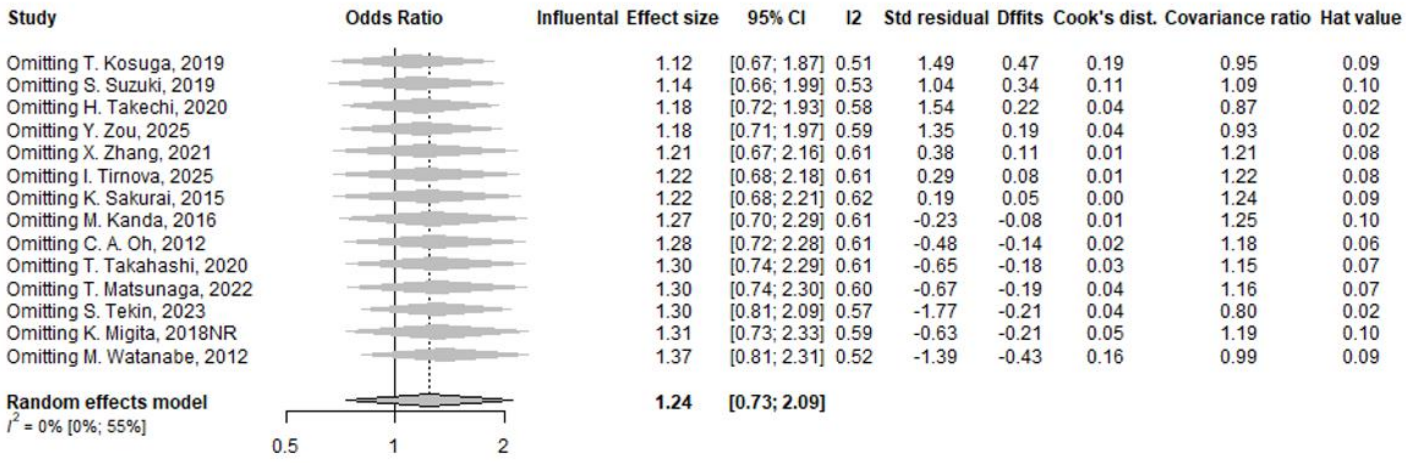
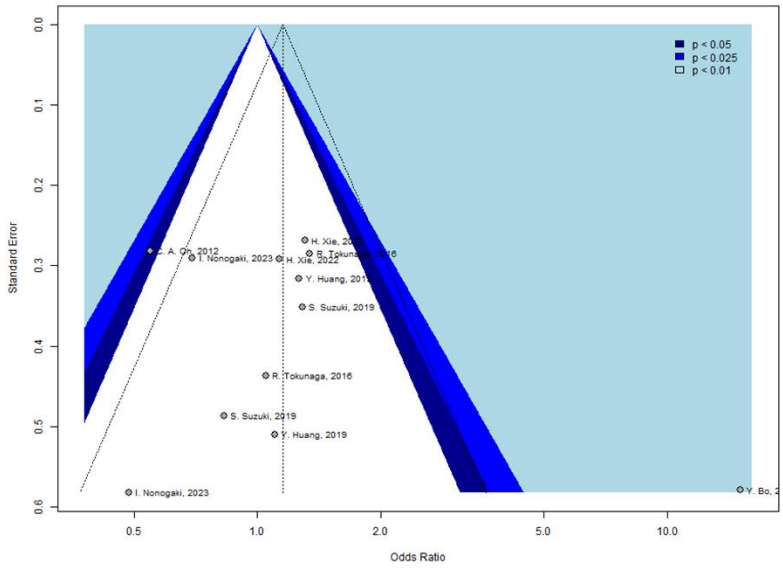


Figure S181: Funnel plot: Association between malnutrition-related complication risk and diabetes mellitus in gastrointestinal cancer (Biological composite scores)



Egger test: t = 1.17, df = 10, p-value = 0.2699

Figure S181.1: Leave-one-out plot: Association between malnutrition-related complication risk and diabetes mellitus in gastrointestinal cancer (Biological composite scores)

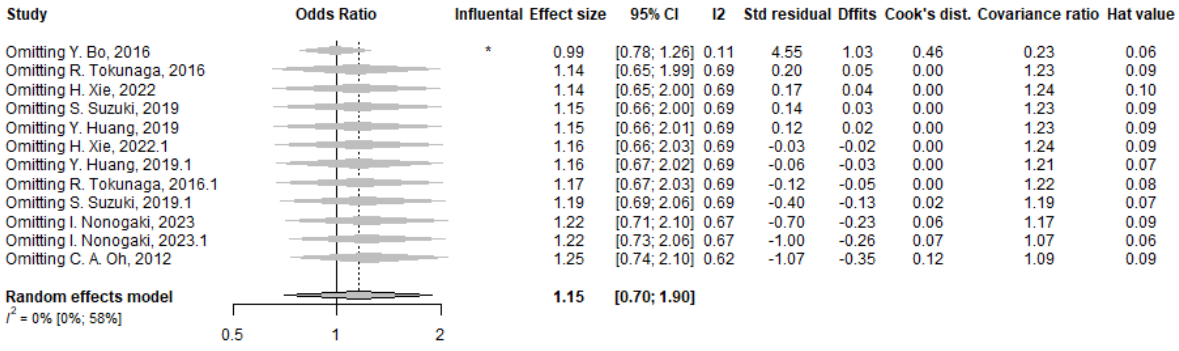
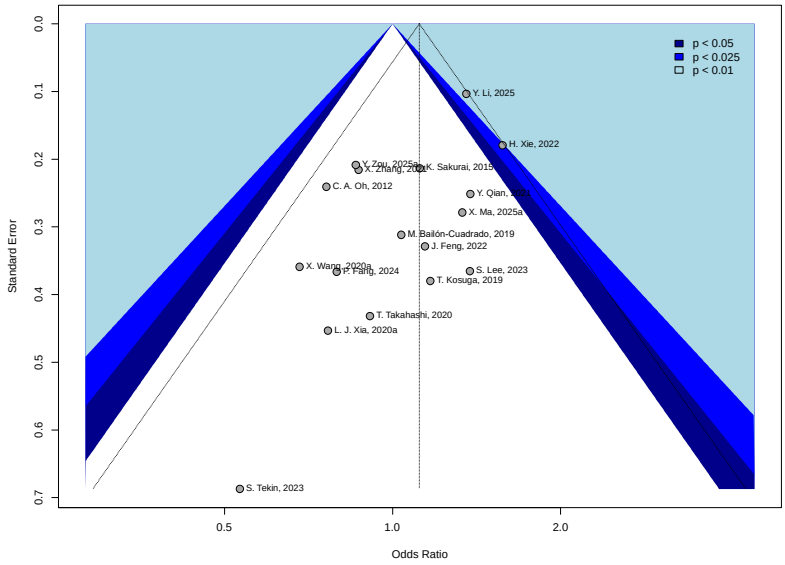


Figure S182: Funnel plot: Association between malnutrition-related complication risk and hypertension in gastrointestinal cancer (Biological composite scores)



Egger test: t = -2.06, df = 15, p-value = 0.0568

Figure S182.1: Leave-one-out plot: Association between malnutrition-related complication risk and hypertension in gastrointestinal cancer (Biological composite scores)

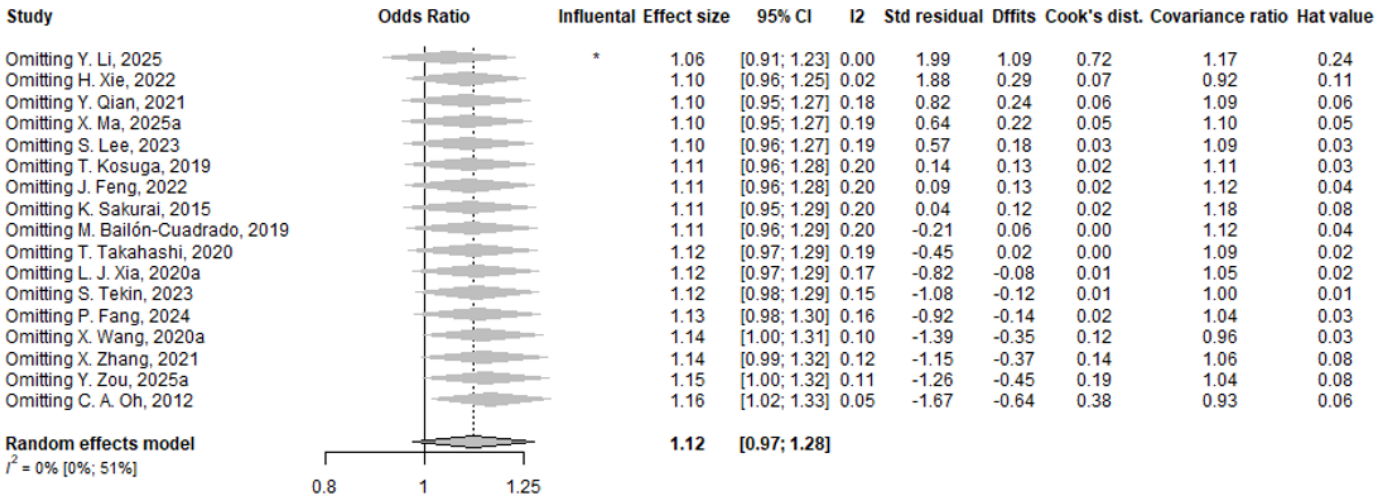
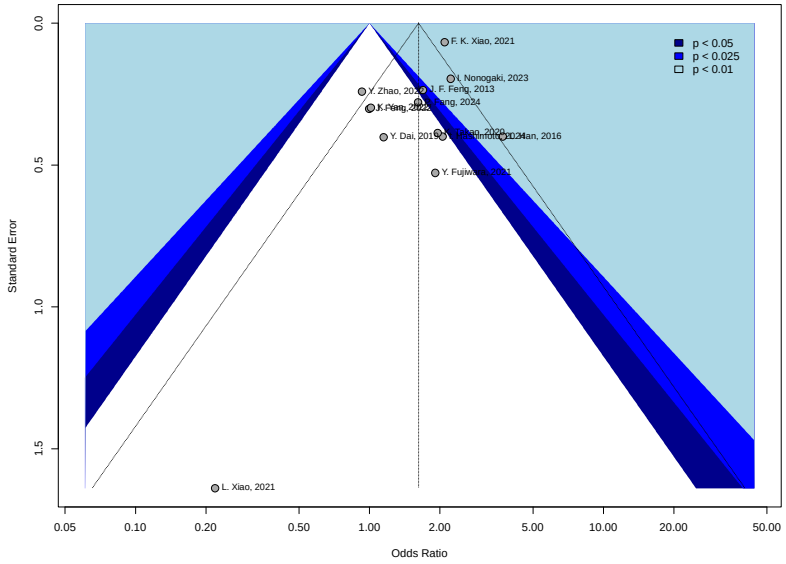


Figure S183: Funnel plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in esophageal squamous cell carcinoma (Biological composite scores)



Egger test: t = -1.87, df = 11, p-value = 0.0881

Figure S183.1: Leave-one-out plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in esophageal squamous cell carcinoma (Biological composite scores)

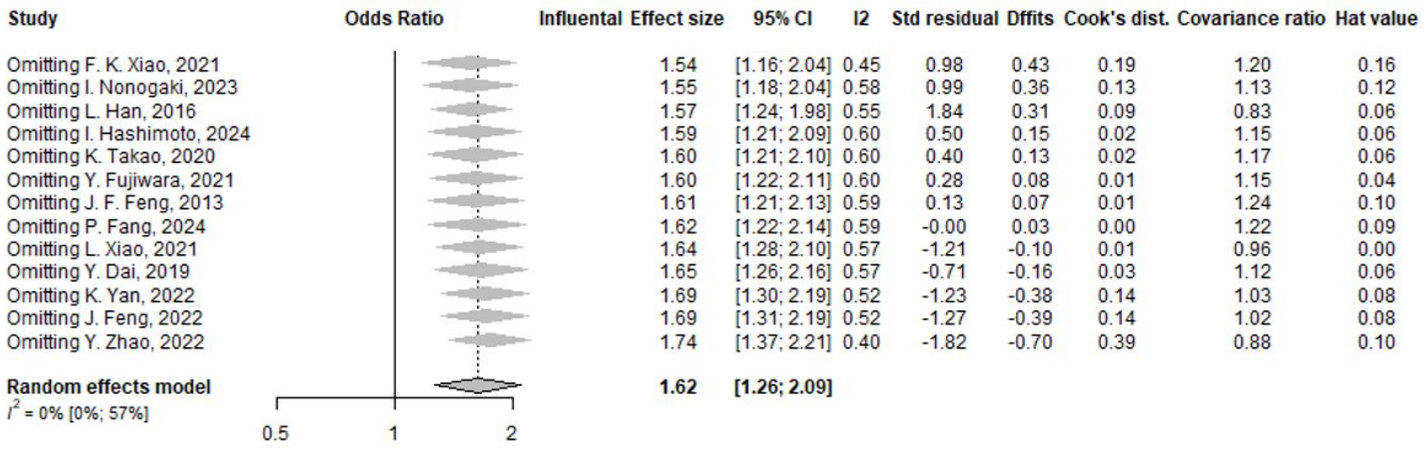
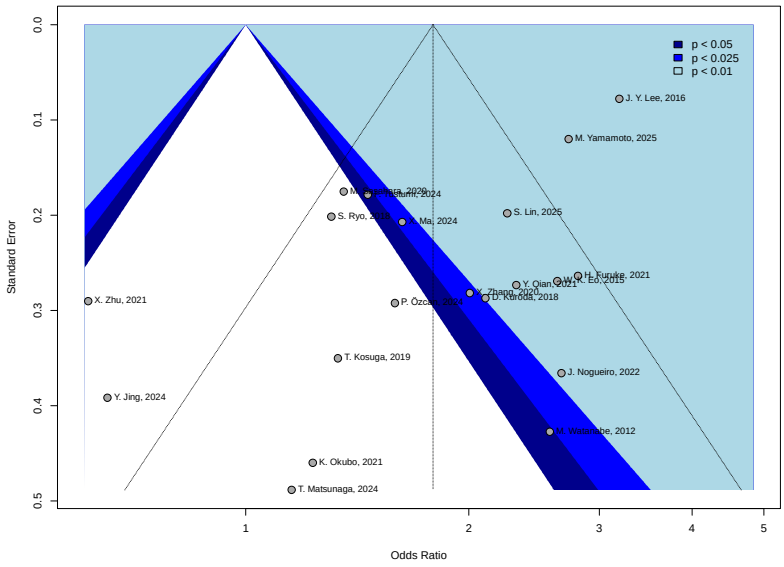


Figure S184: Funnel plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in gastric cancer (Biological composite scores)



Egger test: t = -2.32, df = 18, p-value = 0.0320

Figure S184.1: Leave-one-out plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in gastric cancer (Biological composite scores)

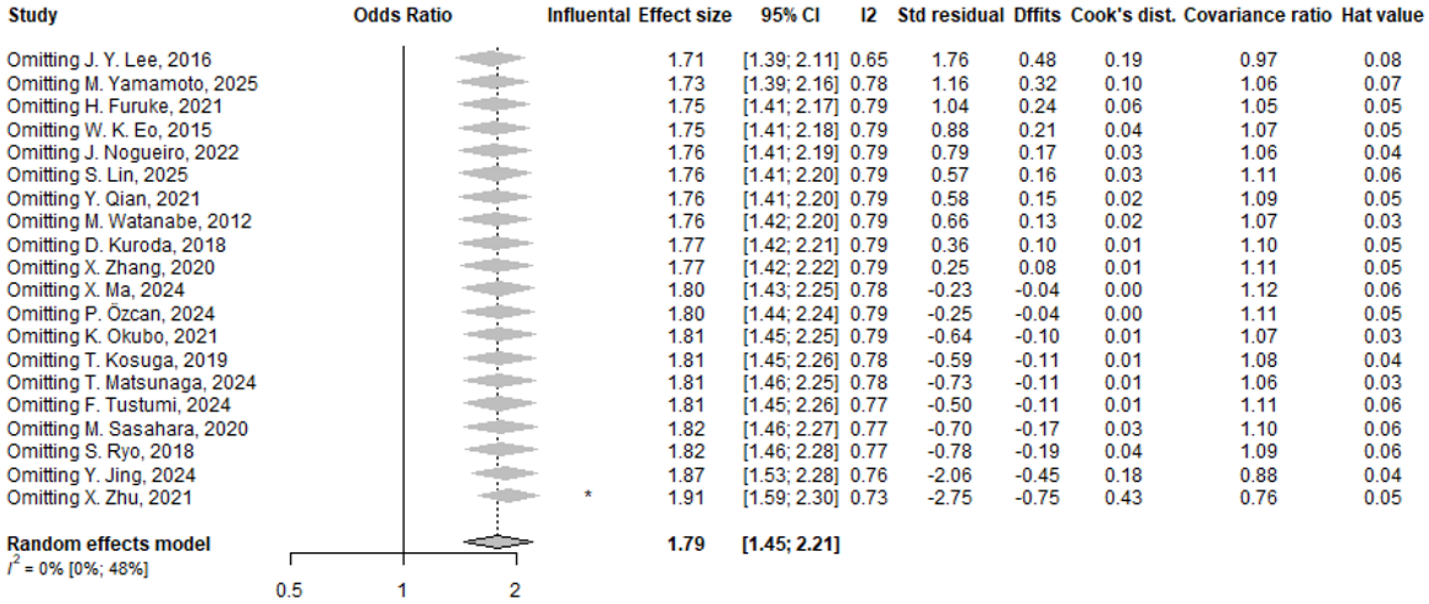
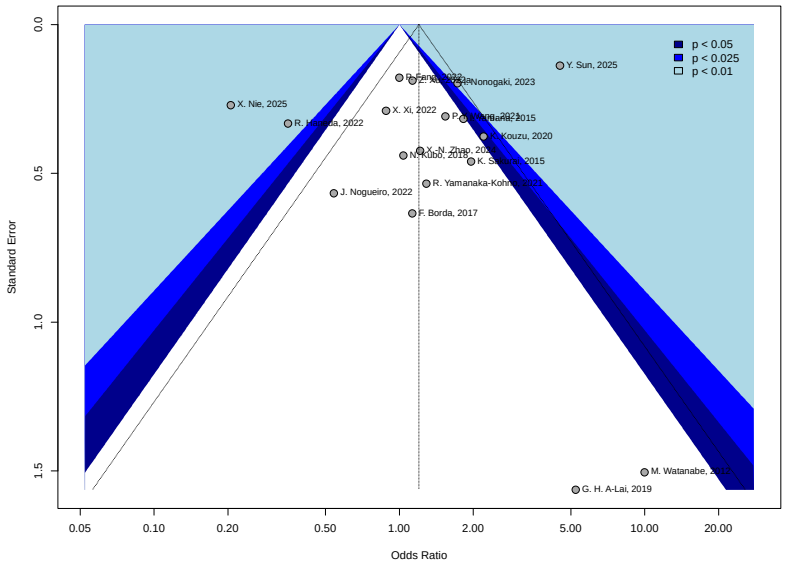
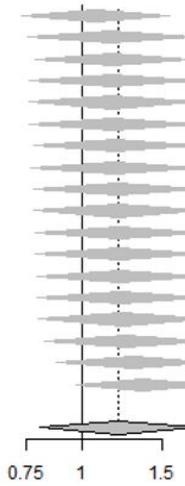


Figure S185: Funnel plot: Association between malnutrition-related complication risk and neoadjuvant chemo or radiotherapy in upper gastrointestinal cancer (Biological composite scores)



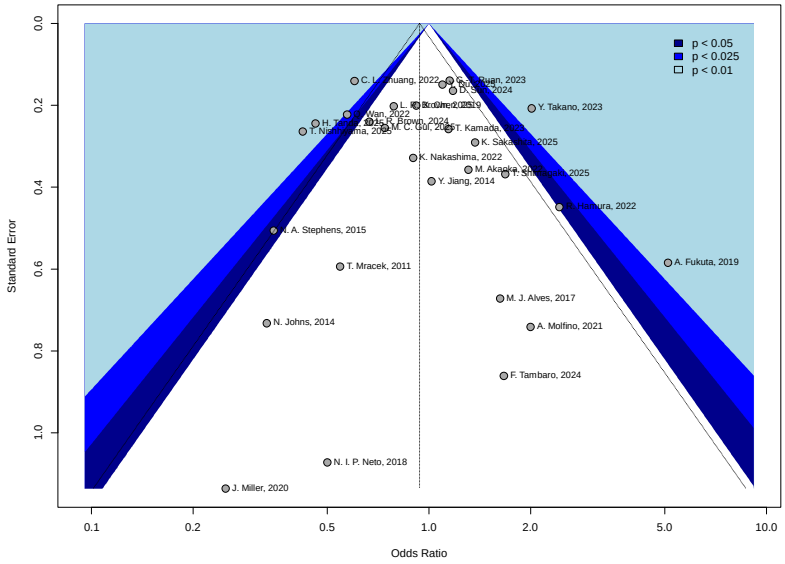
Egger test: t = -0.24, df = 16, p-value = 0.8115

Figure S185.1: Leave-one-out plot: Association between malnutrition-related complication risk and neoadjuvant chemo or radiotherapy in upper gastrointestinal cancer (Biological composite scores)



Study	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Y. Sun, 2025		1.07	[0.73; 1.56]	0.77	2.27	0.70	0.37	0.87	0.07
Omitting K. Kouzu, 2020		1.16	[0.76; 1.76]	0.90	0.79	0.20	0.04	1.09	0.06
Omitting M. Watanabe, 2012		1.17	[0.78; 1.74]	0.90	1.30	0.15	0.02	0.97	0.01
Omitting I. Yamana, 2015		1.17	[0.76; 1.79]	0.90	0.56	0.14	0.02	1.12	0.06
Omitting K. Sakurai, 2015		1.17	[0.76; 1.79]	0.90	0.60	0.14	0.02	1.10	0.05
Omitting I. Nonogaki, 2023		1.17	[0.76; 1.80]	0.90	0.51	0.14	0.02	1.13	0.07
Omitting G. H. A-Lai, 2019		1.18	[0.78; 1.78]	0.90	0.87	0.10	0.01	1.03	0.01
Omitting P. Y. Wang, 2021		1.18	[0.77; 1.82]	0.90	0.33	0.08	0.01	1.13	0.06
Omitting R. Yamanaka-Kohno, 2021		1.20	[0.78; 1.84]	0.90	0.08	0.01	0.00	1.12	0.05
Omitting X.-N. Zhao, 2024		1.20	[0.78; 1.85]	0.90	0.01	-0.00	0.00	1.13	0.06
Omitting F. Borda, 2017		1.21	[0.79; 1.85]	0.90	-0.07	-0.02	0.00	1.11	0.04
Omitting Z. Xu, 2022a		1.21	[0.78; 1.86]	0.90	-0.09	-0.03	0.00	1.15	0.07
Omitting N. Kubo, 2018		1.21	[0.79; 1.86]	0.90	-0.18	-0.05	0.00	1.13	0.05
Omitting P. Fang, 2022		1.22	[0.79; 1.88]	0.89	-0.26	-0.08	0.01	1.14	0.07
Omitting X. Xi, 2022		1.23	[0.80; 1.89]	0.90	-0.42	-0.12	0.01	1.13	0.07
Omitting J. Nogueiro, 2022		1.25	[0.82; 1.89]	0.90	-0.91	-0.20	0.04	1.06	0.05
Omitting R. Haneda, 2022		1.30	[0.88; 1.93]	0.88	-1.77	-0.45	0.18	0.94	0.06
Omitting X. Nie, 2025	*	1.36	[0.97; 1.91]	0.84	-3.12	-0.84	0.44	0.71	0.07
Random effects model		**1.20**	**[0.80; 1.80]**						
I^2 = 0% [0%; 50%]									

Figure S186: Funnel plot: Association between cachexia and sex in resectable gastrointestinal cancer

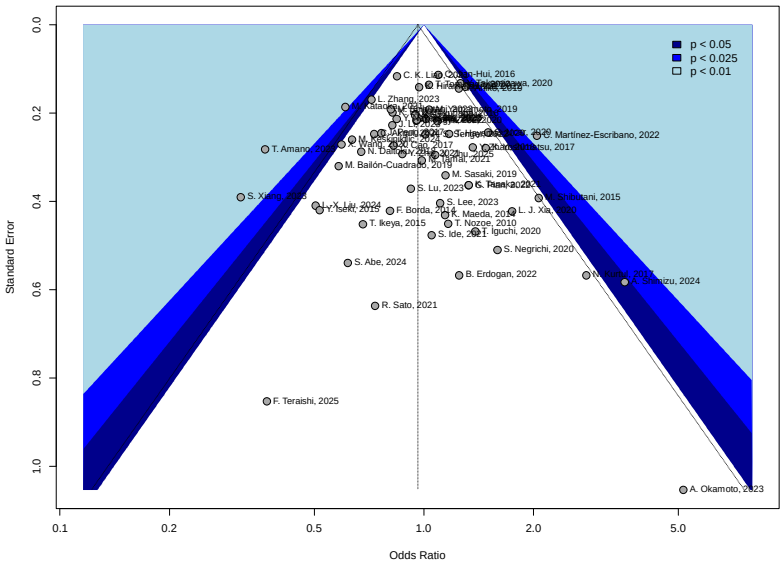


Egger test: t = -0.12, df = 26, p-value = 0.9048

Figure S186.1: Leave-one-out plot: Association between cachexia and sex in resectable gastrointestinal cancer

Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Y. Takano, 2023		0.90	[0.72; 1.12]	0.62	1.69	0.40	0.15	0.96	0.05
Omitting A. Fukuta, 2019		0.90	[0.74; 1.10]	0.65	2.47	0.36	0.12	0.81	0.02
Omitting R. Hamura, 2022		0.91	[0.73; 1.13]	0.67	1.57	0.28	0.07	0.96	0.03
Omitting T. Shimagaki, 2025		0.92	[0.73; 1.15]	0.68	1.04	0.20	0.04	1.03	0.04
Omitting K. Sakashita, 2025		0.92	[0.73; 1.16]	0.68	0.72	0.15	0.02	1.07	0.04
Omitting M. Akaoka, 2022		0.93	[0.74; 1.17]	0.69	0.59	0.11	0.01	1.07	0.04
Omitting A. Molfino, 2021		0.93	[0.74; 1.16]	0.69	0.88	0.11	0.01	1.03	0.02
Omitting D. Sun, 2024		0.93	[0.73; 1.17]	0.68	0.48	0.11	0.01	1.10	0.05
Omitting G.-T. Ruan, 2023		0.93	[0.73; 1.17]	0.68	0.44	0.10	0.01	1.10	0.05
Omitting M. J. Alves, 2017		0.93	[0.74; 1.17]	0.69	0.68	0.09	0.01	1.05	0.02
Omitting T. Kamada, 2023		0.93	[0.74; 1.17]	0.69	0.38	0.08	0.01	1.09	0.04
Omitting Y. Du, 2025		0.93	[0.74; 1.18]	0.68	0.33	0.07	0.01	1.10	0.05
Omitting F. Tambaro, 2024		0.93	[0.74; 1.17]	0.69	0.59	0.06	0.00	1.05	0.01
Omitting Y. Jiang, 2014		0.94	[0.74; 1.18]	0.69	0.14	0.02	0.00	1.09	0.03
Omitting X. Chen, 2019		0.94	[0.74; 1.19]	0.69	-0.05	-0.02	0.00	1.10	0.05
Omitting K. Nakashima, 2022		0.94	[0.75; 1.19]	0.69	-0.08	-0.02	0.00	1.09	0.04
Omitting N. I. P. Neto, 2018		0.94	[0.75; 1.18]	0.69	-0.54	-0.06	0.00	1.04	0.01
Omitting L. R. Brown, 2025		0.95	[0.75; 1.20]	0.69	-0.36	-0.09	0.01	1.10	0.05
Omitting J. Miller, 2020		0.95	[0.76; 1.18]	0.69	-1.09	-0.10	0.01	1.00	0.01
Omitting M. C. Gül, 2025		0.95	[0.75; 1.20]	0.69	-0.47	-0.11	0.01	1.09	0.04
Omitting T. Mracek, 2011		0.95	[0.76; 1.19]	0.69	-0.74	-0.11	0.01	1.05	0.02
Omitting N. Johns, 2014		0.95	[0.76; 1.19]	0.68	-1.23	-0.15	0.02	0.99	0.02
Omitting L. R. Brown, 2024		0.95	[0.76; 1.20]	0.68	-0.69	-0.15	0.02	1.08	0.05
Omitting Q. Wan, 2022		0.96	[0.77; 1.21]	0.67	-1.02	-0.23	0.05	1.05	0.05
Omitting N. A. Stephens, 2015		0.96	[0.77; 1.20]	0.68	-1.53	-0.23	0.05	0.96	0.03
Omitting C. L. Zhuang, 2022		0.96	[0.77; 1.21]	0.65	-0.98	-0.24	0.06	1.06	0.05
Omitting H. Tanda, 2025		0.97	[0.78; 1.21]	0.66	-1.48	-0.32	0.10	0.99	0.05
Omitting T. Nishhiyama, 2025		0.97	[0.78; 1.21]	0.65	-1.65	-0.34	0.11	0.97	0.04
Random effects model		**0.94**	**[0.75; 1.17]**						
I^2 = 0% [0%; 42%]									

Figure S187: Funnel plot: Association between malnutrition-related complication risk and sex in colorectal cancer (Biological composite scores)



Egger test: t = 0.30, df = 60, p-value = 0.7645

Figure S187.1: Leave-one-out plot: Association between malnutrition-related complication risk and sex in colorectal cancer (Biological composite scores)

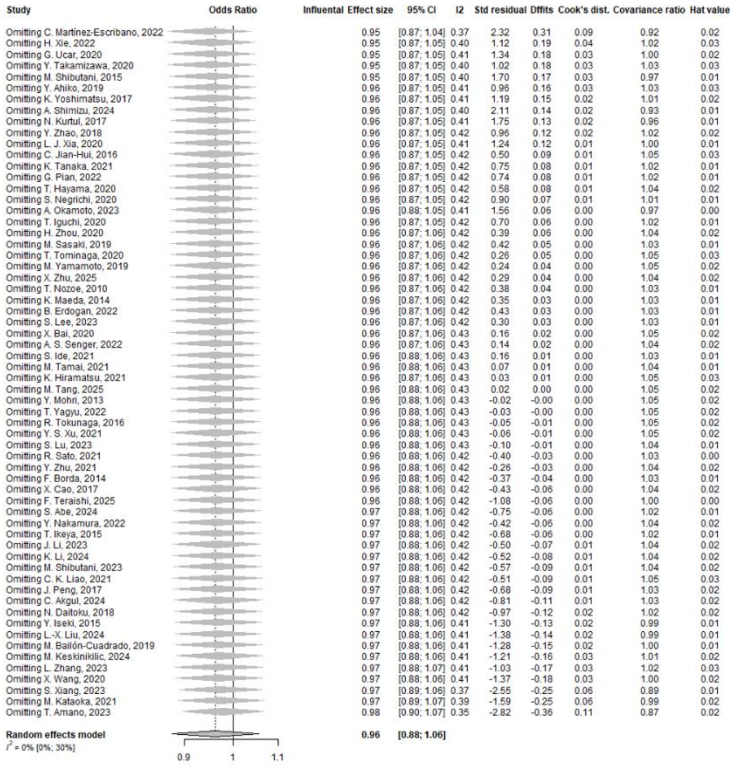
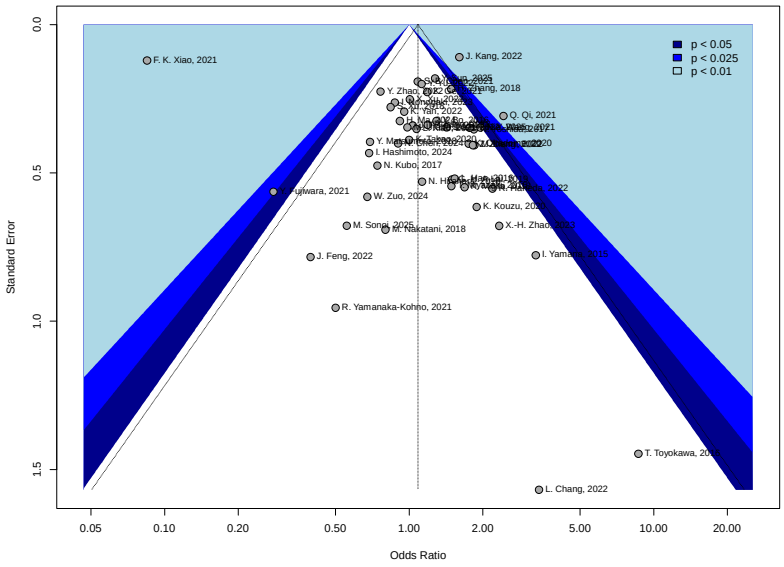
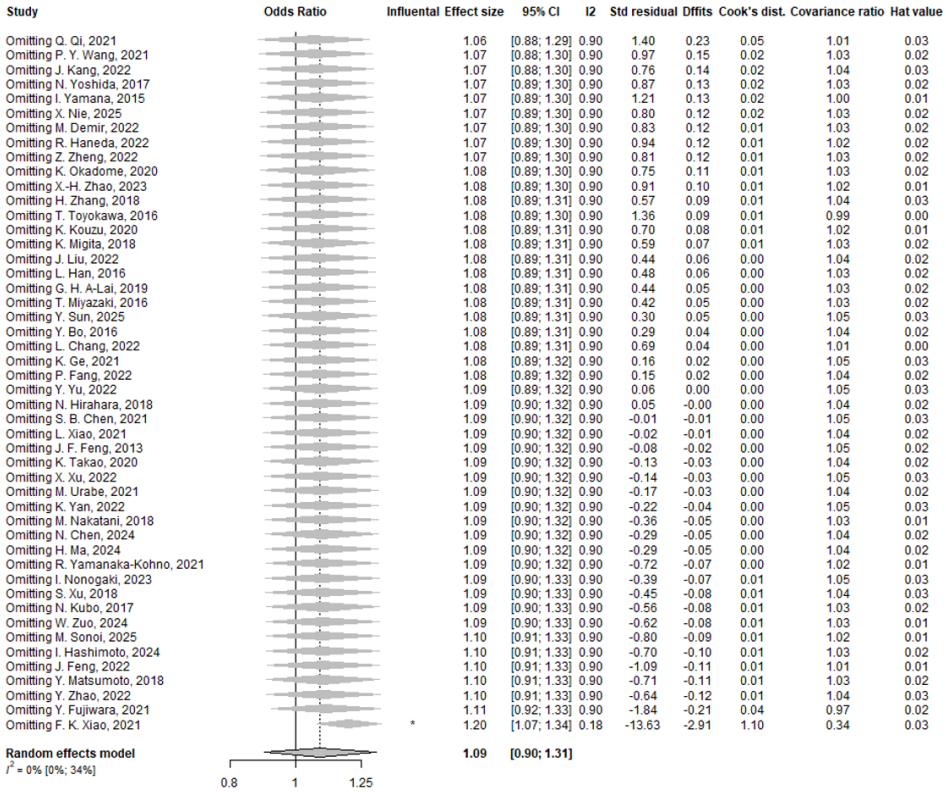


Figure S188: Funnel plot: Association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



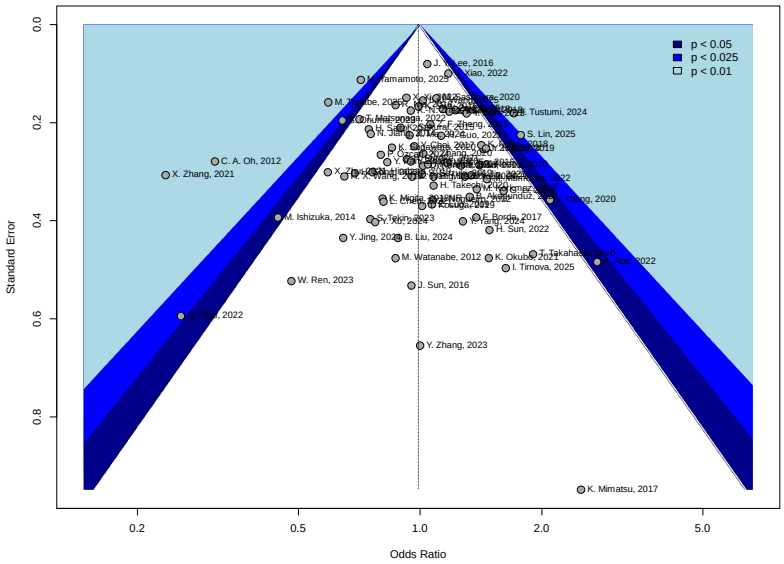
Egger test: t = 1.81, df = 46, p-value = 0.0765

Figure S188.1: Leave-one-out plot: Association between malnutrition-related complication risk and sex in esophageal cancer (Biological composite scores)



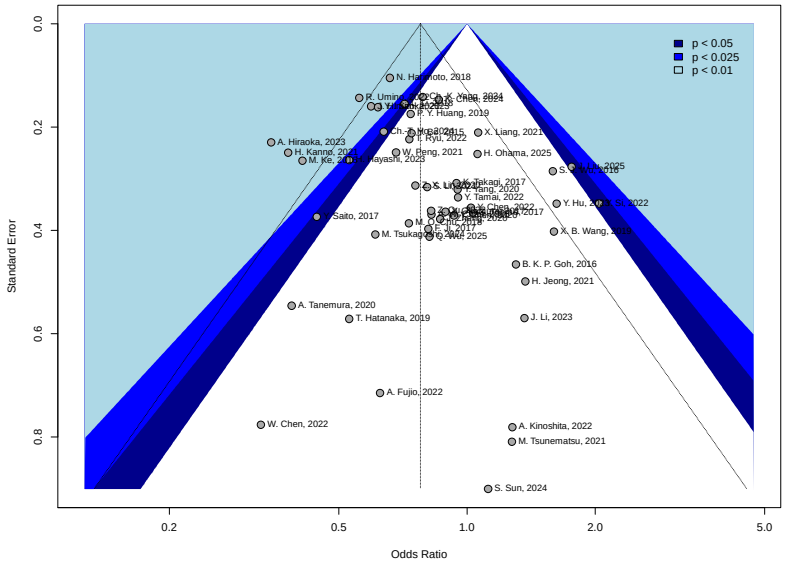
Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Q. Qi, 2021		1.06	[0.88; 1.29]	0.90	1.40	0.23	0.05	1.01	0.03
Omitting P. Y. Wang, 2021		1.07	[0.88; 1.30]	0.90	0.97	0.15	0.02	1.03	0.02
Omitting J. Kang, 2022		1.07	[0.88; 1.30]	0.90	0.76	0.14	0.02	1.04	0.03
Omitting N. Yoshida, 2017		1.07	[0.89; 1.30]	0.90	0.87	0.13	0.02	1.03	0.02
Omitting I. Yamana, 2015		1.07	[0.89; 1.30]	0.90	1.21	0.13	0.02	1.00	0.01
Omitting X. Nie, 2025		1.07	[0.89; 1.30]	0.90	0.80	0.12	0.02	1.03	0.02
Omitting M. Demir, 2022		1.07	[0.89; 1.30]	0.90	0.83	0.12	0.01	1.03	0.02
Omitting R. Haneda, 2022		1.07	[0.89; 1.30]	0.90	0.94	0.12	0.01	1.02	0.02
Omitting Z. Zheng, 2022		1.07	[0.89; 1.30]	0.90	0.81	0.12	0.01	1.03	0.02
Omitting K. Okadome, 2020		1.08	[0.89; 1.30]	0.90	0.75	0.11	0.01	1.03	0.02
Omitting X.-H. Zhao, 2023		1.08	[0.89; 1.30]	0.90	0.91	0.10	0.01	1.02	0.01
Omitting H. Zhang, 2018		1.08	[0.89; 1.31]	0.90	0.57	0.09	0.01	1.04	0.03
Omitting T. Toyokawa, 2016		1.08	[0.89; 1.30]	0.90	1.36	0.09	0.01	0.99	0.00
Omitting K. Kouzu, 2020		1.08	[0.89; 1.31]	0.90	0.70	0.08	0.01	1.02	0.01
Omitting K. Migita, 2018		1.08	[0.89; 1.31]	0.90	0.59	0.07	0.01	1.03	0.02
Omitting J. Liu, 2022		1.08	[0.89; 1.31]	0.90	0.44	0.06	0.00	1.04	0.02
Omitting L. Han, 2016		1.08	[0.89; 1.31]	0.90	0.48	0.06	0.00	1.03	0.02
Omitting G. H. A-Lai, 2019		1.08	[0.89; 1.31]	0.90	0.44	0.05	0.00	1.03	0.02
Omitting T. Miyazaki, 2016		1.08	[0.89; 1.31]	0.90	0.42	0.05	0.00	1.03	0.02
Omitting Y. Sun, 2025		1.08	[0.89; 1.31]	0.90	0.30	0.05	0.00	1.05	0.03
Omitting Y. Bo, 2016		1.08	[0.89; 1.31]	0.90	0.29	0.04	0.00	1.04	0.02
Omitting L. Chang, 2022		1.08	[0.89; 1.31]	0.90	0.69	0.04	0.00	1.01	0.00
Omitting K. Ge, 2021		1.08	[0.89; 1.32]	0.90	0.16	0.02	0.00	1.05	0.03
Omitting P. Fang, 2022		1.08	[0.89; 1.32]	0.90	0.15	0.02	0.00	1.04	0.02
Omitting Y. Yu, 2022		1.09	[0.89; 1.32]	0.90	0.06	0.00	0.00	1.05	0.03
Omitting N. Hirahara, 2018		1.09	[0.90; 1.32]	0.90	0.05	-0.00	0.00	1.04	0.02
Omitting S. B. Chen, 2021		1.09	[0.90; 1.32]	0.90	-0.01	-0.01	0.00	1.05	0.03
Omitting L. Xiao, 2021		1.09	[0.90; 1.32]	0.90	-0.02	-0.01	0.00	1.04	0.02
Omitting J. F. Feng, 2013		1.09	[0.90; 1.32]	0.90	-0.08	-0.02	0.00	1.05	0.02
Omitting K. Takao, 2020		1.09	[0.90; 1.32]	0.90	-0.13	-0.03	0.00	1.04	0.02
Omitting X. Xu, 2022		1.09	[0.90; 1.32]	0.90	-0.14	-0.03	0.00	1.05	0.03
Omitting M. Urabe, 2021		1.09	[0.90; 1.32]	0.90	-0.17	-0.03	0.00	1.04	0.02
Omitting K. Yan, 2022		1.09	[0.90; 1.32]	0.90	-0.22	-0.04	0.00	1.05	0.03
Omitting M. Nakatani, 2018		1.09	[0.90; 1.32]	0.90	-0.36	-0.05	0.00	1.03	0.01
Omitting N. Chen, 2024		1.09	[0.90; 1.32]	0.90	-0.29	-0.05	0.00	1.04	0.02
Omitting H. Ma, 2024		1.09	[0.90; 1.32]	0.90	-0.29	-0.05	0.00	1.04	0.02
Omitting R. Yamanaka-Kohno, 2021		1.09	[0.90; 1.32]	0.90	-0.72	-0.07	0.00	1.02	0.01
Omitting I. Nonogaki, 2023		1.09	[0.90; 1.33]	0.90	-0.39	-0.07	0.01	1.05	0.03
Omitting S. Xu, 2018		1.09	[0.90; 1.33]	0.90	-0.45	-0.08	0.01	1.04	0.03
Omitting N. Kubo, 2017		1.09	[0.90; 1.33]	0.90	-0.56	-0.08	0.01	1.03	0.02
Omitting W. Zuo, 2024		1.09	[0.90; 1.33]	0.90	-0.62	-0.08	0.01	1.03	0.01
Omitting M. Sonoi, 2025		1.10	[0.91; 1.33]	0.90	-0.80	-0.09	0.01	1.02	0.01
Omitting I. Hashimoto, 2024		1.10	[0.91; 1.33]	0.90	-0.70	-0.10	0.01	1.03	0.02
Omitting J. Feng, 2022		1.10	[0.91; 1.33]	0.90	-1.09	-0.11	0.01	1.01	0.01
Omitting Y. Matsumoto, 2018		1.10	[0.91; 1.33]	0.90	-0.71	-0.11	0.01	1.03	0.02
Omitting Y. Zhao, 2022		1.10	[0.91; 1.33]	0.90	-0.64	-0.12	0.01	1.04	0.03
Omitting Y. Fujiwara, 2021		1.11	[0.92; 1.33]	0.90	-1.84	-0.21	0.04	0.97	0.02
Omitting F. K. Xiao, 2021	*	1.20	[1.07; 1.34]	0.18	-13.63	-2.91	1.10	0.34	0.03
Random effects model		**1.09**	**[0.90; 1.31]**						
I^2 = 0% [0%; 34%]									

Figure S189: Funnel plot: Association between malnutrition-related complication risk and sex in gastric cancer (Biological composite scores)



Egger test: t = -0.05, df = 78, p-value = 0.9592

Figure S190: Funnel plot: Association between malnutrition-related complication risk and sex in hepatocellular carcinoma (Biological composite scores)



Egger test: t = 1.82, df = 48, p-value = 0.0749

Figure S190.1: Leave-one-out plot: Association between malnutrition-related complication risk and sex in hepatocellular carcinoma (Biological composite scores)

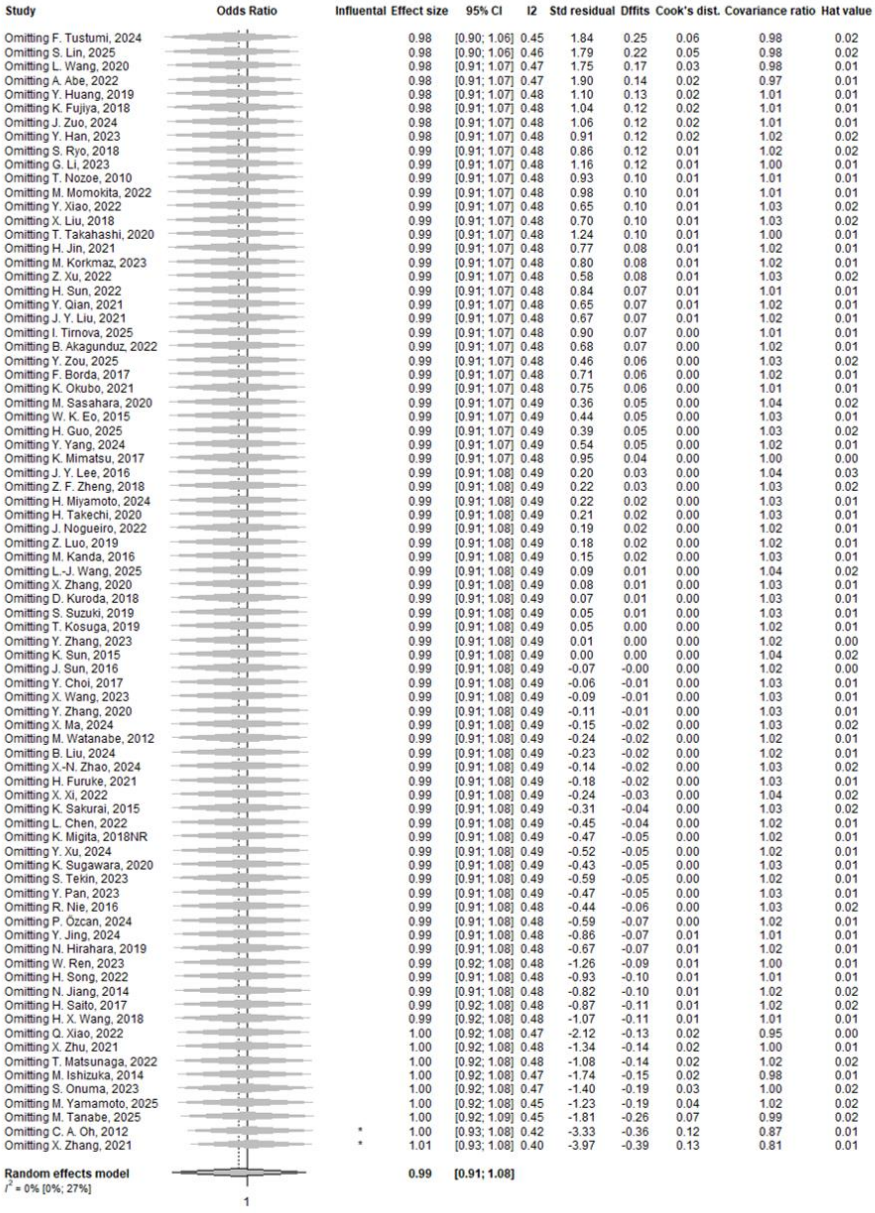
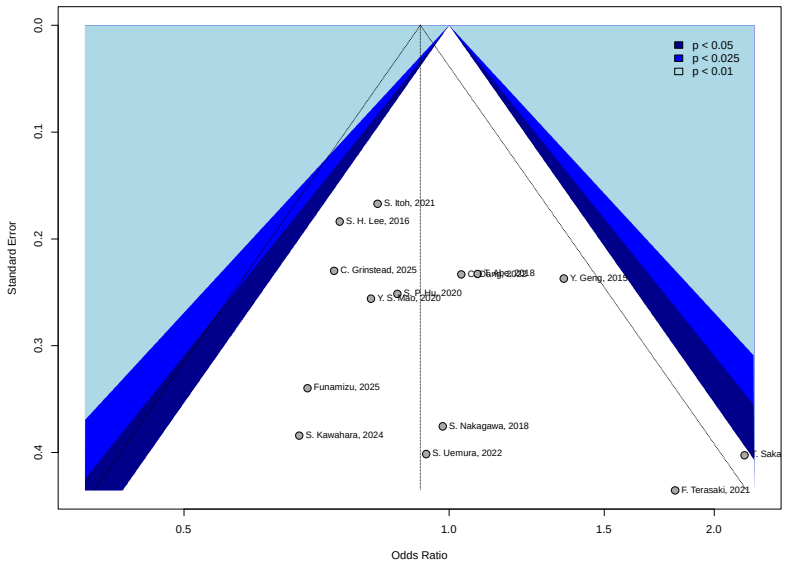


Figure S191: Funnel plot: Association between malnutrition-related complication risk and sex in PDAC cancer (Biological composite scores)



Egger test: t = 0.81, df = 12, p-value = 0.4329

Figure S191.1: Leave-one-out plot: Association between malnutrition-related complication risk and sex in PDAC cancer (Biological composite scores)

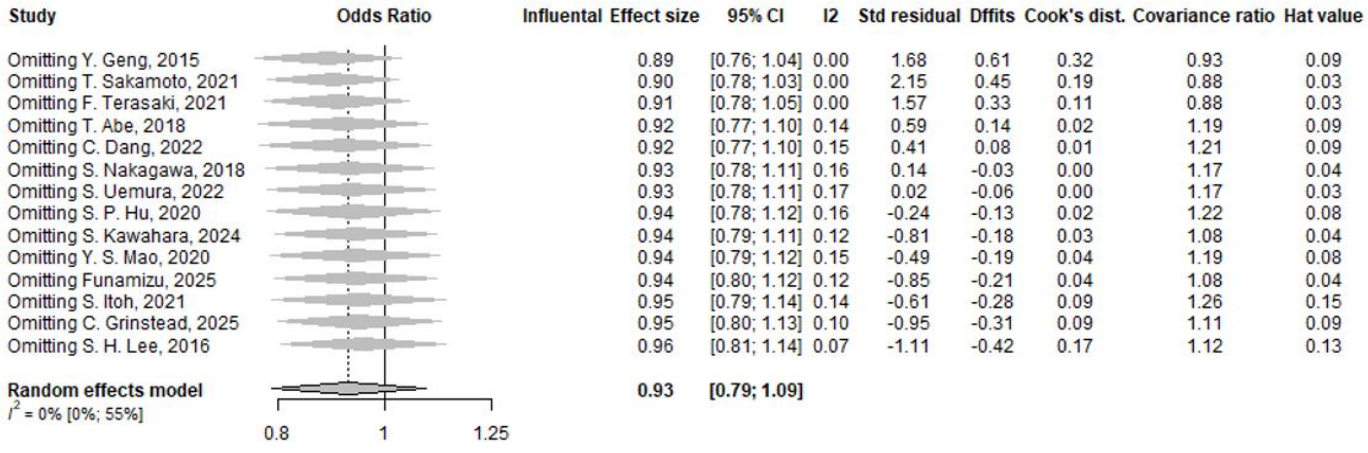
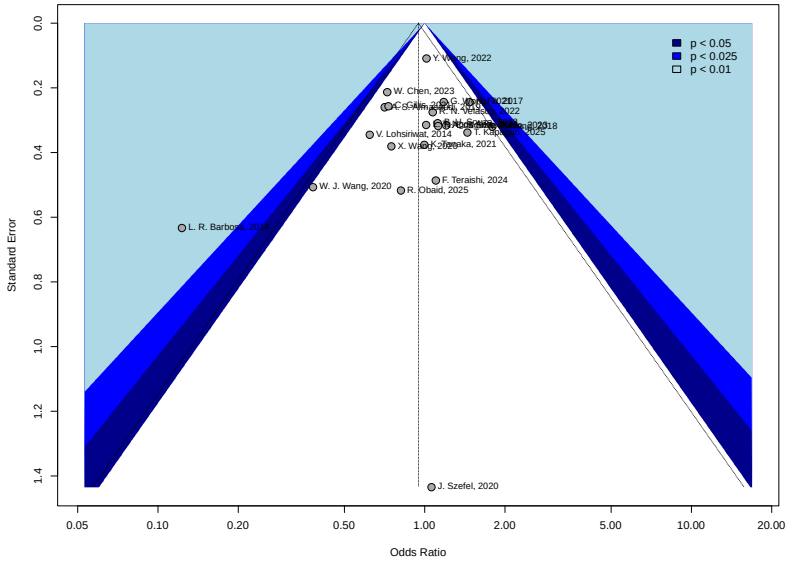
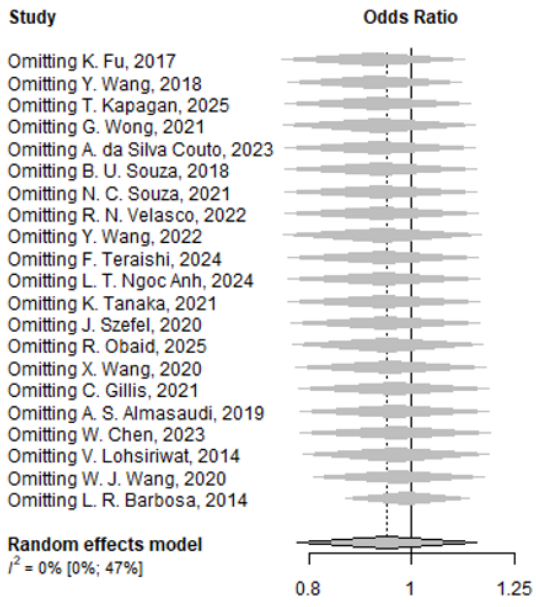


Figure S192: Funnel plot: Association between malnutrition risk and sex in colorectal cancer (Symptom-based risk assessment tools)



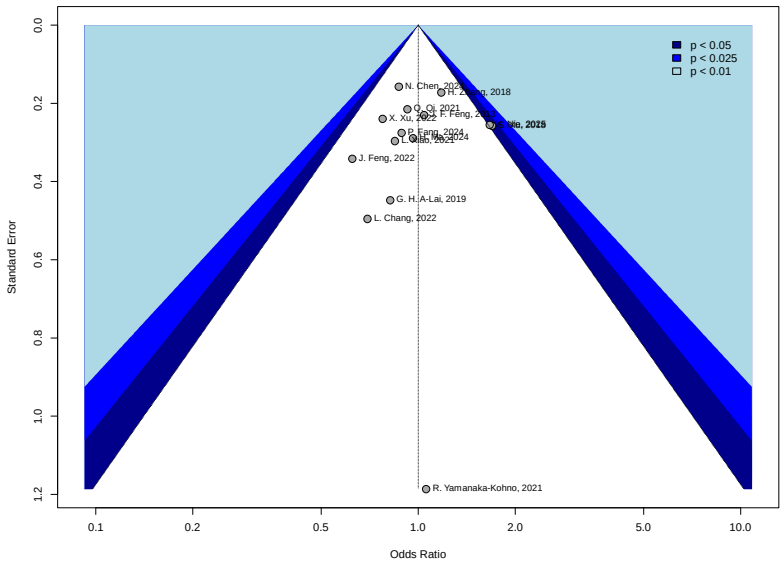
Egger test: t = -1.44, df = 19, p-value = 0.1650

Figure S192.1: Leave-one-out plot: Association between malnutrition risk and sex in colorectal cancer (Symptom-based risk assessment tools)



Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting K. Fu, 2017	0.92	[0.76; 1.12]	0.31	1.27	0.32	0.09	1.02	0.06
Omitting Y. Wang, 2018	0.92	[0.76; 1.11]	0.30	1.62	0.31	0.09	0.92	0.05
Omitting T. Kapagan, 2025	0.93	[0.76; 1.13]	0.35	0.99	0.22	0.05	1.05	0.05
Omitting G. Wong, 2021	0.93	[0.76; 1.15]	0.37	0.60	0.18	0.03	1.12	0.06
Omitting A. da Silva Couto, 2023	0.93	[0.76; 1.15]	0.37	0.58	0.15	0.02	1.11	0.05
Omitting B. U. Souza, 2018	0.94	[0.76; 1.15]	0.38	0.41	0.12	0.02	1.13	0.05
Omitting N. C. Souza, 2021	0.94	[0.76; 1.15]	0.38	0.41	0.12	0.01	1.13	0.05
Omitting R. N. Velasco, 2022	0.94	[0.76; 1.16]	0.38	0.32	0.11	0.01	1.14	0.06
Omitting Y. Wang, 2022	0.94	[0.76; 1.16]	0.38	0.24	0.10	0.01	1.19	0.10
Omitting F. Teraishi, 2024	0.94	[0.77; 1.16]	0.38	0.27	0.08	0.01	1.11	0.03
Omitting L. T. Ngoc Anh, 2024	0.94	[0.76; 1.16]	0.38	0.17	0.07	0.00	1.14	0.05
Omitting K. Tanaka, 2021	0.94	[0.77; 1.16]	0.38	0.11	0.05	0.00	1.13	0.04
Omitting J. Szefel, 2020	0.94	[0.77; 1.16]	0.38	0.08	0.04	0.00	1.09	0.00
Omitting R. Obaid, 2025	0.95	[0.77; 1.17]	0.38	-0.25	-0.01	0.00	1.11	0.03
Omitting X. Wang, 2020	0.95	[0.78; 1.17]	0.37	-0.49	-0.08	0.01	1.11	0.04
Omitting C. Gillis, 2021	0.96	[0.78; 1.18]	0.35	-0.69	-0.16	0.03	1.11	0.06
Omitting A. S. Almasaudi, 2019	0.96	[0.79; 1.18]	0.35	-0.78	-0.18	0.04	1.10	0.06
Omitting W. Chen, 2023	0.97	[0.79; 1.19]	0.34	-0.78	-0.20	0.04	1.11	0.07
Omitting V. Lohsiriwat, 2014	0.97	[0.79; 1.18]	0.35	-0.97	-0.21	0.04	1.05	0.04
Omitting W. J. Wang, 2020	0.97	[0.81; 1.17]	0.30	-1.65	-0.30	0.09	0.90	0.03
Omitting L. R. Barbosa, 2014	0.99	[0.87; 1.13]	0.05	-3.26	-0.52	0.23	0.47	0.02
Random effects model	**0.95**	**[0.78; 1.15]**						

Figure S193: Funnel plot: Association between malnutrition-related complication risk and smoking (active or history) in esophageal cancer (Biological composite scores)



Egger test: t = -0.50, df = 12, p-value = 0.6267

Figure S193.1: Leave-one-out plot: Association between malnutrition-related complication risk and smoking (active or history) in esophageal cancer (Biological composite scores)

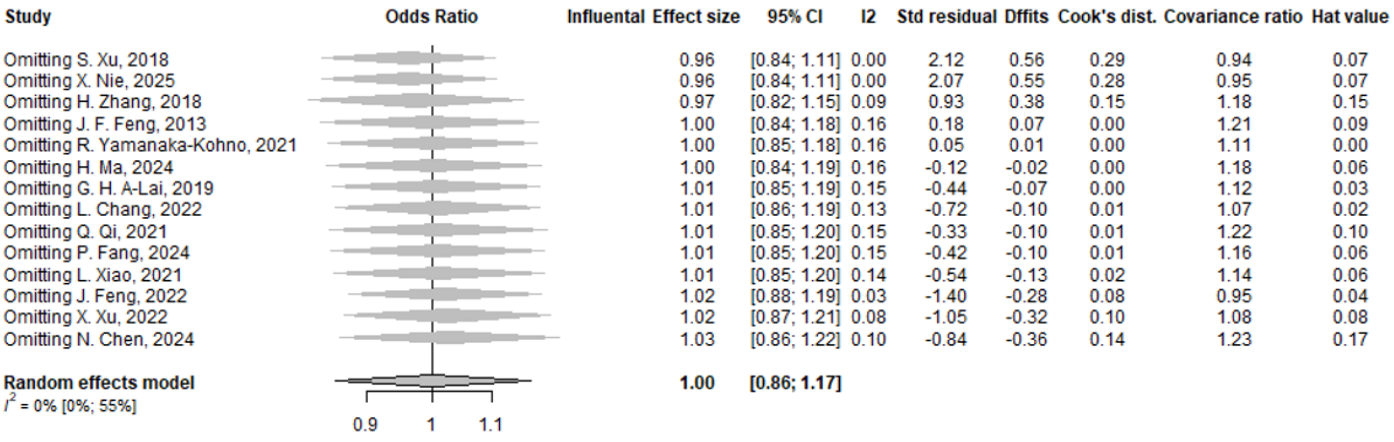
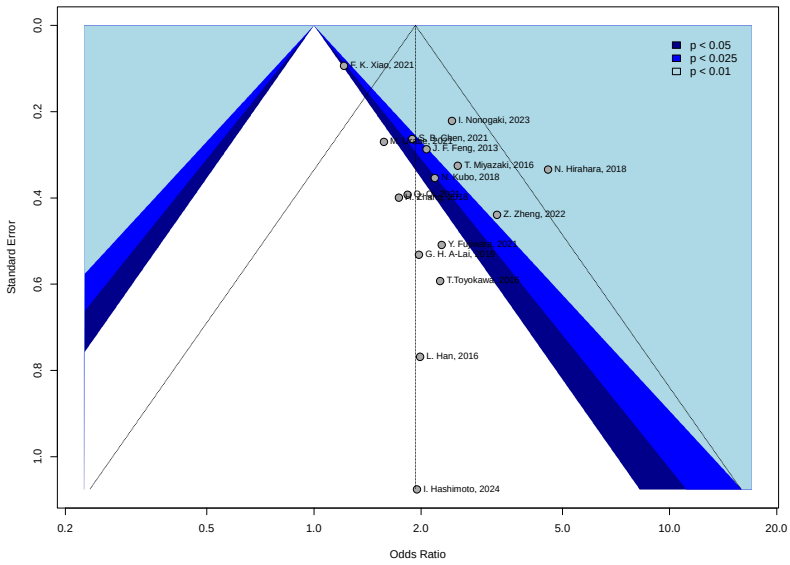


Figure S194: Funnel plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in esophageal cancer (Biological composite scores)

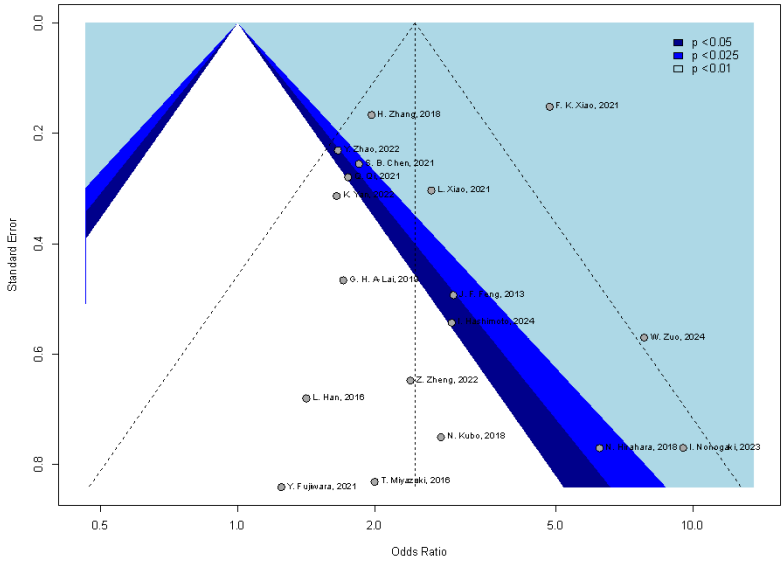


Egger test: t = 4.44, df = 14, p-value = 0.0006

Figure S194.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in esophageal cancer (Biological composite scores)

Study	Odds Ratio	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting J. Y. Lee, 2016			2.21	[1.79; 2.71]	0.63	1.51	0.39	0.14	1.01	0.07
Omitting M. Yamamoto, 2025			2.22	[1.80; 2.75]	0.71	1.16	0.30	0.09	1.05	0.07
Omitting T. Nozoe, 2010			2.23	[1.81; 2.75]	0.72	1.22	0.26	0.06	1.03	0.05
Omitting Y. Qian, 2021			2.24	[1.82; 2.77]	0.73	0.95	0.20	0.04	1.05	0.04
Omitting T. Matsunaga, 2022			2.24	[1.81; 2.78]	0.73	0.74	0.19	0.04	1.09	0.06
Omitting D. Kuroda, 2018			2.25	[1.82; 2.78]	0.73	0.76	0.18	0.03	1.07	0.04
Omitting K. Fujiya, 2018			2.25	[1.82; 2.79]	0.73	0.61	0.16	0.03	1.09	0.05
Omitting P. Özcan, 2024			2.26	[1.83; 2.79]	0.73	0.79	0.14	0.02	1.05	0.03
Omitting M. Kanda, 2016			2.27	[1.84; 2.81]	0.73	0.47	0.08	0.01	1.06	0.02
Omitting S. Lin, 2025			2.27	[1.83; 2.82]	0.73	0.23	0.08	0.01	1.11	0.05
Omitting K. Sakurai, 2015			2.27	[1.83; 2.83]	0.73	0.16	0.06	0.00	1.11	0.06
Omitting K. Ge, 2021			2.28	[1.84; 2.83]	0.73	0.08	0.04	0.00	1.10	0.04
Omitting M. Ishizuka, 2014			2.28	[1.84; 2.83]	0.73	0.05	0.03	0.00	1.09	0.03
Omitting M. Tanabe, 2025			2.29	[1.84; 2.85]	0.72	-0.09	0.00	0.00	1.12	0.06
Omitting T. Kosuga, 2019			2.30	[1.86; 2.84]	0.73	-0.35	-0.04	0.00	1.07	0.03
Omitting M. Sasahara, 2020			2.30	[1.86; 2.85]	0.72	-0.34	-0.05	0.00	1.09	0.04
Omitting H. Saito, 2017			2.30	[1.85; 2.86]	0.72	-0.32	-0.06	0.00	1.11	0.06
Omitting I. Tirnova, 2025			2.30	[1.86; 2.85]	0.72	-0.57	-0.06	0.00	1.05	0.02
Omitting T. Takahashi, 2020			2.33	[1.89; 2.87]	0.72	-0.97	-0.17	0.03	1.03	0.03
Omitting S. Ryo, 2018			2.34	[1.90; 2.88]	0.71	-1.13	-0.22	0.05	1.02	0.03
Omitting N. Hirahara, 2019			2.39	[1.96; 2.92]	0.68	-1.92	-0.48	0.21	0.92	0.04
Omitting Z. Xishan, 2020			2.41	[1.99; 2.92]	0.67	-2.26	-0.57	0.28	0.86	0.04
Omitting X. Zhu, 2021			2.41	[1.99; 2.92]	0.67	-2.29	-0.58	0.29	0.86	0.04
Random effects model			**2.29**	**[1.86; 2.81]**						
I^2 = 0% [0%; 45%]										

Figure S195: Funnel plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in esophageal cancer (Biological composite scores)

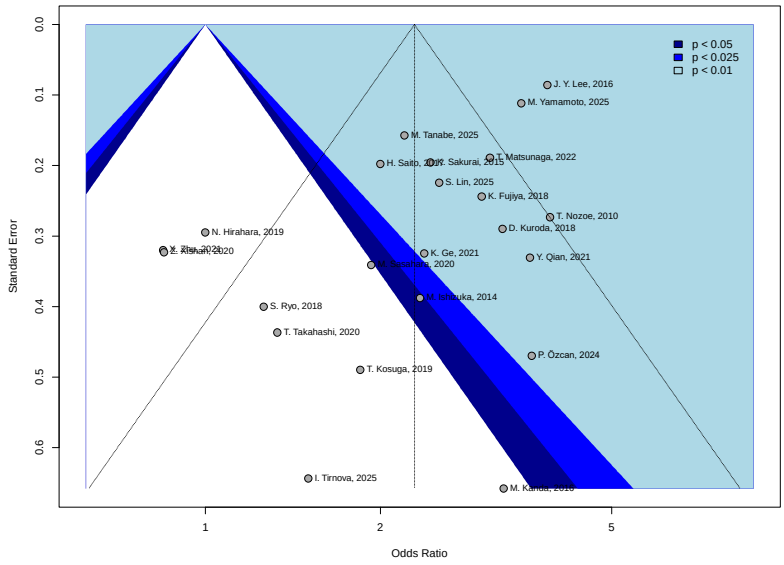


Egger test: t = -1.62, df = 16, p-value = 0.1245

Figure S195.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in esophageal cancer (Biological composite scores)

Study	Odds Ratio	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting F. K. Xiao, 2021		*	2.08	[1.72; 2.51]	0.01	4.58	2.84	1.92	0.57	0.13
Omitting W. Zuo, 2024			2.36	[1.87; 2.99]	0.55	1.90	0.33	0.10	0.87	0.03
Omitting I. Nonogaki, 2023			2.39	[1.88; 3.03]	0.57	1.69	0.23	0.05	0.90	0.02
Omitting N. Hirahara, 2018			2.40	[1.87; 3.09]	0.58	1.15	0.17	0.03	1.00	0.02
Omitting J. F. Feng, 2013			2.43	[1.87; 3.17]	0.60	0.34	0.06	0.00	1.12	0.04
Omitting I. Hashimoto, 2024			2.44	[1.87; 3.18]	0.60	0.30	0.05	0.00	1.11	0.04
Omitting L. Xiao, 2021			2.44	[1.86; 3.20]	0.60	0.19	0.05	0.00	1.16	0.08
Omitting N. Kubo, 2018			2.45	[1.88; 3.19]	0.60	0.16	0.01	0.00	1.10	0.02
Omitting Z. Zheng, 2022			2.46	[1.89; 3.20]	0.60	-0.03	-0.02	0.00	1.11	0.03
Omitting T. Miyazaki, 2016			2.46	[1.90; 3.21]	0.60	-0.23	-0.04	0.00	1.09	0.02
Omitting Y. Fujiwara, 2021			2.48	[1.92; 3.21]	0.59	-0.76	-0.11	0.01	1.05	0.02
Omitting L. Han, 2016			2.49	[1.92; 3.22]	0.59	-0.75	-0.13	0.02	1.06	0.03
Omitting G. H. A-Lai, 2019			2.50	[1.92; 3.25]	0.59	-0.67	-0.16	0.02	1.09	0.05
Omitting S. B. Chen, 2021			2.53	[1.93; 3.30]	0.58	-0.75	-0.24	0.06	1.14	0.09
Omitting H. Zhang, 2018			2.53	[1.92; 3.32]	0.56	-0.68	-0.25	0.07	1.18	0.12
Omitting Q. Qi, 2021			2.53	[1.94; 3.30]	0.58	-0.87	-0.27	0.07	1.11	0.09
Omitting K. Yan, 2022			2.53	[1.95; 3.29]	0.58	-0.96	-0.28	0.08	1.09	0.08
Omitting Y. Zhao, 2022			2.56	[1.97; 3.33]	0.55	-1.12	-0.37	0.14	1.09	0.10
Random effects model			**2.45**	**[1.91; 3.15]**						
I^2 = 0% [0%; 50%]										

Figure S196: Funnel plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in gastric cancer (Biological composite scores)



Egger test:t = -2.51, df = 21, p-value = 0.0204

Figure S196.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in gastric cancer (Biological composite scores)

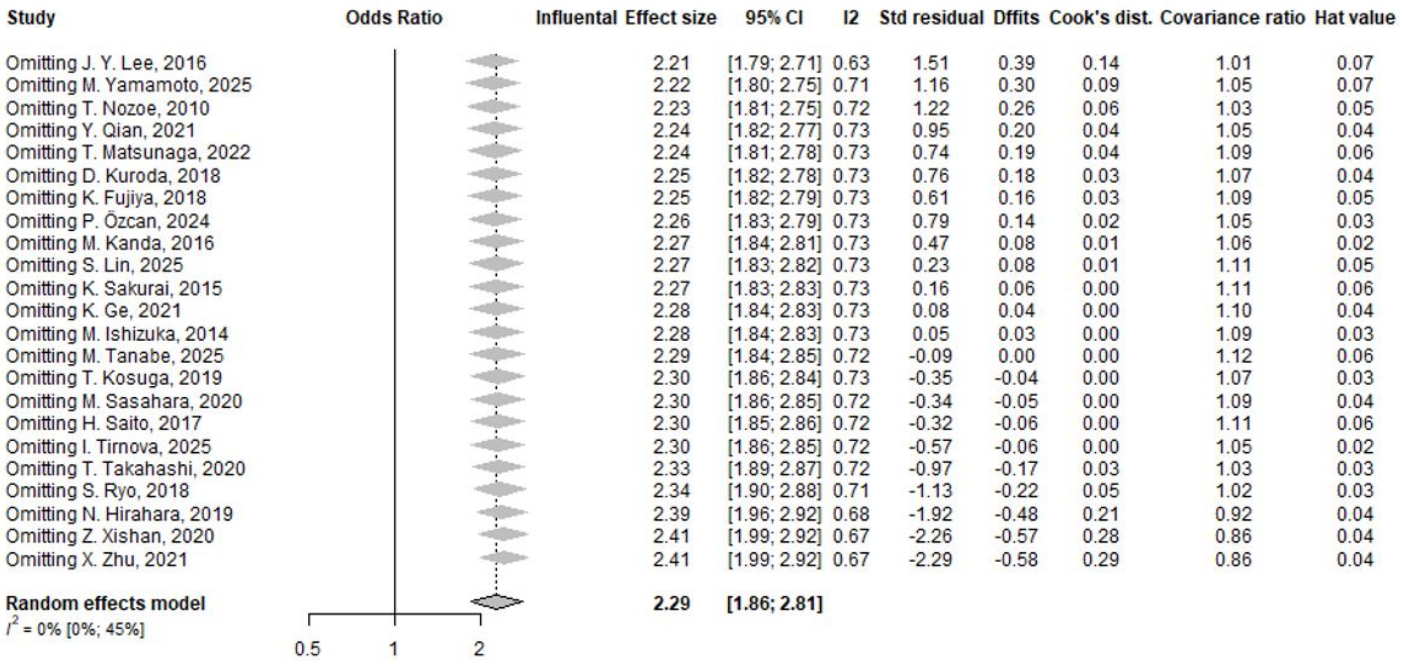
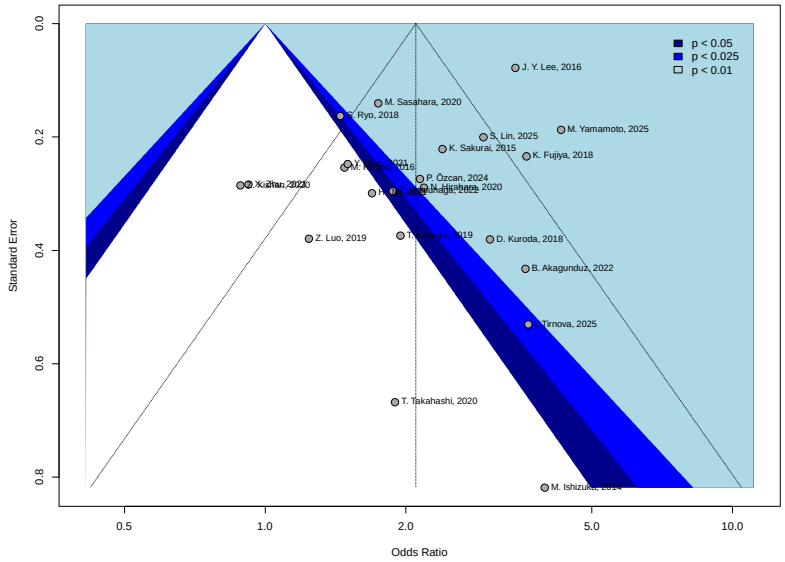


Figure S197: Funnel plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in gastric cancer (Biological composite scores)

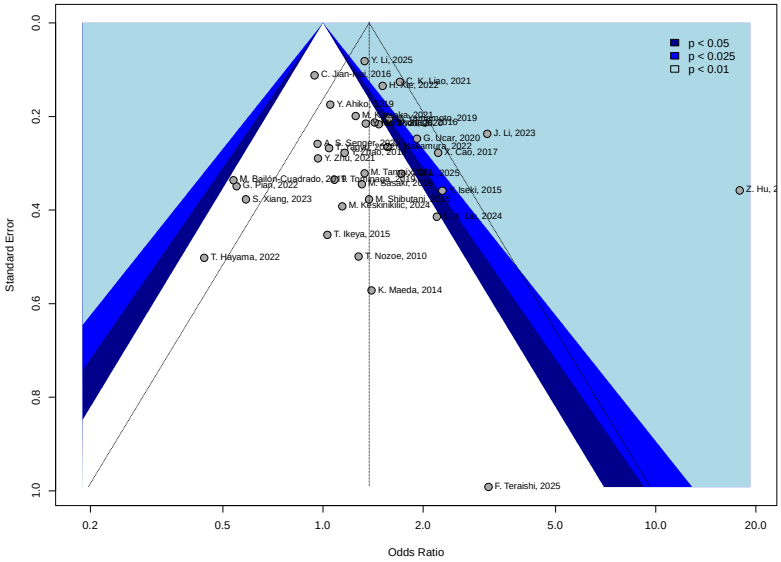


Egger test: t = -2.07, df = 20, p-value = 0.0520

Figure S197.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T4 vs. <T4) in gastric cancer (Biological composite scores)

Study	Odds Ratio	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting M. Yamamoto, 2025			2.01	[1.65; 2.44]	0.74	2.00	0.50	0.21	0.93	0.06
Omitting J. Y. Lee, 2016			2.02	[1.64; 2.48]	0.65	1.47	0.42	0.16	1.02	0.07
Omitting K. Fujiya, 2018			2.04	[1.66; 2.50]	0.77	1.35	0.32	0.10	1.02	0.05
Omitting S. Lin, 2025			2.06	[1.67; 2.54]	0.77	0.84	0.21	0.04	1.08	0.06
Omitting B. Akagunduz, 2022			2.06	[1.68; 2.54]	0.77	0.98	0.18	0.03	1.03	0.03
Omitting D. Kuroda, 2018			2.07	[1.68; 2.56]	0.77	0.71	0.14	0.02	1.06	0.04
Omitting I. Tirnova, 2025			2.07	[1.68; 2.55]	0.77	0.88	0.14	0.02	1.04	0.02
Omitting K. Sakurai, 2015			2.08	[1.68; 2.58]	0.77	0.32	0.08	0.01	1.11	0.06
Omitting M. Ishizuka, 2014			2.08	[1.69; 2.56]	0.77	0.72	0.08	0.01	1.04	0.01
Omitting N. Hirahara, 2020			2.10	[1.69; 2.59]	0.77	0.09	0.02	0.00	1.10	0.05
Omitting P. Özcan, 2024			2.10	[1.69; 2.60]	0.77	0.05	0.02	0.00	1.10	0.05
Omitting T. Takahashi, 2020			2.10	[1.70; 2.60]	0.77	-0.14	-0.01	0.00	1.07	0.02
Omitting T. Kosuga, 2019			2.11	[1.70; 2.60]	0.77	-0.15	-0.02	0.00	1.09	0.04
Omitting T. Matsunaga, 2022			2.11	[1.71; 2.61]	0.77	-0.25	-0.05	0.00	1.10	0.05
Omitting H. Jin, 2021			2.12	[1.72; 2.62]	0.77	-0.47	-0.10	0.01	1.09	0.04
Omitting M. Sasahara, 2020			2.13	[1.72; 2.64]	0.76	-0.49	-0.13	0.02	1.11	0.07
Omitting Y. Qian, 2021			2.14	[1.73; 2.64]	0.76	-0.79	-0.18	0.03	1.07	0.05
Omitting M. Kanda, 2016			2.14	[1.73; 2.64]	0.76	-0.83	-0.19	0.04	1.07	0.05
Omitting Z. Luo, 2019			2.14	[1.74; 2.63]	0.77	-1.04	-0.20	0.04	1.03	0.04
Omitting S. Ryo, 2018			2.15	[1.75; 2.66]	0.74	-0.99	-0.26	0.07	1.07	0.06
Omitting X. Zhu, 2021			2.19	[1.80; 2.66]	0.74	-1.99	-0.46	0.18	0.92	0.05
Omitting Z. Xishan, 2020			2.19	[1.81; 2.66]	0.74	-2.10	-0.48	0.20	0.90	0.05
Random effects model			**2.10**	**[1.71; 2.57]**						
I^2 = 0% [0%; 46%]										

Figure S198: Funnel plot: Association between malnutrition-related complication risk and colorectal tumour location (colon vs. rectum) (Biological composite scores)



Egger test: t = 0.21, df = 33, p-value = 0.8320

Figure S198.1: Leave-one-out plot: Association between malnutrition-related complication risk and colorectal tumour location (colon vs. rectum) (Biological composite scores)

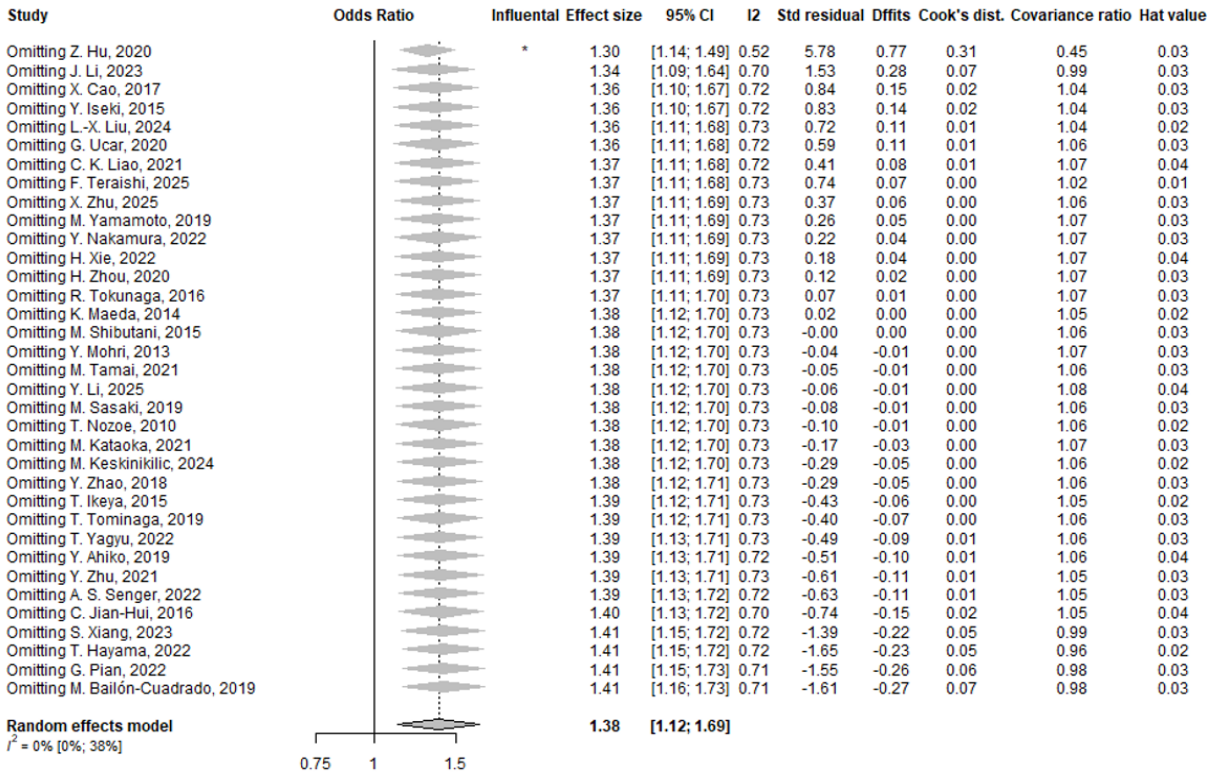
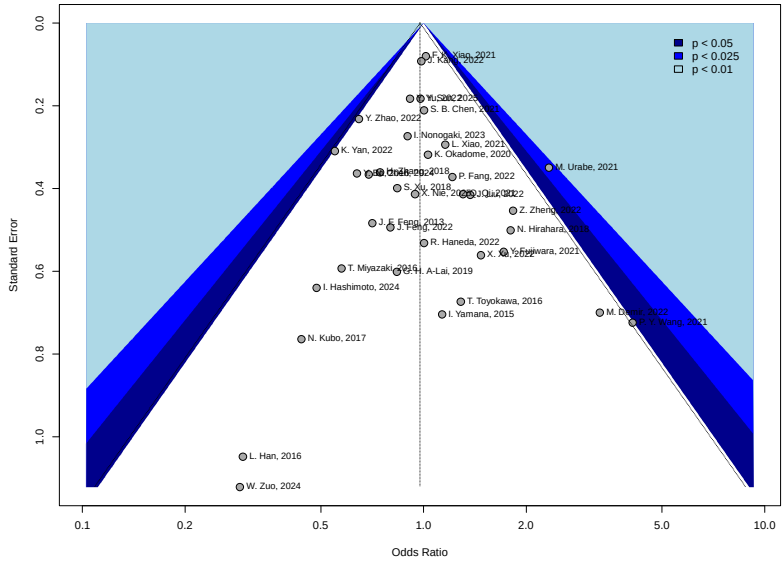


Figure S199: Funnel plot: Association between malnutrition-related complication risk and esophagus tumour location (upper vs. middle or lower part) (Biological composite scores)



Egger test: t = 0.29, df = 34, p-value = 0.7712

Figure S199.1: Leave-one-out plot: Association between malnutrition-related complication risk and esophagus tumour location (upper vs. middle or lower part) (Biological composite scores)

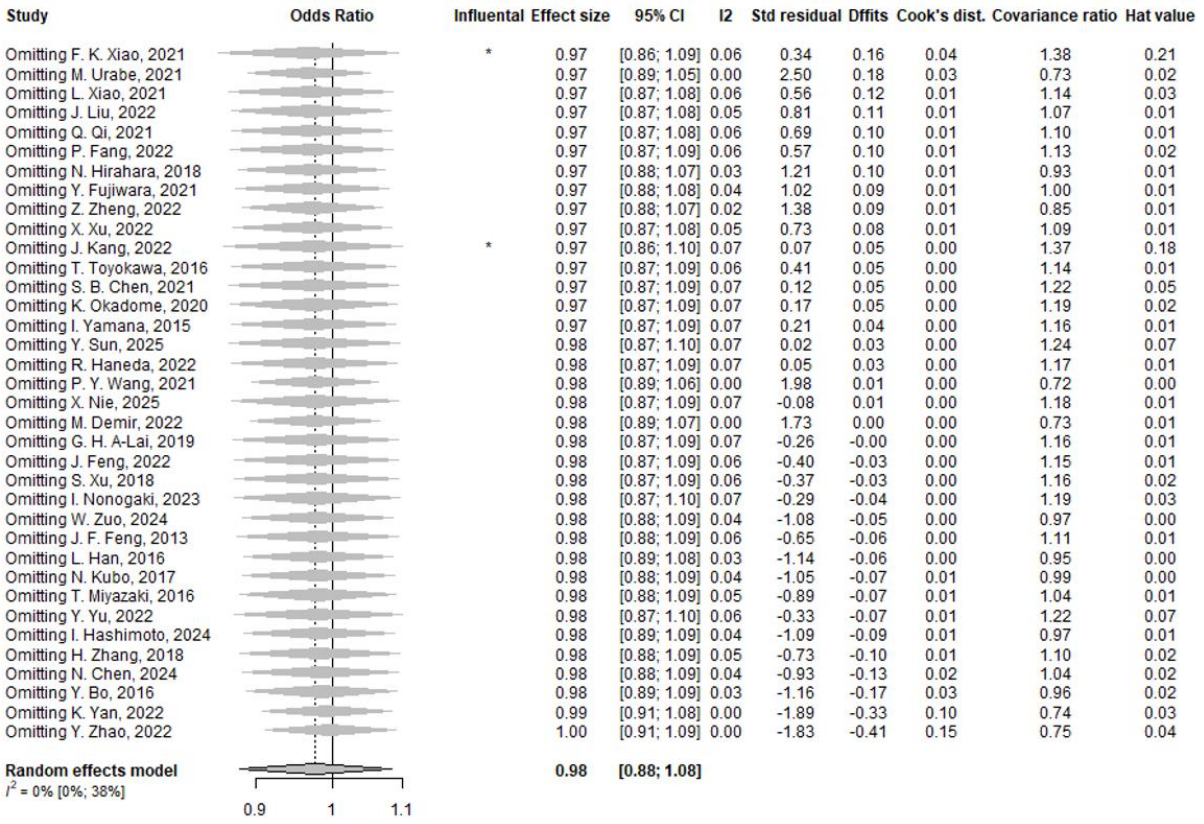
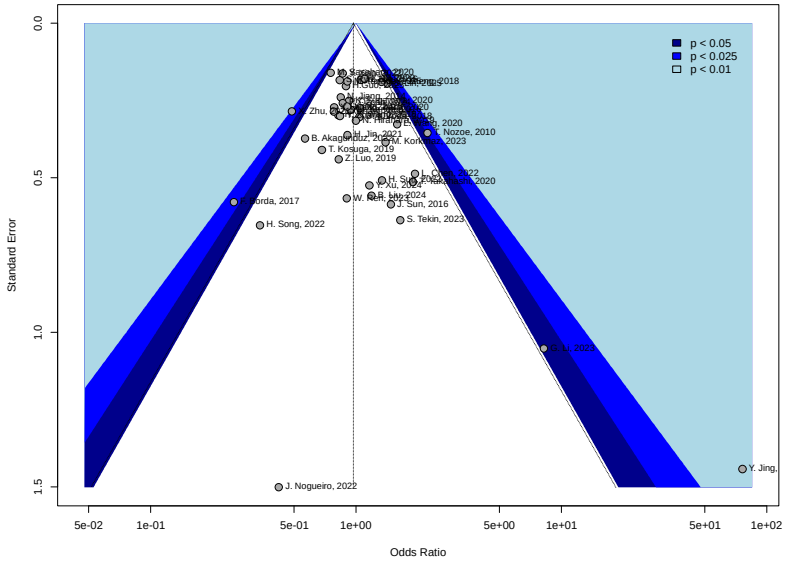


Figure S200: Funnel plot: Association between malnutrition-related complication risk and gastric tumour location (upper vs. middle or lower part) (Biological composite scores)



Egger test: t = -0.01, df = 40, p-value = 0.9907

Figure S200.1: Leave-one-out plot: Association between malnutrition-related complication risk and gastric tumour location (upper vs. middle or lower part) (Biological composite scores)

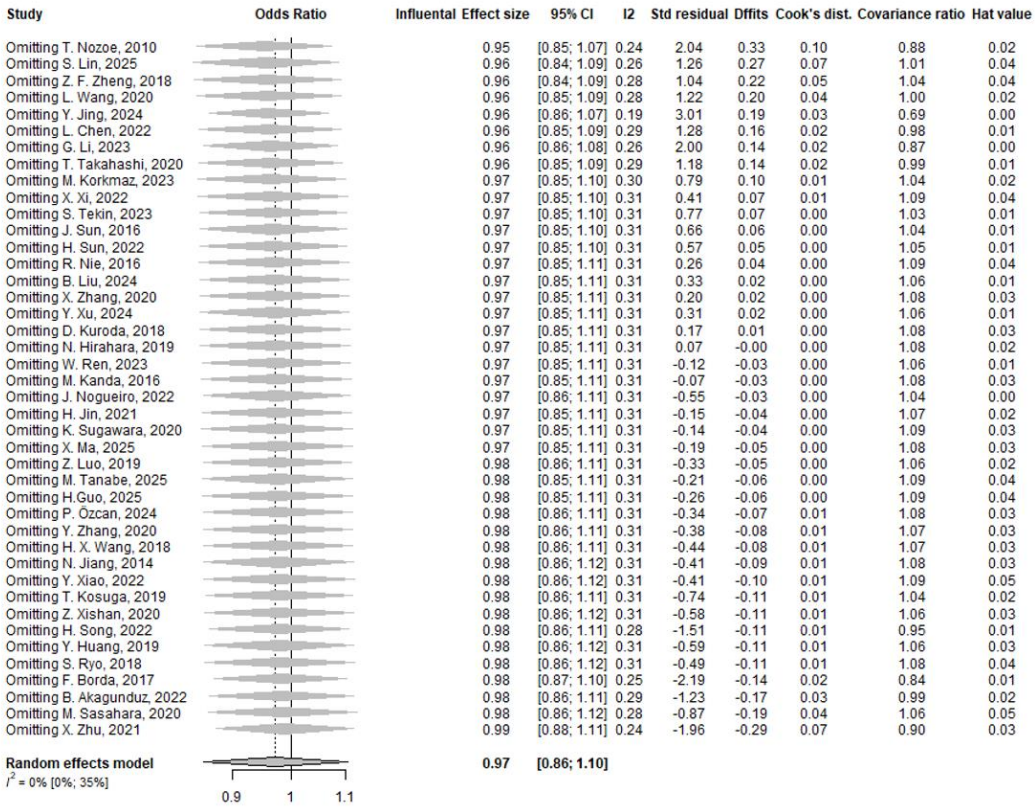
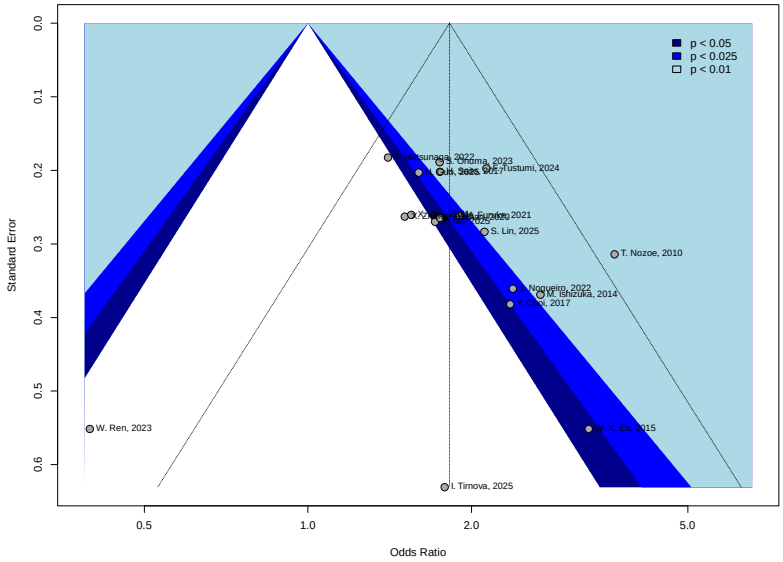


Figure S201: Funnel plot: Association between malnutrition-related complication risk and macrovascular invasion in gastric cancer (Biological composite scores)



Egger test: t = -0.36, df = 16, p-value = 0.7201

Figure S201.1: Leave-one-out plot: Association between malnutrition-related complication risk and macrovascular invasion in gastric cancer (Biological composite scores)

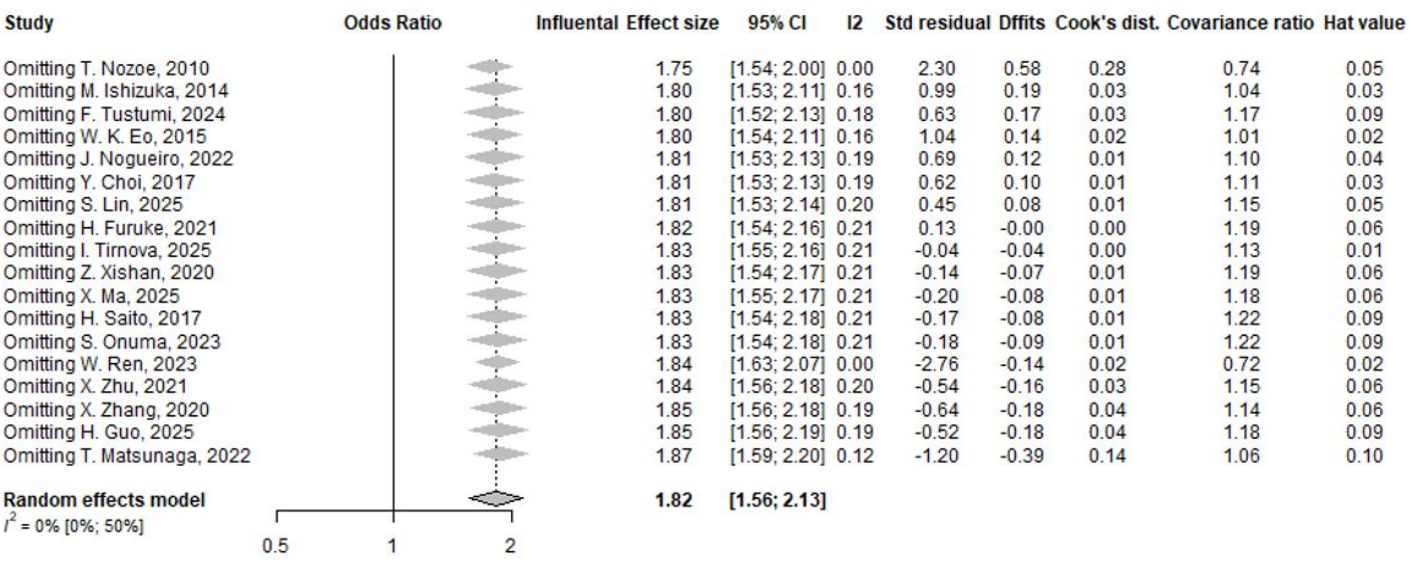
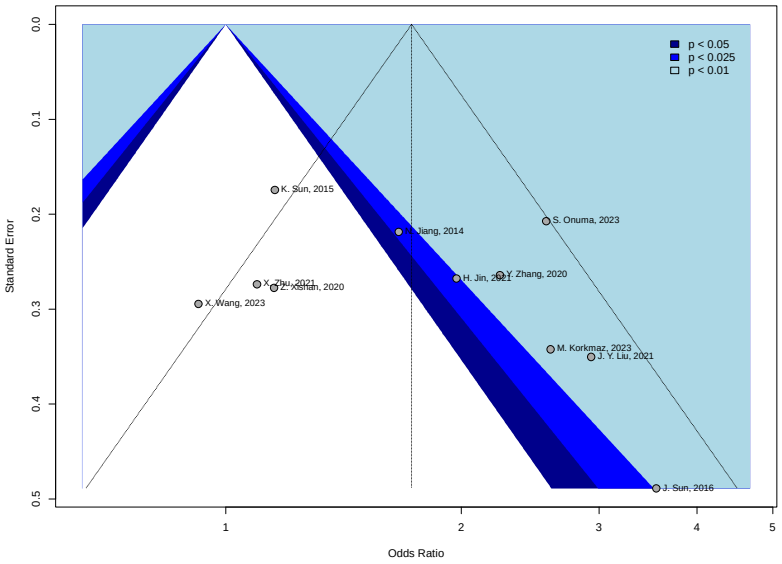


Figure S202: Funnel plot: Association between malnutrition-related complication risk and age ≥65 in gastric cancer (Biological composite scores)



Egger test: t = 0.86, df = 9, p-value = 0.4125

Figure S202.1: Leave-one-out plot: Association between malnutrition-related complication risk and age ≥65 in gastric cancer (Biological composite scores)

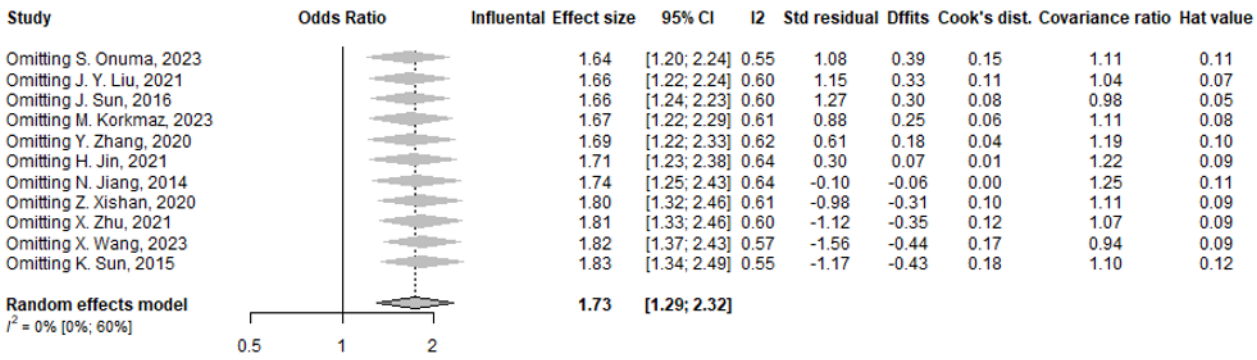
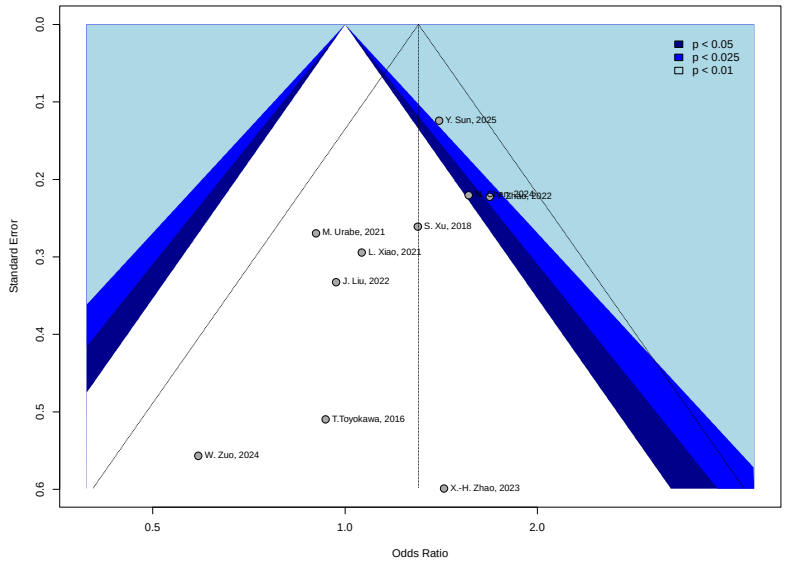


Figure S203: Funnel plot: Association between malnutrition-related complication risk and age ≥65 in esophageal cancer (Biological composite scores)



Egger test:t = -1.76, df = 8, p-value = 0.1167

Figure S203.1: Leave-one-out plot: Association between malnutrition-related complication risk and age ≥65 in esophageal cancer (Biological composite scores)

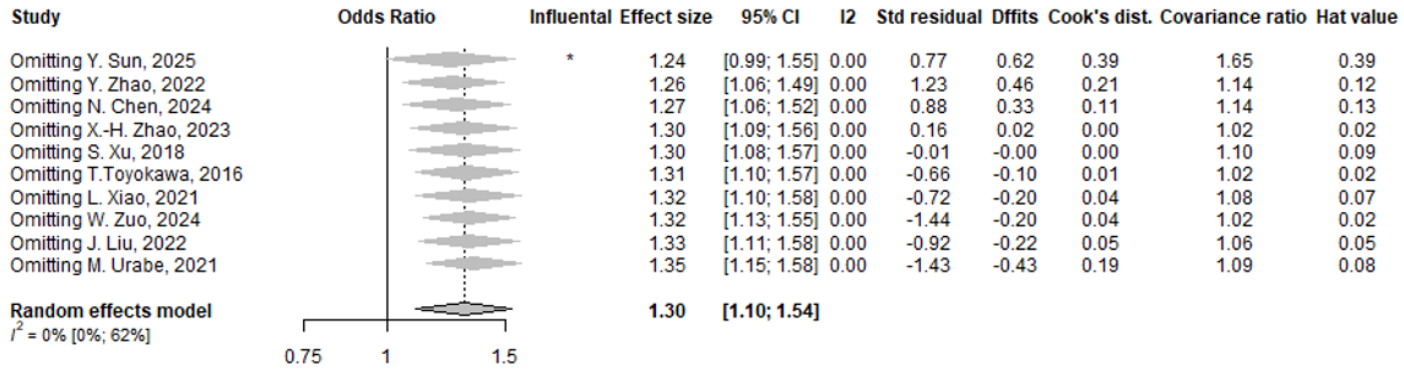
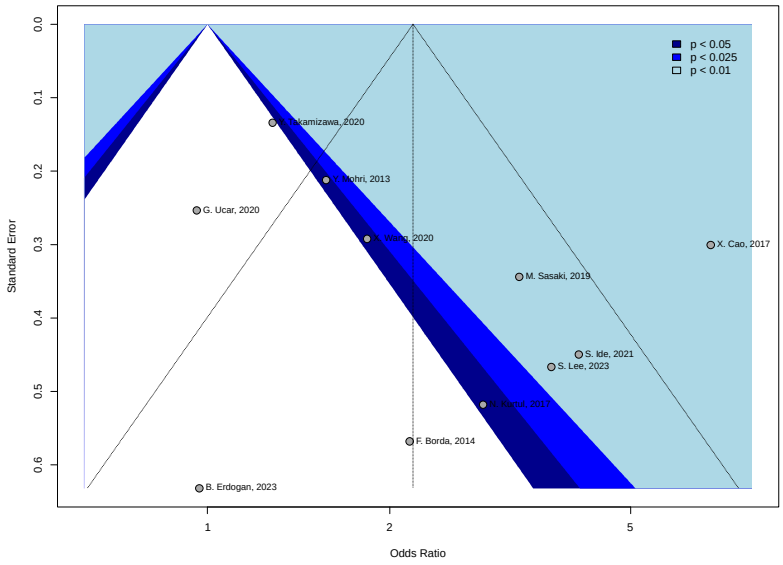


Figure S204: Funnel plot: Association between malnutrition-related complication risk and age ≥65 in colorectal cancer (Biological composite scores)



Egger test: t = 1.31, df = 9, p-value = 0.2221

Figure S204.1: Leave-one-out plot: Association between malnutrition-related complication risk and age ≥65 in colorectal cancer (Biological composite scores)

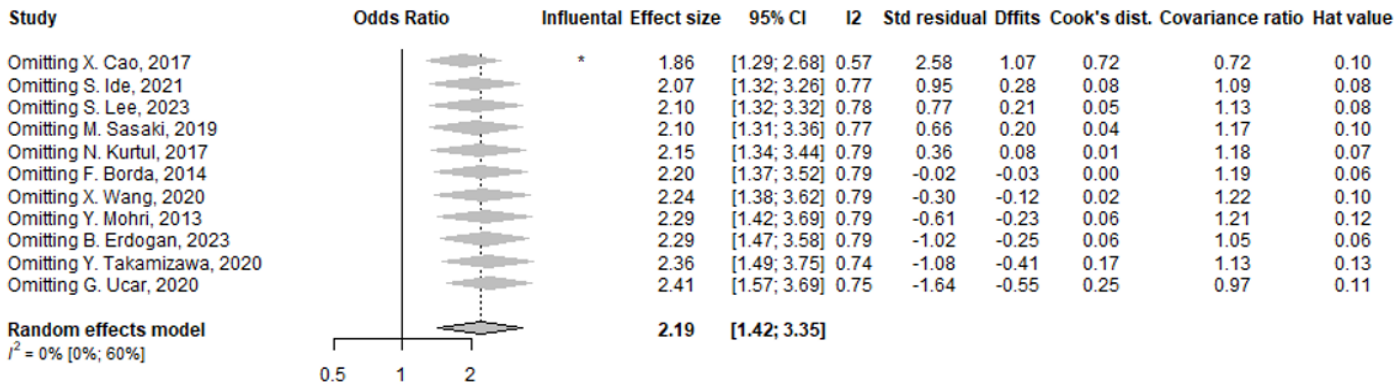
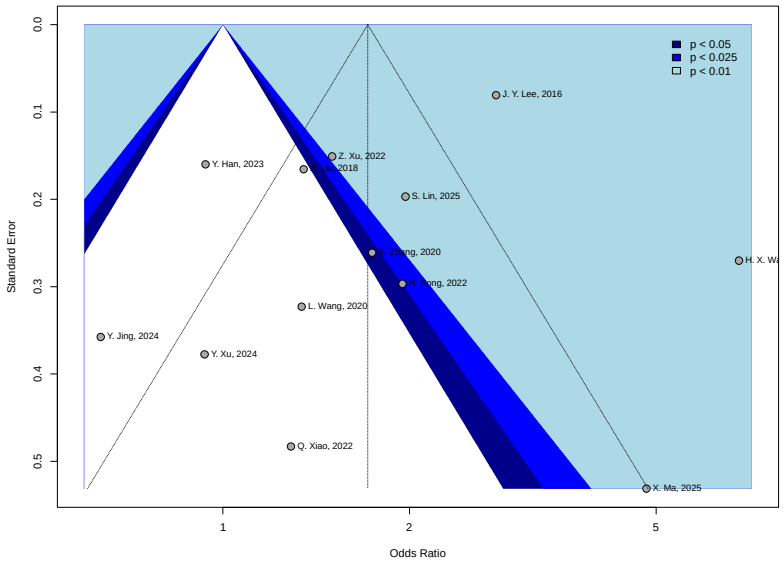


Figure S205: Funnel plot: Association between malnutrition-related complication risk and age ≥60 in gastric cancer (Biological composite scores)



Egger test:t = -0.87, df = 11, p-value = 0.4049

Figure S205.1: Leave-one-out plot: Association between malnutrition-related complication risk and age ≥60 in gastric cancer (Biological composite scores)

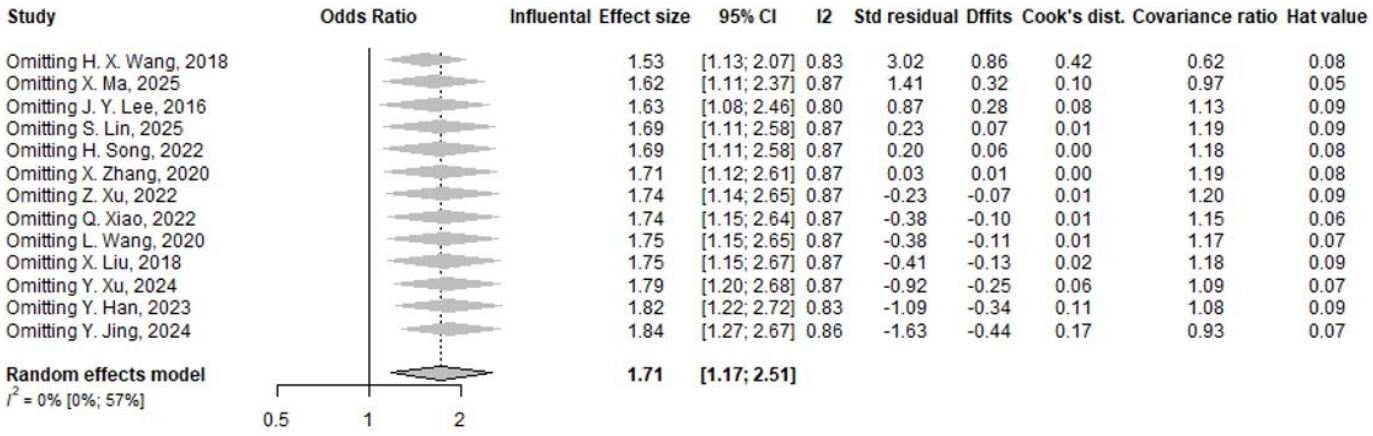
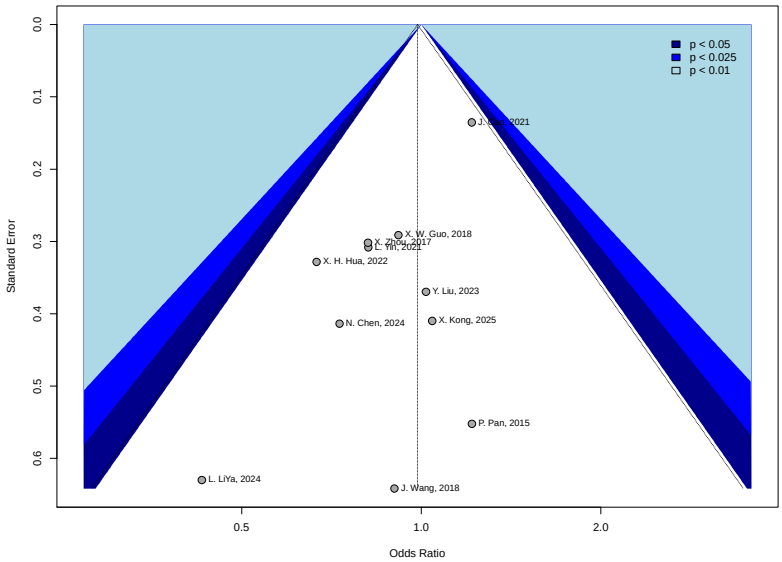
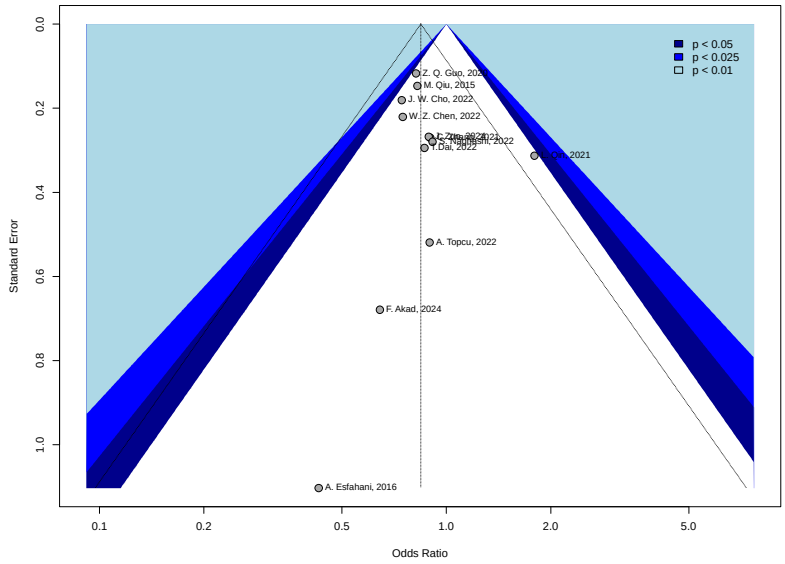


Figure S206: Funnel plot: Association between malnutrition risk and sex in esophageal cancer (Symptom-based risk assessment tools)



Egger test: t = -2.67, df = 9, p-value = 0.0254

Figure S207 Funnel plot: Association between malnutrition risk and sex in gastric cancer (Symptom-based risk assessment tools)



Egger test: t = 0.28, df = 10, p-value = 0.7876

Figure S207.1 Leave-one-out plot: Association between malnutrition risk and sex in gastric cancer (Symptom-based risk assessment tools)

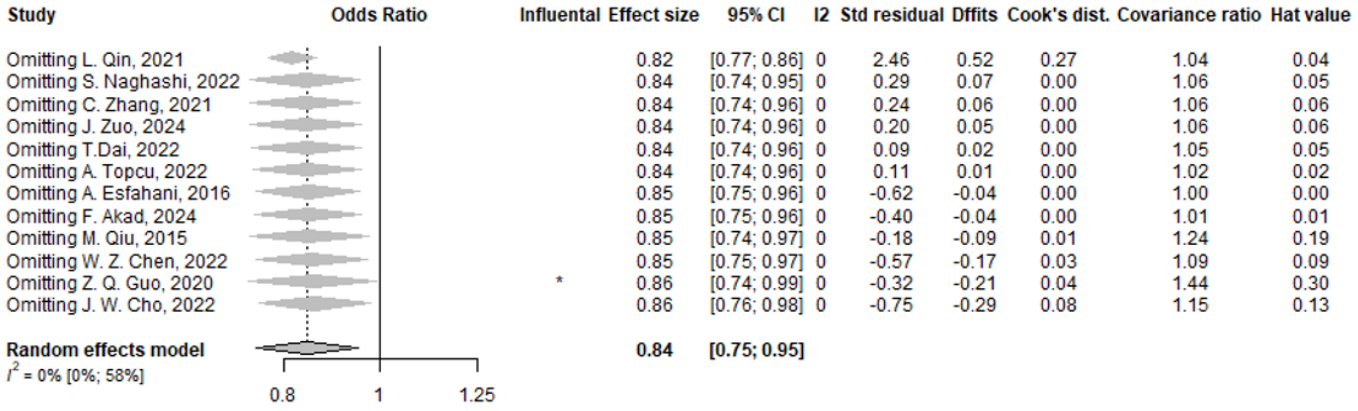
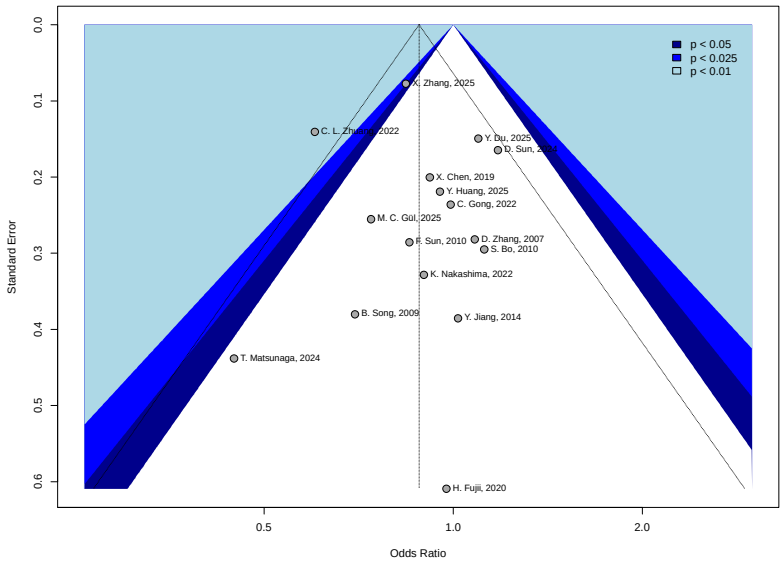


Figure S208: Funnel plot: Association between cachexia and sex in gastric cancer

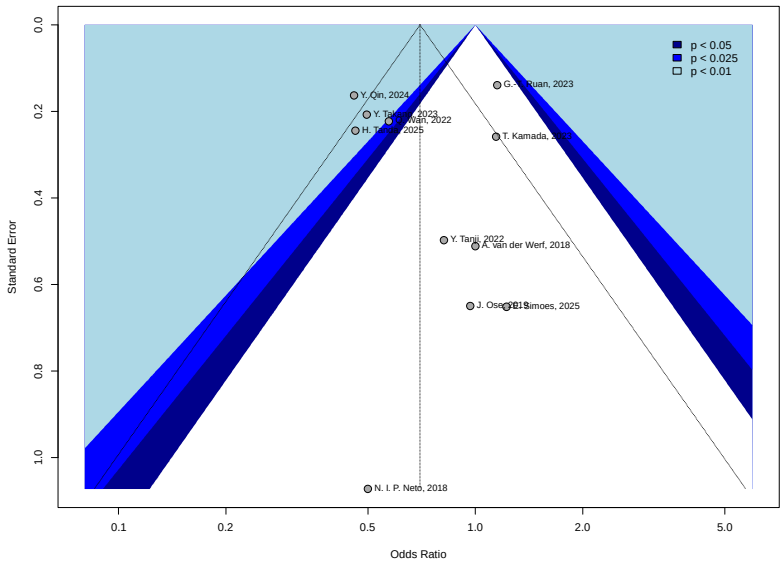


Egger test:t = 0.01, df = 14, p-value = 0.9939

Figure S208.1 Leave-one-out plot: Association between cachexia and sex in gastric cancer

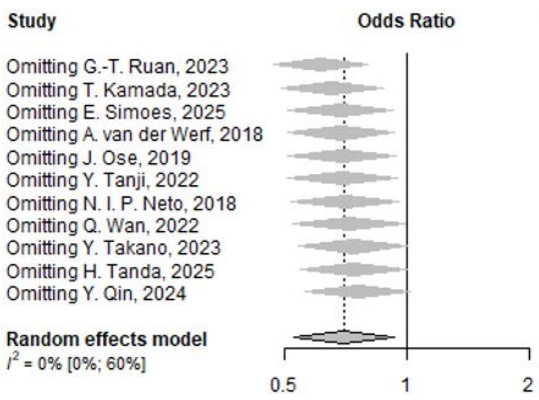
Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting D. Sun, 2024		0.85	[0.76; 0.95]	0.03	1.85	0.68	0.39	0.86	0.09
Omitting Y. Du, 2025		0.86	[0.76; 0.96]	0.09	1.46	0.56	0.28	1.00	0.11
Omitting S. Bo, 2010		0.88	[0.77; 0.99]	0.19	0.79	0.13	0.02	1.07	0.03
Omitting D. Zhang, 2007		0.88	[0.77; 0.99]	0.19	0.71	0.12	0.01	1.09	0.04
Omitting C. Gong, 2022		0.88	[0.77; 1.00]	0.21	0.47	0.08	0.01	1.14	0.05
Omitting Y. Huang, 2025		0.88	[0.77; 1.00]	0.21	0.33	0.05	0.00	1.16	0.06
Omitting Y. Jiang, 2014		0.88	[0.78; 1.00]	0.21	0.36	0.02	0.00	1.11	0.02
Omitting X. Chen, 2019		0.88	[0.78; 1.00]	0.22	0.18	0.01	0.00	1.18	0.07
Omitting H. Fujii, 2020		0.88	[0.78; 1.00]	0.22	0.16	-0.02	0.00	1.11	0.01
Omitting K. Nakashima, 2022		0.88	[0.78; 1.00]	0.22	0.05	-0.03	0.00	1.13	0.03
Omitting F. Sun, 2010		0.89	[0.78; 1.00]	0.22	-0.13	-0.07	0.00	1.14	0.04
Omitting T. Matsunaga, 2024		0.89	[0.79; 0.99]	0.10	-1.54	-0.11	0.01	0.89	0.02
Omitting B. Song, 2009		0.89	[0.78; 1.00]	0.20	-0.61	-0.12	0.01	1.08	0.02
Omitting M. C. Gül, 2025		0.89	[0.79; 1.01]	0.20	-0.67	-0.17	0.03	1.10	0.04
Omitting X. Zhang, 2025	*	0.90	[0.78; 1.03]	0.20	-0.50	-0.30	0.10	1.42	0.26
Omitting C. L. Zhuang, 2022	*	0.92	[0.84; 1.01]	0.00	-2.82	-0.80	0.50	0.83	0.12
Random effects model		**0.88**	**[0.78; 0.99]**						
I^2 = 0% [0%; 52%]									

Figure S209. Funnel plot: Association between cachexia and sex in colorectal cancer



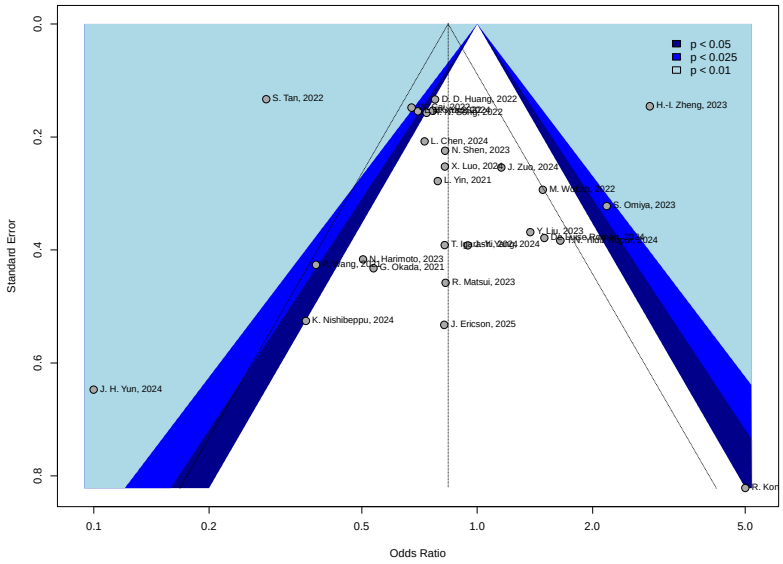
Egger test: t = 0.18, df = 9, p-value = 0.8614

Figure S209.1. Leave-one-out plot: Association between cachexia and sex in colorectal cancer



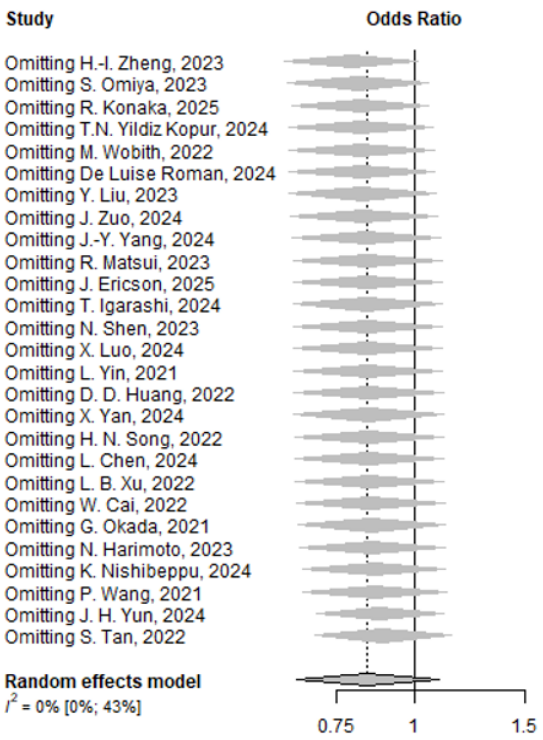
Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting G.-T. Ruan, 2023	*	0.61	[0.47; 0.80]	0.36	2.33	1.31	1.05	0.88	0.17
Omitting T. Kamada, 2023		0.66	[0.49; 0.88]	0.67	1.45	0.53	0.26	1.02	0.11
Omitting E. Simoes, 2025		0.69	[0.51; 0.93]	0.71	0.80	0.14	0.02	1.07	0.03
Omitting A. van der Werf, 2018		0.69	[0.51; 0.93]	0.71	0.62	0.13	0.02	1.12	0.05
Omitting J. Ose, 2019		0.69	[0.51; 0.94]	0.71	0.46	0.07	0.01	1.12	0.03
Omitting Y. Tanji, 2022		0.70	[0.51; 0.95]	0.71	0.27	0.04	0.00	1.16	0.05
Omitting N. I. P. Neto, 2018		0.70	[0.52; 0.95]	0.71	-0.31	-0.06	0.00	1.11	0.01
Omitting Q. Wan, 2022		0.72	[0.53; 0.99]	0.70	-0.59	-0.24	0.06	1.22	0.13
Omitting Y. Takano, 2023		0.74	[0.54; 1.00]	0.68	-1.08	-0.42	0.18	1.14	0.14
Omitting H. Tanda, 2025		0.74	[0.55; 1.00]	0.68	-1.23	-0.44	0.18	1.08	0.12
Omitting Y. Qin, 2024		0.76	[0.56; 1.02]	0.60	-1.56	-0.68	0.39	1.05	0.16
Random effects model		**0.70**	**[0.53; 0.93]**						

Figure S210 Funnel plot: Association between malnutrition diagnosis and sex in resectable gastrointestinal cancer (GLIM criteria)



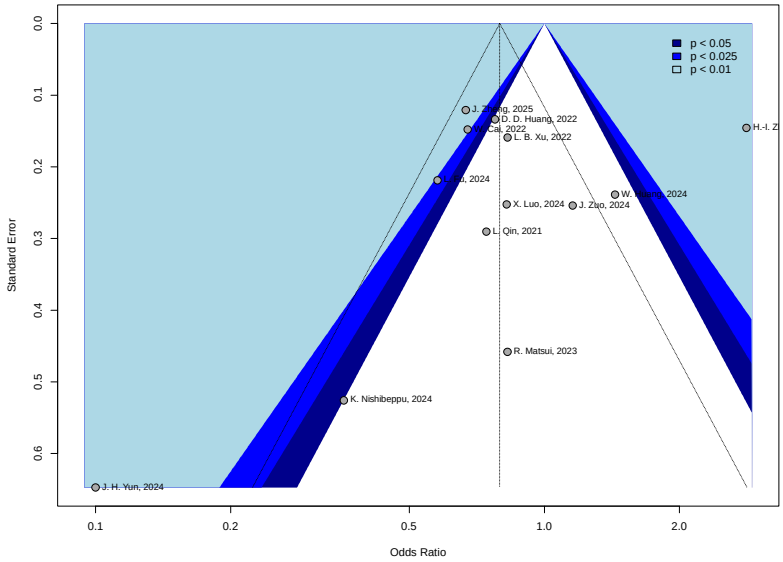
Egger test: t = 0.19, df = 25, p-value = 0.8500

Figure S210.1 Leave-one-out plot: Association between malnutrition diagnosis and sex in resectable gastrointestinal cancer (GLIM criteria)



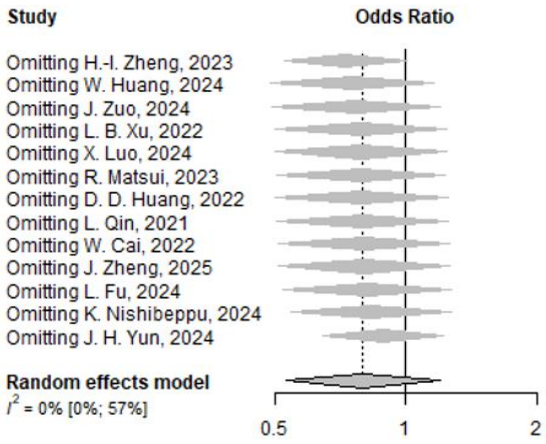
Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting H.-l. Zheng, 2023	0.79	[0.62; 1.01]	0.76	2.36	0.53	0.22	0.87	0.05
Omitting S. Omiya, 2023	0.81	[0.62; 1.05]	0.86	1.52	0.30	0.08	0.98	0.04
Omitting R. Konaka, 2025	0.82	[0.64; 1.05]	0.86	1.83	0.22	0.04	0.92	0.02
Omitting T.N. Yildiz Kopur, 2024	0.82	[0.63; 1.07]	0.86	0.99	0.19	0.04	1.04	0.03
Omitting M. Wobith, 2022	0.82	[0.63; 1.07]	0.86	0.90	0.18	0.03	1.05	0.04
Omitting De Luise Roman, 2024	0.82	[0.63; 1.08]	0.86	0.85	0.16	0.03	1.05	0.03
Omitting Y. Liu, 2023	0.82	[0.63; 1.08]	0.86	0.73	0.14	0.02	1.06	0.04
Omitting J. Zuo, 2024	0.83	[0.63; 1.09]	0.86	0.51	0.11	0.01	1.08	0.04
Omitting J.-Y. Yang, 2024	0.84	[0.64; 1.10]	0.87	0.17	0.03	0.00	1.08	0.03
Omitting R. Matsui, 2023	0.84	[0.64; 1.10]	0.87	-0.02	-0.00	0.00	1.08	0.03
Omitting J. Ericson, 2025	0.84	[0.64; 1.10]	0.87	-0.03	-0.00	0.00	1.08	0.03
Omitting T. Igarashi, 2024	0.84	[0.64; 1.10]	0.87	-0.03	-0.00	0.00	1.08	0.03
Omitting N. Shen, 2023	0.84	[0.64; 1.11]	0.87	-0.03	-0.00	0.00	1.09	0.04
Omitting X. Luo, 2024	0.84	[0.64; 1.11]	0.87	-0.03	-0.00	0.00	1.09	0.04
Omitting L. Yin, 2021	0.84	[0.64; 1.11]	0.87	-0.10	-0.02	0.00	1.09	0.04
Omitting D. D. Huang, 2022	0.84	[0.64; 1.11]	0.87	-0.13	-0.03	0.00	1.10	0.05
Omitting X. Yan, 2024	0.84	[0.64; 1.11]	0.87	-0.15	-0.03	0.00	1.10	0.05
Omitting H. N. Song, 2022	0.84	[0.64; 1.11]	0.87	-0.22	-0.04	0.00	1.10	0.05
Omitting L. Chen, 2024	0.84	[0.64; 1.11]	0.87	-0.23	-0.05	0.00	1.09	0.04
Omitting L. B. Xu, 2022	0.85	[0.64; 1.11]	0.87	-0.30	-0.06	0.00	1.09	0.05
Omitting W. Cai, 2022	0.85	[0.65; 1.12]	0.86	-0.37	-0.08	0.01	1.09	0.05
Omitting G. Okada, 2021	0.85	[0.65; 1.12]	0.87	-0.63	-0.11	0.01	1.06	0.03
Omitting N. Harimoto, 2023	0.85	[0.65; 1.12]	0.86	-0.73	-0.13	0.02	1.06	0.03
Omitting K. Nishibeppu, 2024	0.86	[0.66; 1.12]	0.86	-1.12	-0.19	0.03	1.02	0.03
Omitting P. Wang, 2021	0.86	[0.66; 1.12]	0.86	-1.14	-0.21	0.04	1.02	0.03
Omitting J. H. Yun, 2024	0.88	[0.69; 1.11]	0.86	-2.65	-0.36	0.12	0.80	0.02
Omitting S. Tan, 2022	0.89	[0.69; 1.14]	0.79	-2.08	-0.48	0.20	0.91	0.05
Random effects model	**0.84**	**[0.65; 1.09]**						

Figure S211 Funnel plot: Association between malnutrition diagnosis and sex in gastric cancer (GLIM criteria)



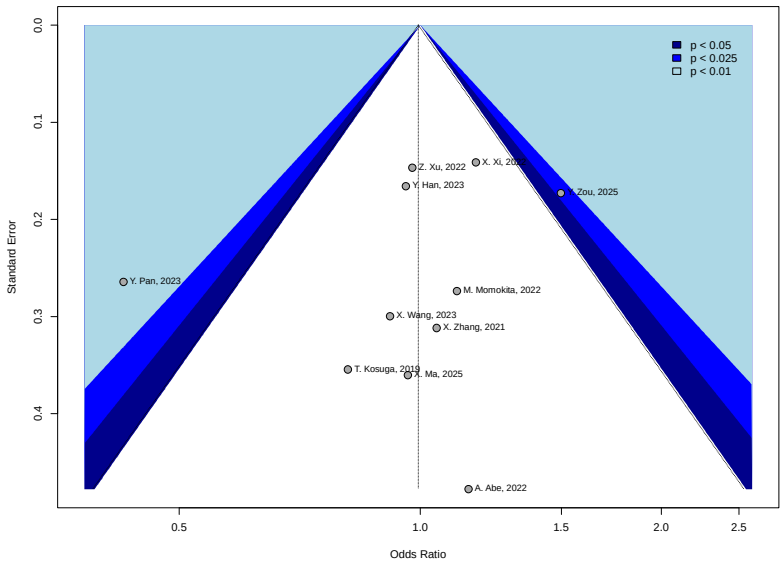
Egger test: t = -1.21, df = 11, p-value = 0.2529

Figure S211.1 Leave-one-out plot: Association between malnutrition diagnosis and sex in gastric cancer (GLIM criteria)



Study	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting H.-I. Zheng, 2023		0.73	[0.53; 1.00]	0.57	2.87	0.68	0.23	0.61	0.09
Omitting W. Huang, 2024		0.75	[0.49; 1.16]	0.88	0.93	0.28	0.08	1.10	0.08
Omitting J. Zuo, 2024		0.77	[0.49; 1.19]	0.89	0.57	0.19	0.04	1.17	0.08
Omitting L. B. Xu, 2022		0.79	[0.50; 1.24]	0.89	0.07	0.06	0.00	1.22	0.09
Omitting X. Luo, 2024		0.79	[0.50; 1.24]	0.89	0.06	0.05	0.00	1.21	0.08
Omitting R. Matsui, 2023		0.79	[0.50; 1.23]	0.89	0.06	0.05	0.00	1.18	0.06
Omitting D. D. Huang, 2022		0.79	[0.50; 1.25]	0.88	-0.03	0.03	0.00	1.22	0.09
Omitting L. Qin, 2021		0.79	[0.51; 1.25]	0.89	-0.09	0.01	0.00	1.20	0.08
Omitting W. Cai, 2022		0.80	[0.51; 1.26]	0.88	-0.25	-0.05	0.00	1.21	0.09
Omitting J. Zheng, 2025		0.80	[0.51; 1.26]	0.88	-0.27	-0.05	0.00	1.21	0.09
Omitting L. Fu, 2024		0.81	[0.52; 1.27]	0.88	-0.48	-0.12	0.02	1.18	0.08
Omitting K. Nishibeppu, 2024		0.83	[0.55; 1.27]	0.88	-1.02	-0.24	0.06	1.05	0.05
Omitting J. H. Yun, 2024		0.89	[0.64; 1.22]	0.87	-2.74	-0.66	0.34	0.60	0.04
Random effects model		**0.80**	**[0.53; 1.20]**						

Figure S212. Funnel plot: Association between malnutrition-related complication risk and smoking (active or history) in gastric cancer (Biological composite scores)



Egger test: t = -0.98, df = 9, p-value = 0.3513

Figure S212.1 Leave-one-out plot: Association between malnutrition-related complication risk and smoking (active or history) in gastric cancer (Biological composite scores)

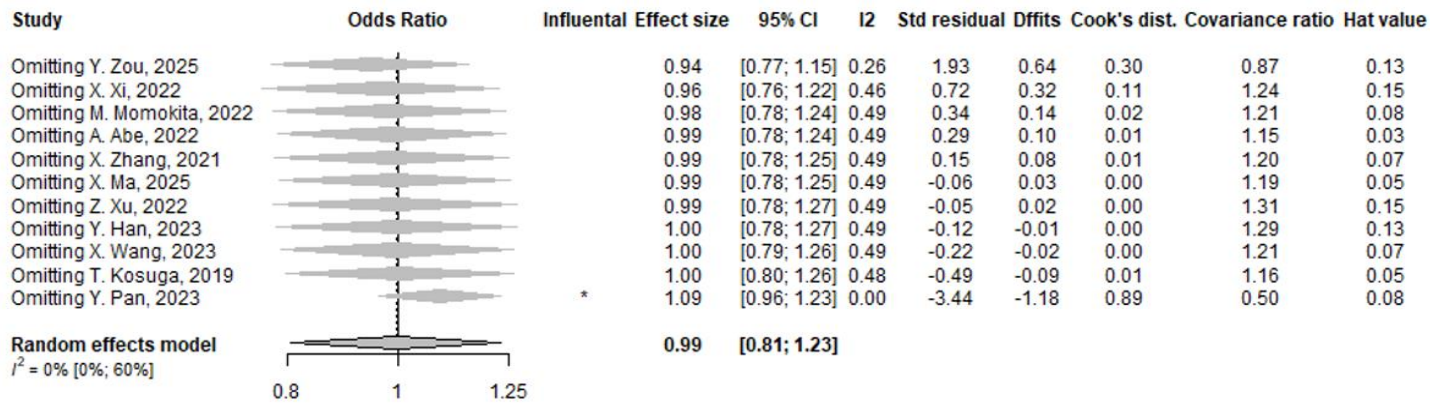
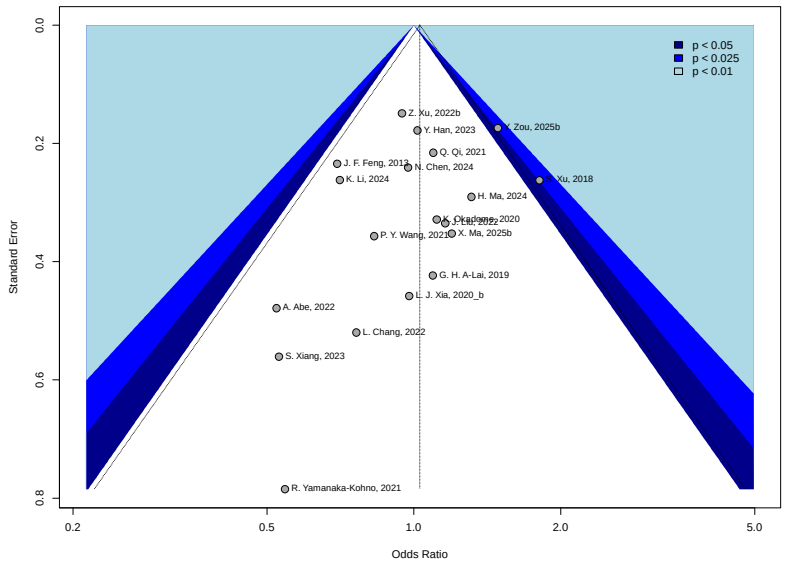


Figure S213: Funnel plot: Association between malnutrition-related complication risk and active alcohol consumption in gastrointestinal cancer (Biological composite scores)



Egger test: t = -1.00, df = 17, p-value = 0.3302

Figure S213.1 Leave-one-out plot: Association between malnutrition-related complication risk and active alcohol consumption in gastrointestinal cancer (Biological composite scores)

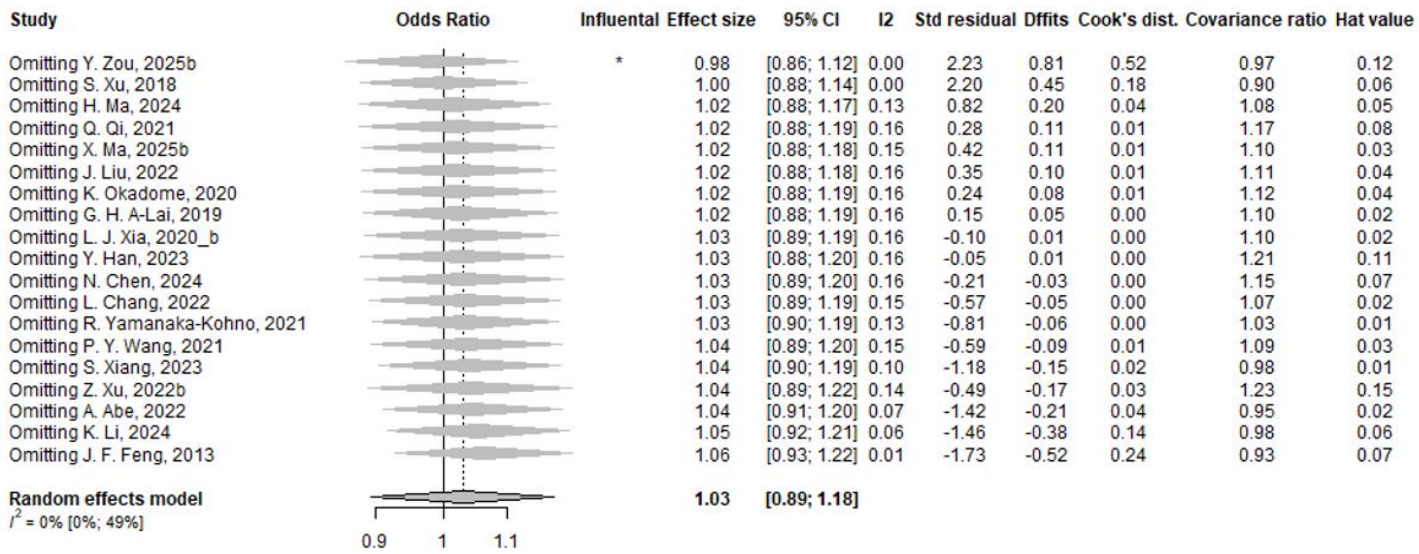
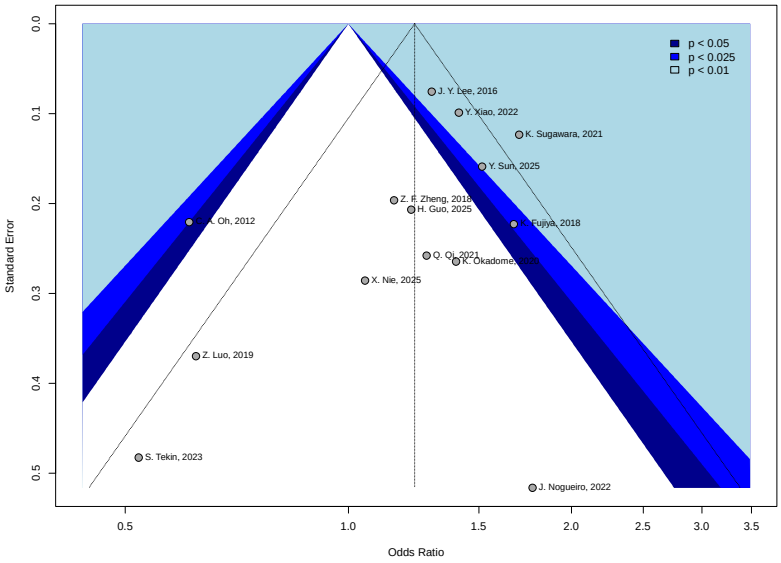


Figure S214 Funnel plot: Association between malnutrition-related complication risk and comorbidities in upper gastrointestinal cancer (Biological composite scores)



Egger test: t = -2.04, df = 12, p-value = 0.0637

Figure S214.1 Leave-one-out plot Association between malnutrition-related complication risk and comorbidities in upper gastrointestinal cancer (Biological composite scores)

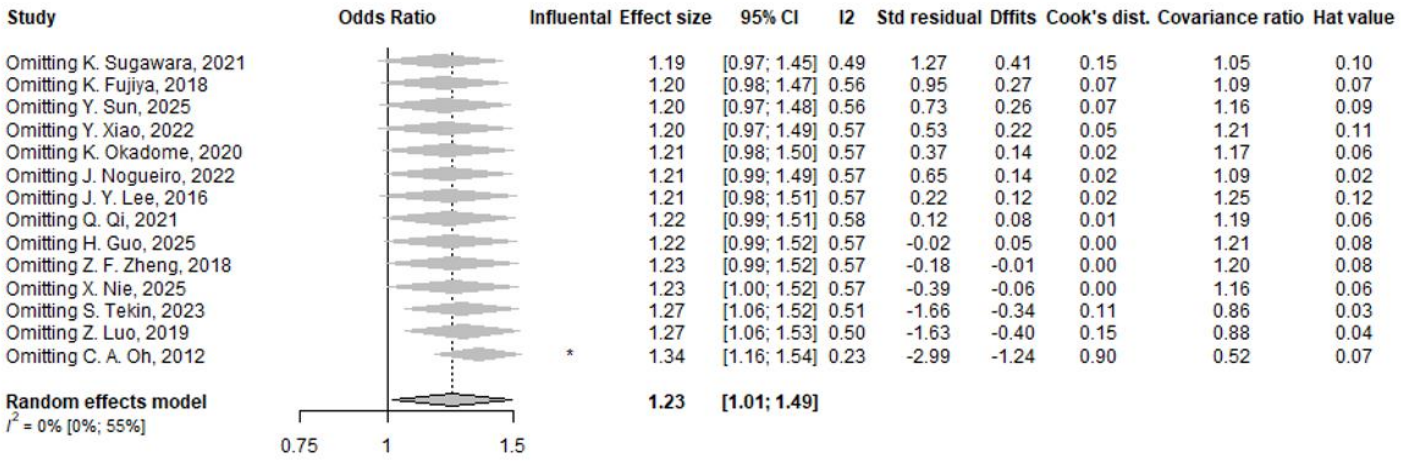
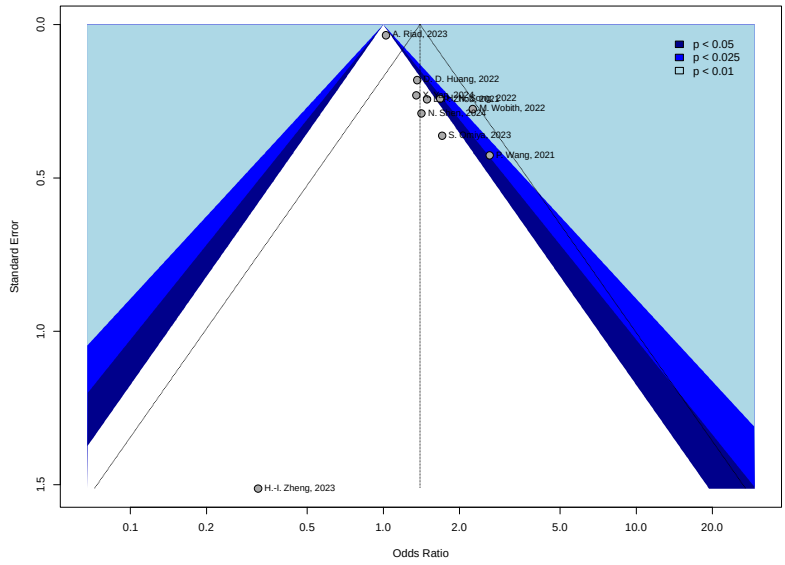


Figure S215 Funnel plot: Association between malnutrition diagnosis and ASA score (American Society of Anesthesiologists Physical Status Classification) in gastrointestinal cancer (GLIM criteria)



Egger test: t = 1.20, df = 8, p-value = 0.2658

Figure S215.1 Leave-one-out plot: Association between malnutrition diagnosis and ASA score (American Society of Anesthesiologists Physical Status Classification) in gastrointestinal cancer (GLIM criteria)

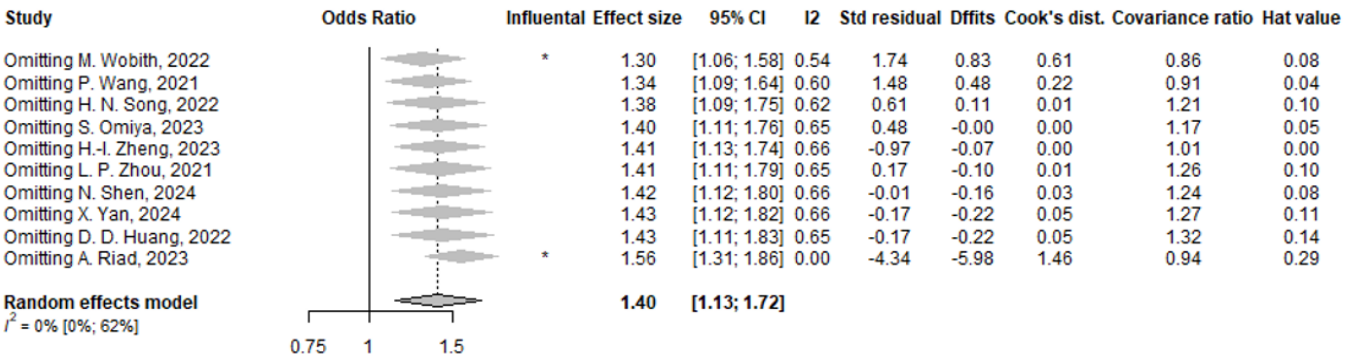
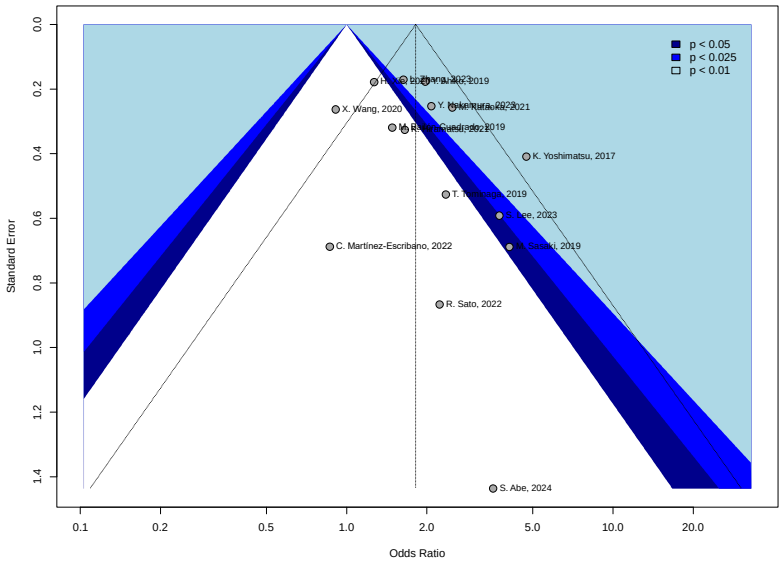


Figure S216 Funnel plot: Association between malnutrition-related complication risk and ASA score (American Society of Anesthesiologists Physical Status Classification) in colorectal cancer (Biological composite scores)

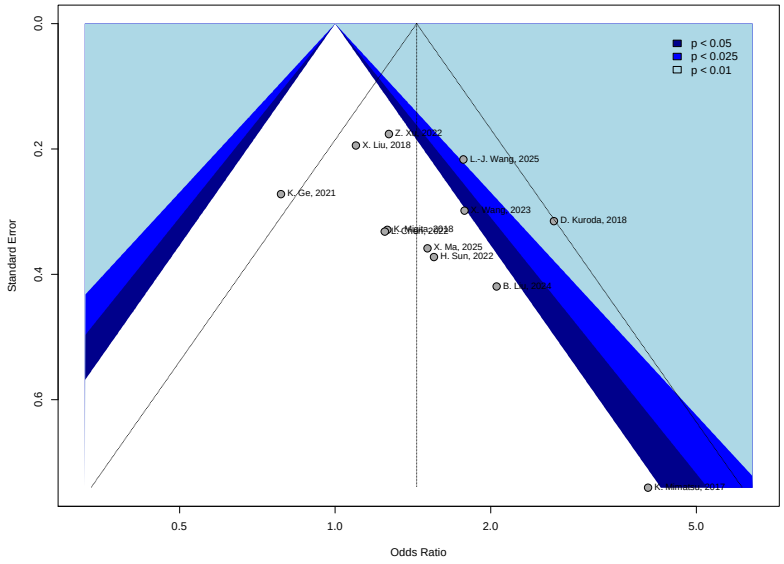


Egger test: t = 0.91, df = 13, p-value = 0.3800

Figure S216.1 Leave-one-out plot: Association between malnutrition-related complication risk and ASA score (American Society of Anesthesiologists Physical Status Classification) in colorectal cancer (Biological composite scores)

Study	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting K. Yoshimatsu, 2017		1.70	[1.38; 2.08]	0.25	2.28	0.68	0.38	0.71	0.05
Omitting M. Kataoka, 2021		1.76	[1.36; 2.28]	0.39	0.90	0.28	0.08	1.13	0.09
Omitting S. Lee, 2023		1.77	[1.39; 2.26]	0.40	1.14	0.21	0.05	1.00	0.03
Omitting M. Sasaki, 2019		1.78	[1.40; 2.27]	0.41	1.12	0.18	0.03	1.00	0.02
Omitting Y. Nakamura, 2023		1.80	[1.38; 2.35]	0.43	0.36	0.07	0.01	1.21	0.10
Omitting T. Tominaga, 2019		1.81	[1.40; 2.34]	0.44	0.44	0.04	0.00	1.13	0.04
Omitting Y. Ahiko, 2019		1.81	[1.38; 2.37]	0.43	0.25	0.04	0.00	1.26	0.13
Omitting S. Abe, 2024		1.82	[1.41; 2.34]	0.44	0.46	-0.01	0.00	1.09	0.01
Omitting R. Sato, 2022		1.82	[1.41; 2.35]	0.44	0.22	-0.02	0.00	1.12	0.02
Omitting K. Hiramatsu, 2021		1.84	[1.41; 2.40]	0.45	-0.24	-0.12	0.02	1.19	0.07
Omitting C. Martínez-Escribano, 2022		1.85	[1.45; 2.36]	0.42	-1.02	-0.15	0.02	1.02	0.02
Omitting L. Zhang, 2023		1.86	[1.42; 2.43]	0.44	-0.36	-0.18	0.04	1.25	0.13
Omitting M. Bailón-Cuadrado, 2019		1.86	[1.43; 2.41]	0.44	-0.51	-0.19	0.04	1.17	0.07
Omitting X. Wang, 2020		1.90	[1.54; 2.34]	0.23	-2.26	-0.45	0.14	0.75	0.09
Omitting H. Xie, 2020		1.91	[1.48; 2.46]	0.34	-1.26	-0.46	0.19	1.08	0.13
Random effects model		**1.82**	**[1.43; 2.31]**						
I^2 = 0% [0%; 54%]									

Figure S217 Funnel plot: Association between malnutrition-related complication risk and CA19-9 level in upper gastrointestinal cancer (Biological composite scores)



Egger test: t = 1.07, df = 10, p-value = 0.3118

Figure S217.1 Leave-one-out plot: Association between malnutrition-related complication risk and CA19-9 level in upper gastrointestinal cancer (Biological composite scores)

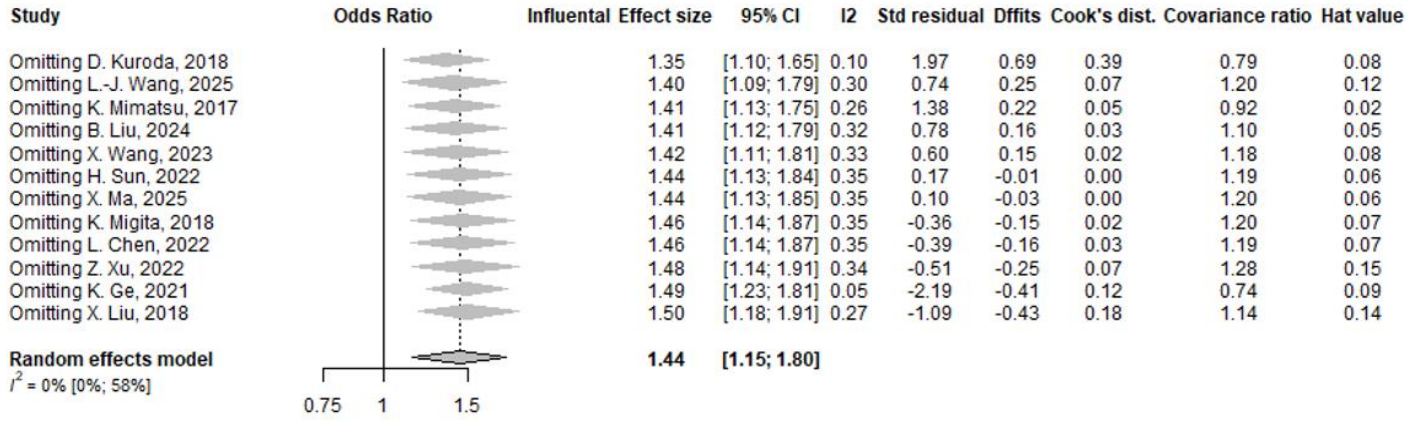
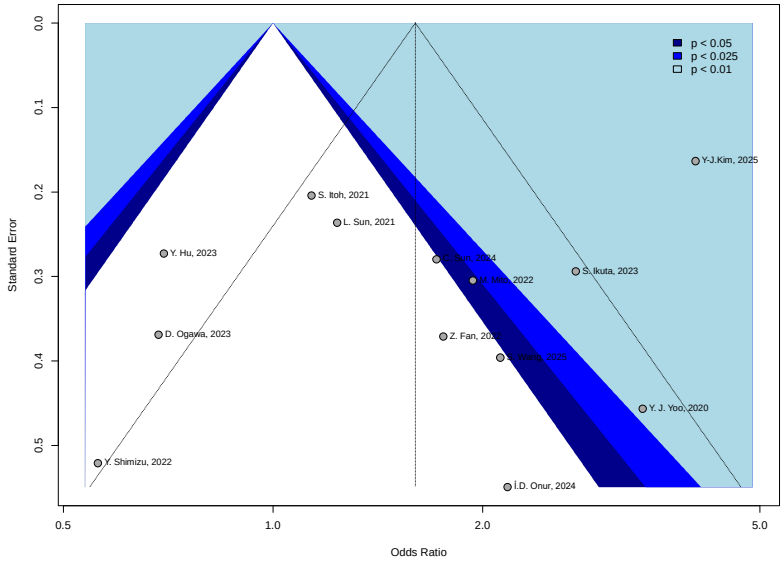


Figure S218 Funnel plot: Association between malnutrition-related complication risk and CA19-9 level in hepato-biliopancreatic cancer (Biological composite scores)



Egger test: t = -0.89, df = 11, p-value = 0.3905

Figure S218.1 Leave-one-out plot: Association between malnutrition-related complication risk and CA19-9 level in hepato-biliopancreatic cancer (Biological composite scores)

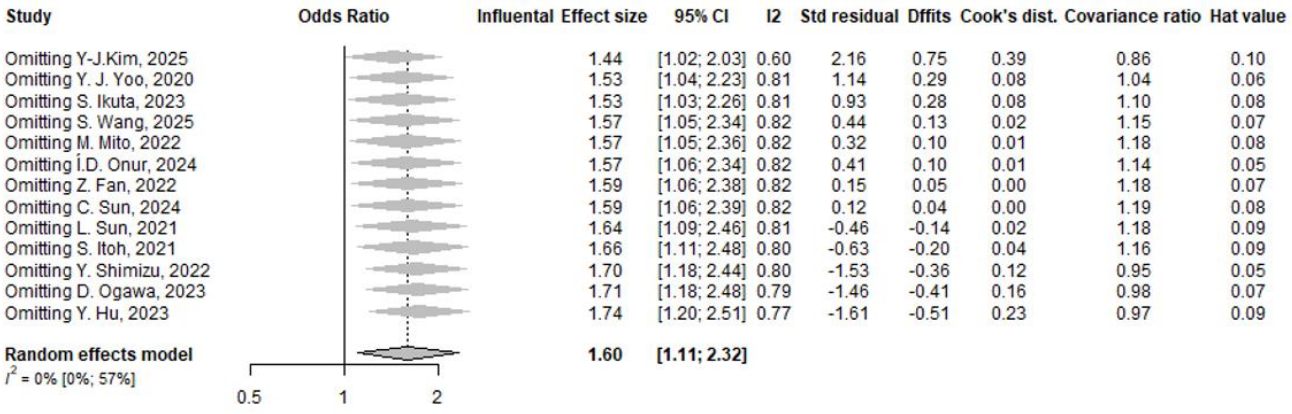
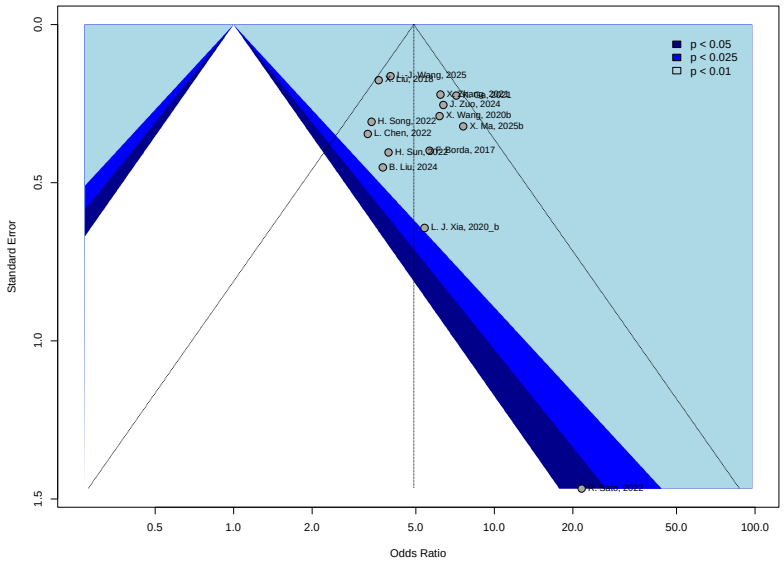


Figure S219 Funnel plot: Association between malnutrition-related complication risk and anaemia in gastrointestinal cancer (Biological composite scores)



Egger test: t = 1.11, df = 12, p-value = 0.2873

Figure S219.1 Leave-one-out plot: Association between malnutrition-related complication risk and anaemia in gastrointestinal cancer (Biological composite scores)

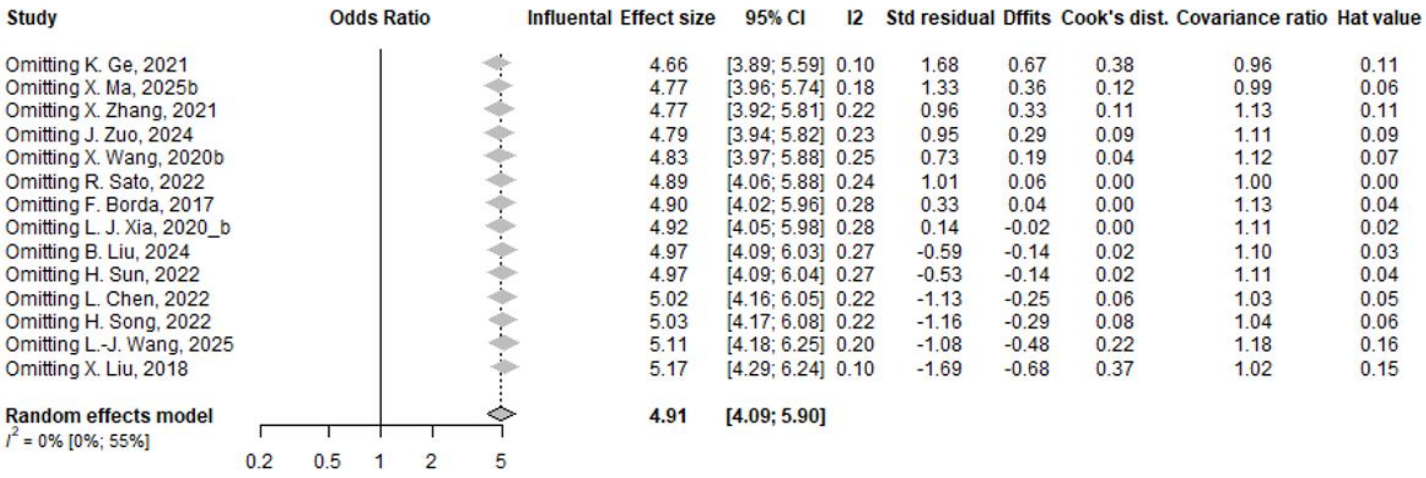
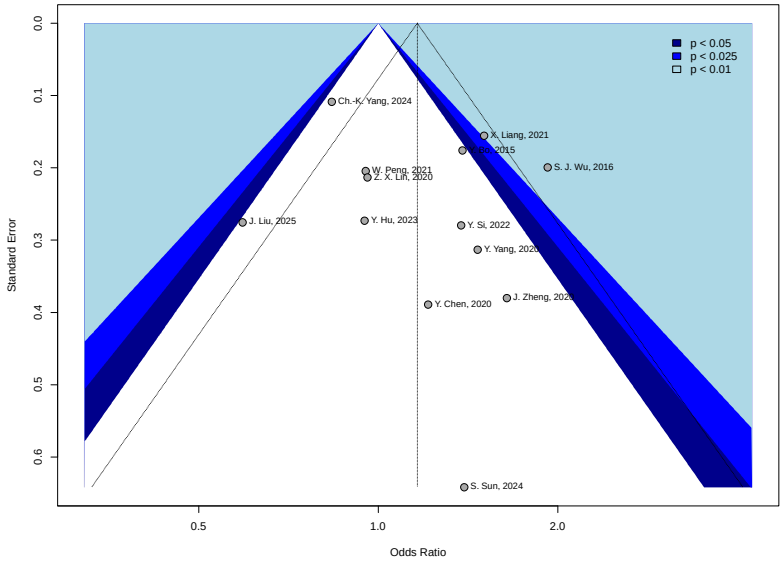


Figure S220 Funnel plot: Association between malnutrition-related complication risk and alpha-fetoprotein level in hepatocellular carcinoma (Biological composite scores)



Egger test: t = 0.60, df = 11, p-value = 0.5634

Figure S220.1 Leave-one-out plot: Association between malnutrition-related complication risk and alpha-fetoprotein level in hepatocellular carcinoma (Biological composite scores)

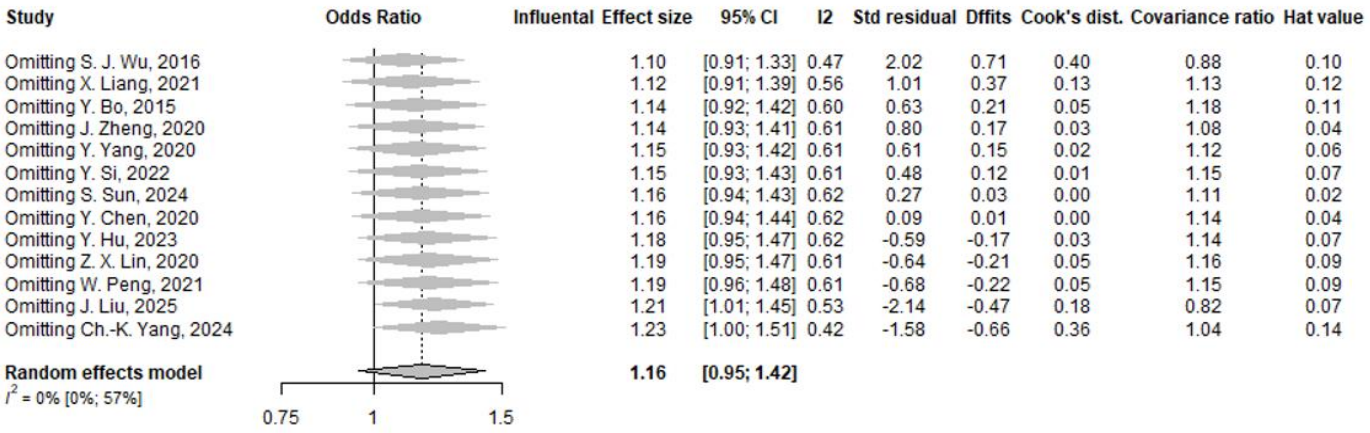
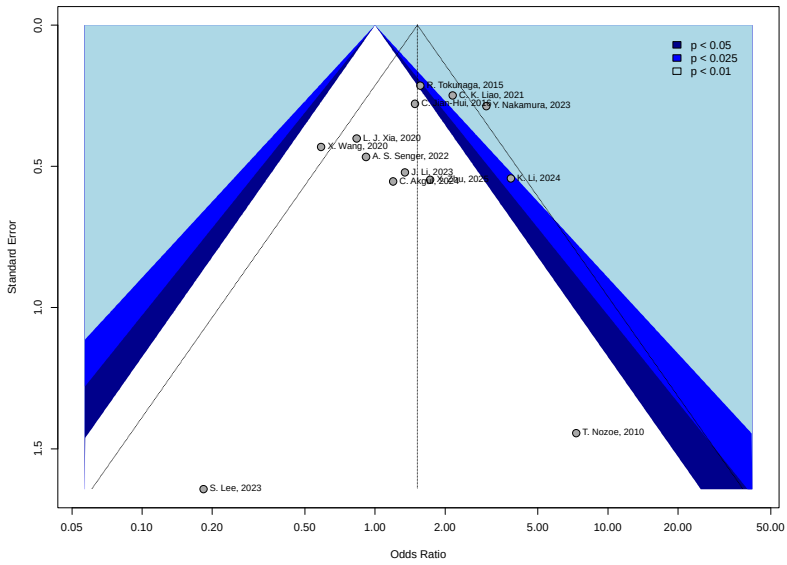


Figure S221: Funnel plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in colorectal cancer (Biological composite scores)



Egger test: t = -1.91, df = 11, p-value = 0.0819

Figure S221.1: Leave-one-out plot: Association between malnutrition-related complication risk and T stage (T>1 vs. T≤1) in colorectal cancer (Biological composite scores)

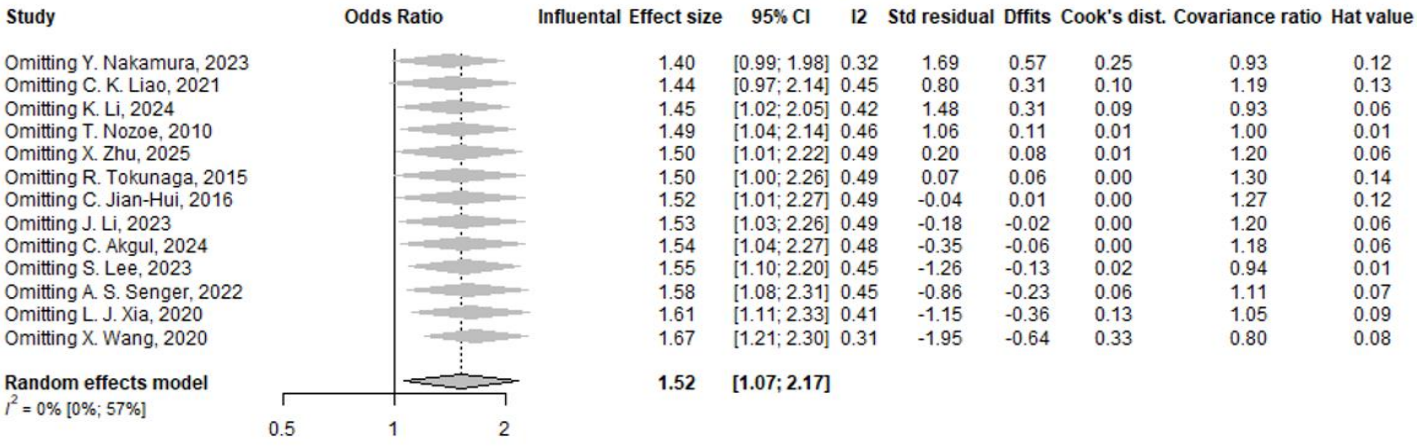
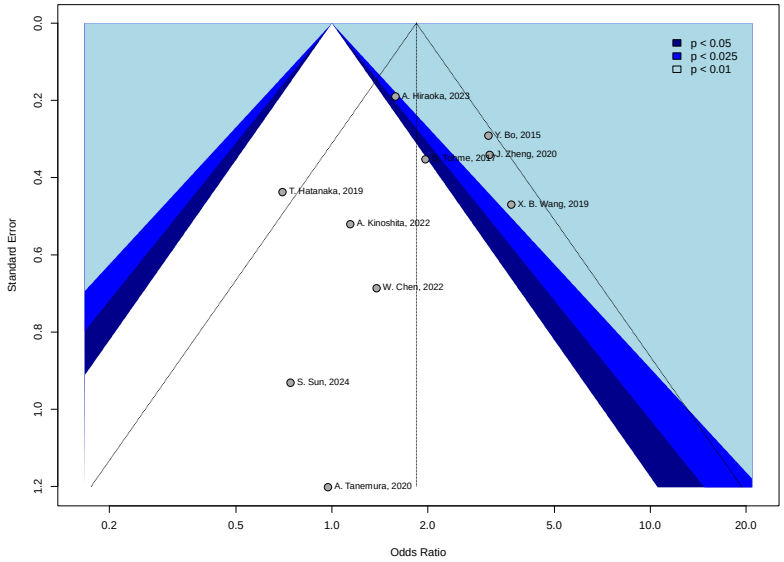
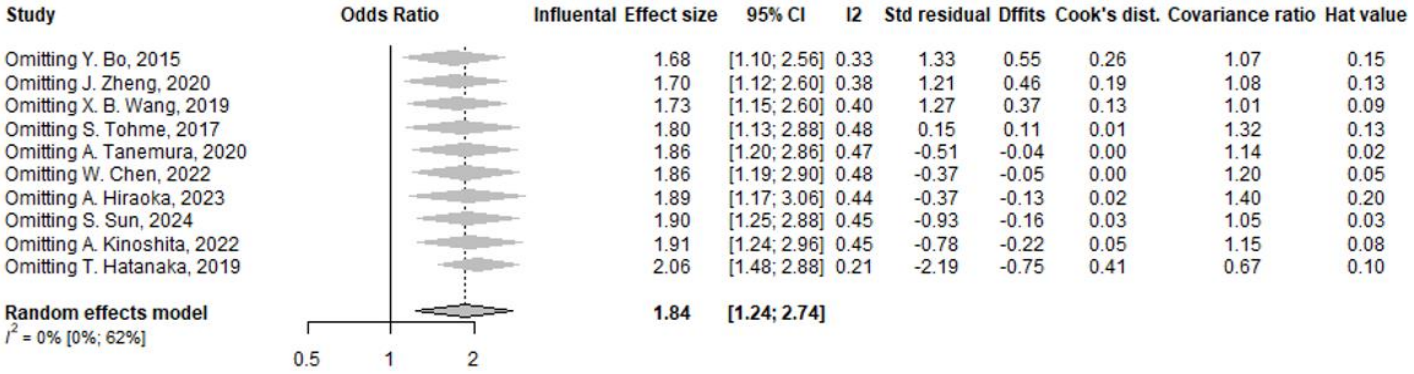


Figure S222: Funnel plot: Association between malnutrition-related complication risk and BCLC stage (C vs. B) in hepatocellular carcinoma (Biological composite scores)



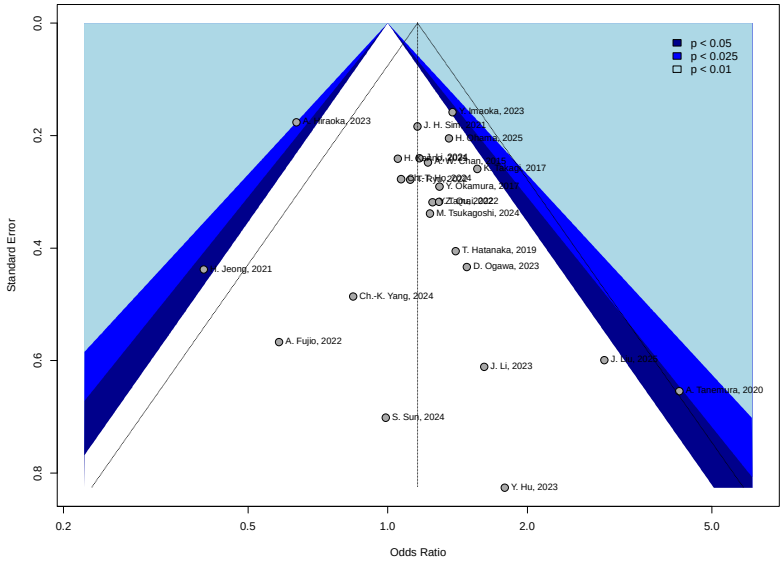
Egger test: t = -0.36, df = 8, p-value = 0.7261

Figure S222.1: Leave-one-out plot: Association between malnutrition-related complication risk and BCLC stage (C vs. B) in hepatocellular carcinoma (Biological composite scores)



Study	Influental	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Y. Bo, 2015		1.68	[1.10; 2.56]	0.33	1.33	0.55	0.26	1.07	0.15
Omitting J. Zheng, 2020		1.70	[1.12; 2.60]	0.38	1.21	0.46	0.19	1.08	0.13
Omitting X. B. Wang, 2019		1.73	[1.15; 2.60]	0.40	1.27	0.37	0.13	1.01	0.09
Omitting S. Tohme, 2017		1.80	[1.13; 2.88]	0.48	0.15	0.11	0.01	1.32	0.13
Omitting A. Tanemura, 2020		1.86	[1.20; 2.86]	0.47	-0.51	-0.04	0.00	1.14	0.02
Omitting W. Chen, 2022		1.86	[1.19; 2.90]	0.48	-0.37	-0.05	0.00	1.20	0.05
Omitting A. Hiraoka, 2023		1.89	[1.17; 3.06]	0.44	-0.37	-0.13	0.02	1.40	0.20
Omitting S. Sun, 2024		1.90	[1.25; 2.88]	0.45	-0.93	-0.16	0.03	1.05	0.03
Omitting A. Kinoshita, 2022		1.91	[1.24; 2.96]	0.45	-0.78	-0.22	0.05	1.15	0.08
Omitting T. Hatanaka, 2019		2.06	[1.48; 2.88]	0.21	-2.19	-0.75	0.41	0.67	0.10
Random effects model		**1.84**	**[1.24; 2.74]**						
I^2 = 0% [0%; 62%]									

Figure S223: Funnel plot: Association between malnutrition-related complication risk and etiology (viral vs. non-viral) in hepatocellular carcinoma (Biological composite scores)



Egger test: t = 0.59, df = 22, p-value = 0.5631

Figure S223.1: Leave-one-out plot: Association between malnutrition-related complication risk and etiology (viral vs. non-viral) in hepatocellular carcinoma (Biological composite scores)

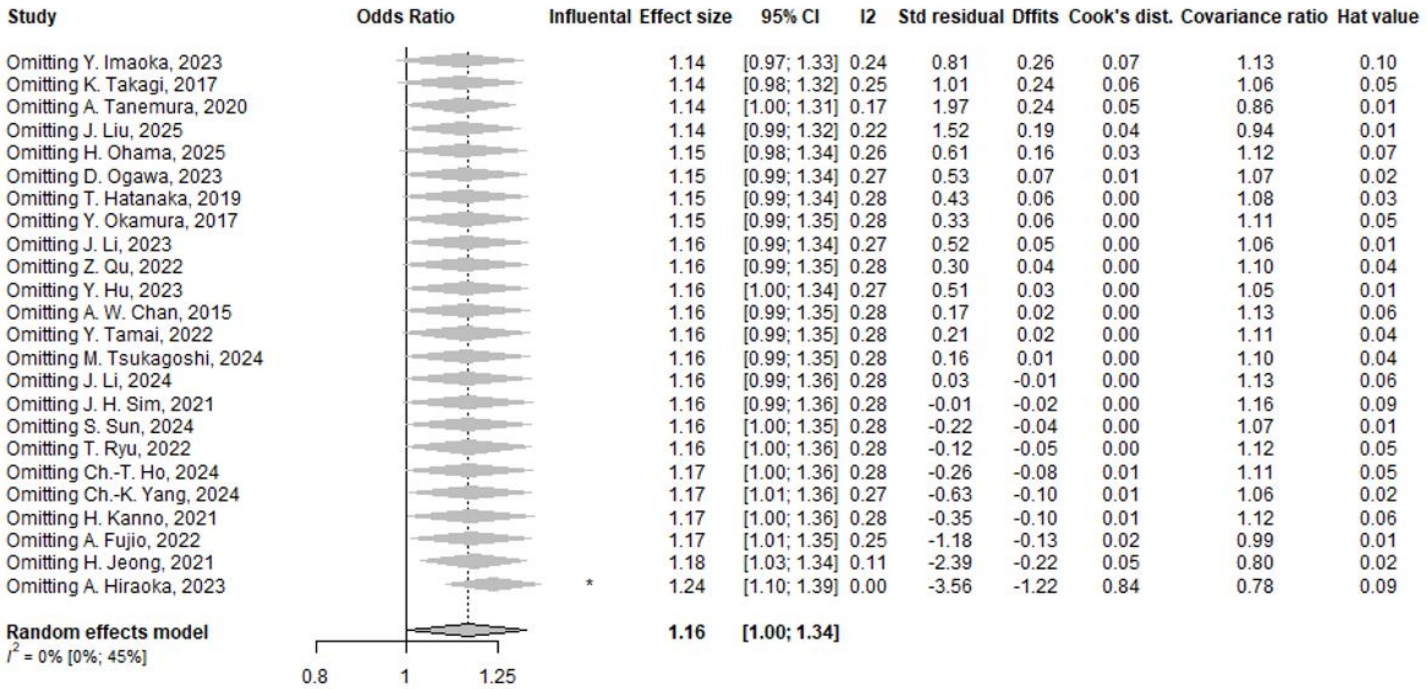
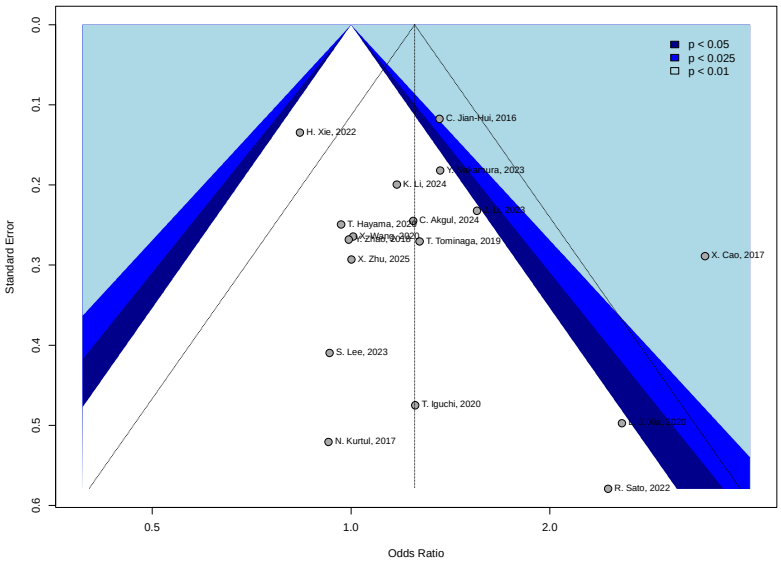
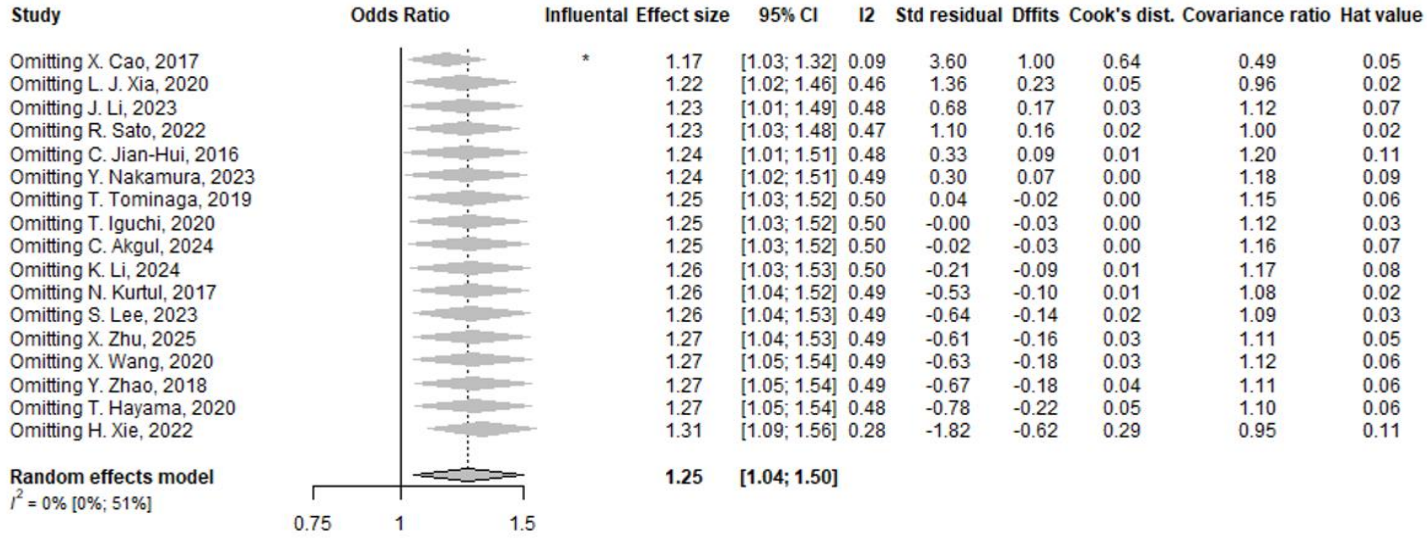


Figure S224: Funnel plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in colorectal cancer (Biological composite scores)



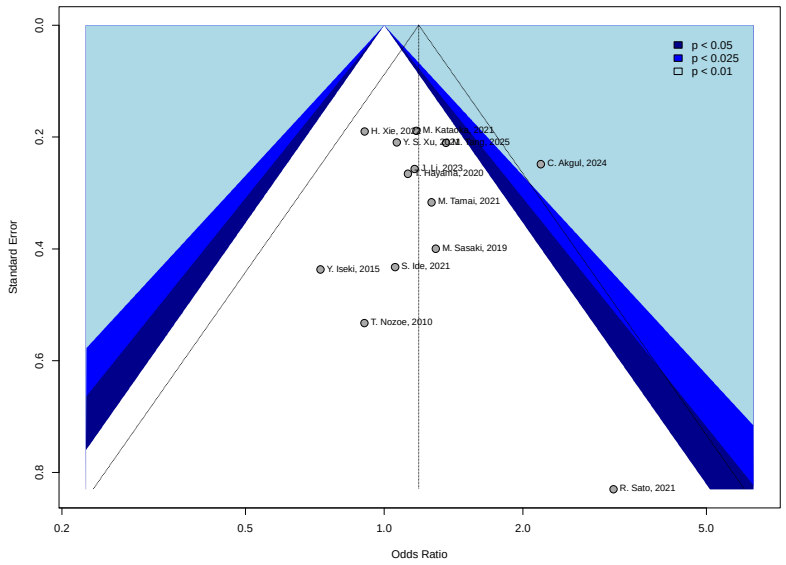
Egger test: t = 0.68, df = 15, p-value = 0.5084

Figure S224.1: Leave-one-out plot: Association between malnutrition-related complication risk and N stage (N≥1 vs. N0) in colorectal cancer (Biological composite scores)



Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting X. Cao, 2017	*	1.17	[1.03; 1.32]	0.09	3.60	1.00	0.64	0.49	0.05
Omitting L. J. Xia, 2020		1.22	[1.02; 1.46]	0.46	1.36	0.23	0.05	0.96	0.02
Omitting J. Li, 2023		1.23	[1.01; 1.49]	0.48	0.68	0.17	0.03	1.12	0.07
Omitting R. Sato, 2022		1.23	[1.03; 1.48]	0.47	1.10	0.16	0.02	1.00	0.02
Omitting C. Jian-Hui, 2016		1.24	[1.01; 1.51]	0.48	0.33	0.09	0.01	1.20	0.11
Omitting Y. Nakamura, 2023		1.24	[1.02; 1.51]	0.49	0.30	0.07	0.00	1.18	0.09
Omitting T. Tominaga, 2019		1.25	[1.03; 1.52]	0.50	0.04	-0.02	0.00	1.15	0.06
Omitting T. Iguchi, 2020		1.25	[1.03; 1.52]	0.50	-0.00	-0.03	0.00	1.12	0.03
Omitting C. Akgul, 2024		1.25	[1.03; 1.52]	0.50	-0.02	-0.03	0.00	1.16	0.07
Omitting K. Li, 2024		1.26	[1.03; 1.53]	0.50	-0.21	-0.09	0.01	1.17	0.08
Omitting N. Kurtul, 2017		1.26	[1.04; 1.52]	0.49	-0.53	-0.10	0.01	1.08	0.02
Omitting S. Lee, 2023		1.26	[1.04; 1.53]	0.49	-0.64	-0.14	0.02	1.09	0.03
Omitting X. Zhu, 2025		1.27	[1.04; 1.53]	0.49	-0.61	-0.16	0.03	1.11	0.05
Omitting X. Wang, 2020		1.27	[1.05; 1.54]	0.49	-0.63	-0.18	0.03	1.12	0.06
Omitting Y. Zhao, 2018		1.27	[1.05; 1.54]	0.49	-0.67	-0.18	0.04	1.11	0.06
Omitting T. Hayama, 2020		1.27	[1.05; 1.54]	0.48	-0.78	-0.22	0.05	1.10	0.06
Omitting H. Xie, 2022		1.31	[1.09; 1.56]	0.28	-1.82	-0.62	0.29	0.95	0.11
Random effects model		**1.25**	**[1.04; 1.50]**						
I^2 = 0% [0%; 51%]									

Figure S225: Funnel plot: Association between malnutrition-related complication risk and macrovascular involvement in colorectal cancer (Biological composite scores)



Egger test: t = 1.32, df = 11, p-value = 0.2137

Figure S225.1: Leave-one-out plot: Association between malnutrition-related complication risk and macrovascular involvement in colorectal cancer (Biological composite scores)

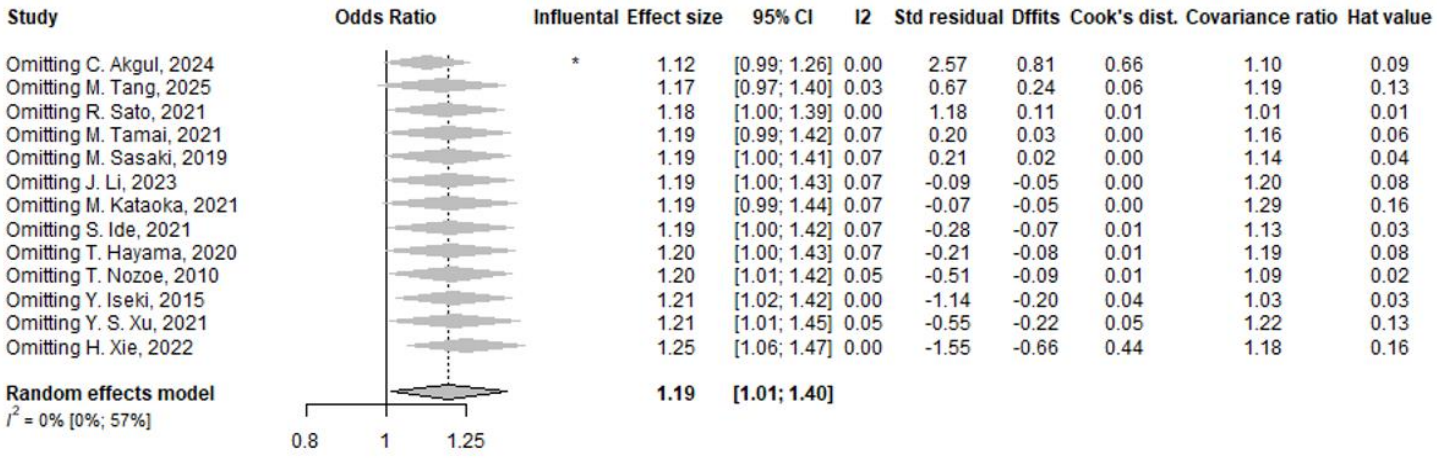
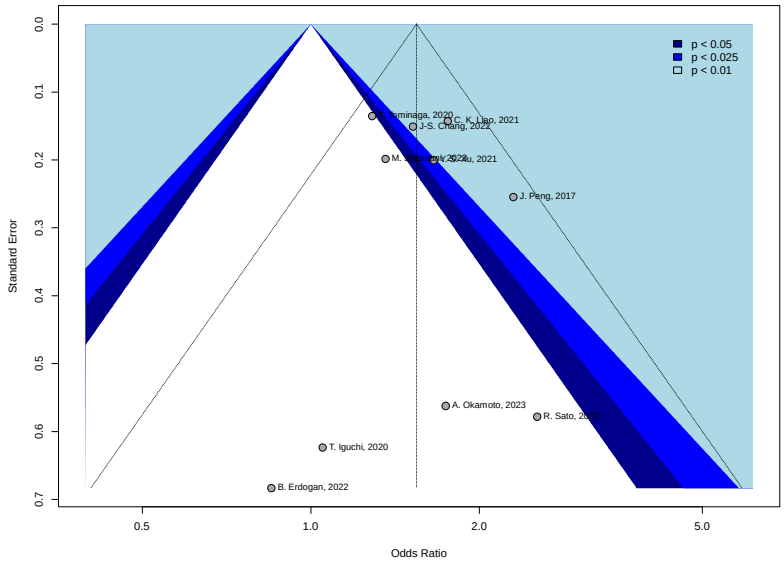


Figure S226: Funnel plot: Association between malnutrition-related complication risk and tumor location (right-sided vs. left-sided) in colorectal cancer (Biological composite scores)



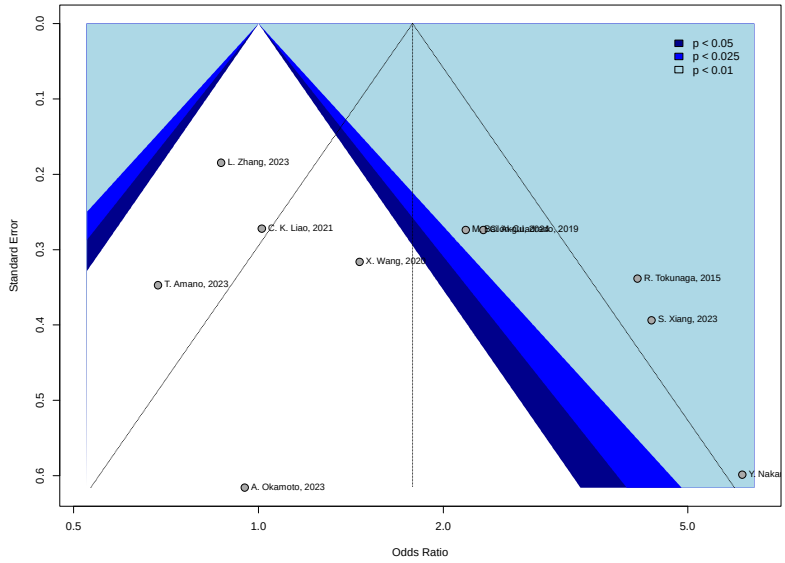
Egger test: t = -0.17, df = 8, p-value = 0.8657

Figure S226.1: Leave-one-out plot: Association between malnutrition-related complication risk and tumor location (right-sided vs. left-sided) in colorectal cancer (Biological composite scores)

Study	Influential	Effect size	95% CI	I2	Std residual	Dffits	Cook's dist.	Covariance ratio	Hat value
Omitting Z. Hu, 2020	*	1.30	[1.14; 1.49]	0.52	5.78	0.77	0.31	0.45	0.03
Omitting J. Li, 2023		1.34	[1.09; 1.64]	0.70	1.53	0.28	0.07	0.99	0.03
Omitting X. Cao, 2017		1.36	[1.10; 1.67]	0.72	0.84	0.15	0.02	1.04	0.03
Omitting Y. Iseki, 2015		1.36	[1.10; 1.67]	0.72	0.83	0.14	0.02	1.04	0.03
Omitting L.-X. Liu, 2024		1.36	[1.11; 1.68]	0.73	0.72	0.11	0.01	1.04	0.02
Omitting G. Ucar, 2020		1.36	[1.11; 1.68]	0.72	0.59	0.11	0.01	1.06	0.03
Omitting C. K. Liao, 2021		1.37	[1.11; 1.68]	0.72	0.41	0.08	0.01	1.07	0.04
Omitting F. Teraishi, 2025		1.37	[1.11; 1.68]	0.73	0.74	0.07	0.00	1.02	0.01
Omitting X. Zhu, 2025		1.37	[1.11; 1.69]	0.73	0.37	0.06	0.00	1.06	0.03
Omitting M. Yamamoto, 2019		1.37	[1.11; 1.69]	0.73	0.26	0.05	0.00	1.07	0.03
Omitting Y. Nakamura, 2022		1.37	[1.11; 1.69]	0.73	0.22	0.04	0.00	1.07	0.03
Omitting H. Xie, 2022		1.37	[1.11; 1.69]	0.73	0.18	0.04	0.00	1.07	0.04
Omitting H. Zhou, 2020		1.37	[1.11; 1.69]	0.73	0.12	0.02	0.00	1.07	0.03
Omitting R. Tokunaga, 2016		1.37	[1.11; 1.70]	0.73	0.07	0.01	0.00	1.07	0.03
Omitting K. Maeda, 2014		1.38	[1.12; 1.70]	0.73	0.02	0.00	0.00	1.05	0.02
Omitting M. Shibutani, 2015		1.38	[1.12; 1.70]	0.73	-0.00	0.00	0.00	1.06	0.03
Omitting Y. Mohri, 2013		1.38	[1.12; 1.70]	0.73	-0.04	-0.01	0.00	1.07	0.03
Omitting M. Tamai, 2021		1.38	[1.12; 1.70]	0.73	-0.05	-0.01	0.00	1.06	0.03
Omitting Y. Li, 2025		1.38	[1.12; 1.70]	0.73	-0.06	-0.01	0.00	1.08	0.04
Omitting M. Sasaki, 2019		1.38	[1.12; 1.70]	0.73	-0.08	-0.01	0.00	1.06	0.03
Omitting T. Nozoe, 2010		1.38	[1.12; 1.70]	0.73	-0.10	-0.01	0.00	1.06	0.02
Omitting M. Kataoka, 2021		1.38	[1.12; 1.70]	0.73	-0.17	-0.03	0.00	1.07	0.03
Omitting M. Keskinikilic, 2024		1.38	[1.12; 1.70]	0.73	-0.29	-0.05	0.00	1.06	0.02
Omitting Y. Zhao, 2018		1.38	[1.12; 1.71]	0.73	-0.29	-0.05	0.00	1.06	0.03
Omitting T. Ikeya, 2015		1.39	[1.12; 1.71]	0.73	-0.43	-0.06	0.00	1.05	0.02
Omitting T. Tominaga, 2019		1.39	[1.12; 1.71]	0.73	-0.40	-0.07	0.00	1.06	0.03
Omitting T. Yagyu, 2022		1.39	[1.13; 1.71]	0.73	-0.49	-0.09	0.01	1.06	0.03
Omitting Y. Ahiko, 2019		1.39	[1.13; 1.71]	0.72	-0.51	-0.10	0.01	1.06	0.04
Omitting Y. Zhu, 2021		1.39	[1.13; 1.71]	0.73	-0.61	-0.11	0.01	1.05	0.03
Omitting A. S. Senger, 2022		1.39	[1.13; 1.72]	0.72	-0.63	-0.11	0.01	1.05	0.03
Omitting C. Jian-Hui, 2016		1.40	[1.13; 1.72]	0.70	-0.74	-0.15	0.02	1.05	0.04
Omitting S. Xiang, 2023		1.41	[1.15; 1.72]	0.72	-1.39	-0.22	0.05	0.99	0.03
Omitting T. Hayama, 2022		1.41	[1.15; 1.72]	0.72	-1.65	-0.23	0.05	0.96	0.02
Omitting G. Pian, 2022		1.41	[1.15; 1.73]	0.71	-1.55	-0.26	0.06	0.98	0.03
Omitting M. Bailón-Cuadrado, 2019		1.41	[1.16; 1.73]	0.71	-1.61	-0.27	0.07	0.98	0.03
Random effects model		**1.38**	**[1.12; 1.69]**						

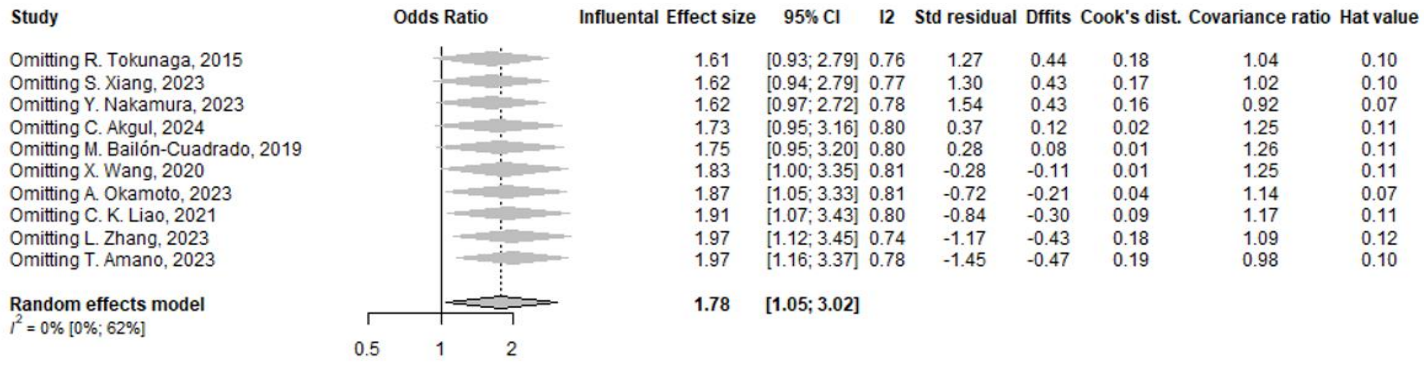
I^2 = 0% [0%; 38%]

Figure S227: Funnel plot: Association between malnutrition-related complication risk and neoadjuvant chemo-, or radiotherapy in colorectal cancer (Biological composite scores)



Egger test: t = -0.91, df = 8, p-value = 0.3885

Figure S227.1: Leave-one-out plot: Association between malnutrition-related complication risk and neoadjuvant chemo-, or radiotherapy in colorectal cancer (Biological composite scores)



Supplementary Table S1.: PRISMA 2020 Checklist and PRISMA 2020 for Abstract Checklist

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where the item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	3-4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	3-4, Supplementary Document 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	4, Supplementary Document 4
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	4, Supplementary Document 5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	4
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	5
Synthesis	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics	5

Section and Topic	Item #	Checklist item	Location where the item is reported
methods		and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	5
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	5
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	5
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	5
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	5
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	4-5
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	6
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	6
Study characteristics	17	Cite each included study and present its characteristics.	6, Supplementary Document 12 Supplementary Table 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	18, Supplementary Table 3
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	6-18 Supplementary Figures 1-124
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	18
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	6-18
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	18, Supplementary Document 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	16, Supplementary

Section and Topic	Item #	Checklist item	Location where the item is reported
			Document 6
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	16, Supplementary Document 9
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	19-22
	23b	Discuss any limitations of the evidence included in the review.	19-22
	23c	Discuss any limitations of the review processes used.	19-22
	23d	Discuss implications of the results for practice, policy, and future research.	19-22
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	3
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	3
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	3
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	23
Competing interests	26	Declare any competing interests of review authors.	23
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	23

NA= not applicable

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

PRISMA 2020 for Abstract Checklist

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	No
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	No
Registration	12	Provide the register name and registration number.	No

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

Supplementary Table S2.: Study characteristics table

First Author	Year of publication	Study Design	Country	Centers (N0)	total number of patients	age (mean±SD or median+ range*)	gender (No. (%) of females)	cancer type
A. Abe	2022	cross-sectional	Japan	1	145	72.2±8.5; **(50-89)	29 (20)	gastric cancer
A. Abe	2022	cross-sectional	Japan	1	95	67.2±13.2; **(37-89)	57 (60)	gastric cancer
F. Akad	2024	cross-sectional	Romania	1	51	66.91±12.68	17 (33.3)	gastric cancer
S. Abe	2024	prospective cohort	Japan	1	93	62 (52-67)	24 (25.8)	rectal cancer
T. Abe	2018	retrospective cohort	Japan	1	329	67 ††(61-74)	131 (39.8)	PDAC
Y. Ahiko	2019	retrospective cohort	Japan	1	830	78 (75-94)	360 (43.4)	colorectal cancer
B. Akagunduz	2022	retrospective cohort	Turkey	1	161	58.7 (32-80)	51 (31.7)	gastric cancer
M. Akaoka	2022	retropective cohort	Japan	1	213	68 (61-74)	42 (19.7)	hepatocellular carcinoma
C. Akgul	2024	cross-sectional	Turkey	1	300	NA	114 (38)	colorectal cancer
O. Akgül	2018	retrospective cohort	NA	NA	637	NA	NA	hepatobiliary cancer
O. Akgül	2018	retrospective cohort	NA	NA	637	NA	NA	hepatobiliary cancer

G. H. A-Lai	2019	retrospective cohort	China	1	90	64.34±NA	19 (21.1)	esophageal cancer
Ş. B. Alkan	2018	cross-sectional	Turkey	1	52	NA	21 (40.4)	gastrointestinal cancer
A. S. Almasaudi	2019	prospective cohort	United Kingdom	1	363	66±12	199 (54.8)	colorectal cancer
A. S. Almasaudi	2020	retrospective cohort	United Kingdom	1	795	NA	437 (55)	colorectal cancer
M. J. Alves	2017	cross-sectional	Brazil	1	38	NA	16 (42.1)	gastrointestinal cancer
T. Amano	2023	retropective cohort	Japan	1	237	67 (64-71)	81 (34.2)	rectal cancer
A. Attar	2012	prospective cohort	France	11	313	¶ 63 **(21-93)	33 (10.5)	gastrointestinal cancer
J. Bachmann	2013	retrospective cohort	Germany	1	242	65 (57-70)	106 (43.8)	PDAC
J. Bachmann	2008	prospective cohort	Germany	1	227	NA	98 (43.2)	PDAC
J. Bachmann	2009	prospective cohort	Germany	1	198	64 (57-79)	82 (41.4)	PDAC
X. Bai	2020	retrospective cohort	China	1	355	58 (20-88); 58.17±13.39	161 (45.4)	colorectal cancer
M. Bailón-Cuadrado	2019	prospective cohort	Spain	1	180	68.67±11.18	62 (34.4)	colorectal cancer
L. R. Barbosa	2014	cross-sectional	Brazil	1	66	61±NA	36 (54.5)	colorectal cancer
M. Bardakci	2021	retrospective cohort	Turkey	1	126	61 (36-88)	51 (40.5)	papilla vateri tumor
M. Barett	2011	prospective cohort	France	8	114	65 (22-92)	41 (36)	colorectal cancer

M. L. Batista	2013	cross-sectional	Brazil	1	43	NA	16 (37.2)	gastrointestinal cancer
M. L. Batista	2016	cross-sectional	Brazil	1	19	NA	8 (42.1)	gastrointestinal cancer
D. H. Bicakli	2019	prospective cohort	Turkey	1	96	61 (28-78)	37 (38.5)	PDAC
S. Bo	2010	cross-sectional	China	1	208	NA	70 (33.7)	gastric cancer
Y. Bo	2015	prospective cohort	China	1	620	53.8±10.6; **(28-80)	125 (20.2)	hepatocellular carcinoma
Y. Bo	2016	retrospective cohort	China	1	239	67.9±5.9; **(60-88)	89 (37.2)	esophageal squamous cell carcinoma
F. Borda	2014	retrospective cohort	Spain	1	207	NA	86 (41.5)	colorectal cancer
F. Borda	2017	retrospective cohort	Spain	1	124	NA	40 (32.3)	gastric cancer
D. R. Brown	2001	cross-sectional	USA	1	64	64±10.7	25 (39.1)	PDAC
L. R. Brown	2024	prospective cohort	United Kingdom	2	385	§66	108 (28.1)	esophageal, gastric cancer
L. Brown	2024	prospective cohort	United Kingdom	2	385	§66	108 (28.1)	esophageal, gastric cancer
L. R. Brown	2025	retropective cohort	United Kingdom	4	465	NA	154 (33.1)	esophageal, gastric cancer
W. Cai	2022	retropective cohort	China	1	1007	NA	267 (26.5)	gastric cancer
S. B. G. Campos	2022	cross-sectional	Brazil	1	31	58.97±14.96	16 (51.6)	colorectal cancer
J. Cao	2021	cross-sectional	China	72	1482	62.68±10.91	273 (18.4)	esophageal cancer

X. Cao	2017	retrospective cohort	China	1	228	69 (27-92); 66.11±12.79	94 (41.2)	colorectal cancer
V. W. Chai	2021	retrospective cohort	Australia	1	228	§ 69	89 (39)	colorectal cancer
V. Casalone	2025	retropective cohort	Italy	1	391	65±NA	159 (40.7)	gastrointestinal
A. W. Chan	2015	retrospective cohort	Hong Kong	1	324	56.8±10.9	41 (12.7)	hepatocellular carcinoma
L. Chang	2022	retrospective cohort	China	1	69	60 (44-78)	2 (2.9)	esophageal cancer
J-S. Chang	2022	retropective cohort	Taiwan	1	768	NA	273 (35.5)	colorectal cancer
L. Chang	2023	retropective cohort	China	1	62	§61**(42-85)	0 (0)	esophageal cancer
F. F. Chen	2016	prospective cohort	China	1	158	66.9±8.7	32 (20.3)	gastric cancer
L. Chen	2022	retrospective cohort	China	1	146	59 (34-82)	44 (30.1)	gastric cancer
M. F. Chen	2021	prospective cohort	Taiwan	1	340	NA	NA	esophageal squamous cell carcinoma
S. B. Chen	2021	retrospective cohort	Taiwan	1	620	61 (38-84)	143 (23.1)	esophageal squamous cell carcinoma
W. Chen	2022	retrospective cohort	China	1	83	57.31±11.8; **(27-82)	12 (14.5)	hepatocellular carcinoma
W. Z. Chen	2022	prospective cohort	China	1	742	72 (65-91)	173 (22.9)	gastric cancer
X. Chen	2019	prospective cohort	China	1	575	64.41±10.6	142 (24.7)	gastric cancer

X. Chen	2022	retrospective cohort	China	1	359	62 (55-68)	84 (23.4)	hepatocellular carcinoma
X. Y. Chen	2019	prospective cohort	China	1	313	§62 ††(50-74)	105 (33.5)	gastric cancer
Y. Chen	2020	retrospective cohort	China	2	325	NA	55 (16.9)	hepatocellular carcinoma
Y. Chen	2022	retrospective cohort	China	1	228	64.3±9.6	20 (8.8)	hepatocellular carcinoma
K. Chen	2024	retropective cohort	China	1	1450	53 (46-62)	219 (15.1)	hepatocellular carcinoma
L.Chen	2023	prospective cohort	china	1	78	NA	78 (100)	gastrointestinal
L. Chen	2024	retropective cohort	China	2	426	NA	139 (32.6)	gastric, colorectal
N. Chen	2024	prospective cohort	China	1	354	§62**(41-83)	27 (7.6)	esophageal cancer
W. Chen	2023	retropective cohort	China	2	850	§64 (50-78)	292 (34.4)	colorectal cancer
J. W. Cho	2022	retrospective cohort	Korea	1	1940	55.3±11.5; **(24-82)	33 (17.0)	gastric cancer
Y. Choi	2017	retrospective cohort	Korea	1	288	62 (28-87)	107 (37.2)	gastric cancer
M. O. Chu	2018	retrospective cohort	Taiwam	1	118	69±10; **(32-90)	44 (37.3)	hepatocellular carcinoma
A. da Silva Couto	2023	retrospective cohort	Brazil	1	191	60.5±11.3	81 (42.4)	colon cancer
Y. Dai	2019	retrospective cohort	China	1	106	58 (41-79)	27 (25.5)	cervical esophageal squamous cell carcinoma
T.Dai	2022	case-control	China	1	242	NA	63 (26)	gastric cancer

N. Daitoku	2018	retrospective cohort	Japan	1	211	63 (34-86)	85 (40.3)	colorectal cancer
C. A. D'Almeida	2013	prospective cohort	Brazil	1	72	57.3±12.8	41 (56.9)	gastrointestinal cancer
L. E. Daly	2018	prospective cohort	Ireland	1	225	65.6 (35.8-83.4)	75 (33.3)	gastrointestinal cancer
C. Dang	2022	prospective cohort	China	1	382	57.5 (28-78)	161 (42.1)	PDAC
C. Dang	2022	retrospective cohort	China	1	792	NA	322 (40.7)	PDAC
A. Daniele	2017	cross-sectional	Italy	1	78	78 (44-87)	39 (50)	colorectal cancer
De Luise Roman	2024	prospective cohort	Spain	1	137	§69.8**(55-89)	49 (35.8)	colorectal cancer
G. S. de Castro	2021	cross-sectional	Italy	1	94	NA (30-90)	40 (42.5)	gastrointestinal cancer
M. Demir	2022	retropective cohort	Turkey	1	101	§59**(35-84)	57 (56.4)	esophageal cancer
D. Diakowska	2010	cross-sectional	Poland	1	135	NA	27 (20)	esophageal cancer
W. P. M. Dijksterhuis	2021	prospective cohort	Netherlands	multicenter	406	§66 ††(59-71)	96 (23.6)	gastrointestinal cancer
T. G. Dolin	2022	cross-sectional	Denmark	1	64	79.6±6.4	38 (59)	colorectal cancer
L. Dou	2020	prospective cohort	China	1	201	64.682±10.483	51 (25.4)	gastrointestinal cancer
Y. Du	2025	retropective cohort	China	1	1101	NA	275 (25)	gastric cancer
H. Duan	2022	cross-sectional	China	1	152	NA	24 (15.8)	hepatocellular carcinoma

W. K. Eo	2015	retrospective cohort	Republic of Korea	1	314	59±NA	106 (33.8)	gastric cancer
B. Erdogan	2022	retropective cohort	Turkey	1	52	NA	22 (42.3)	colorectal cancer
J. Ericson	2025	randomized control trial	Sweden/Norway/Germany	multicenter	117	64±NA	22 (18.8)	esophageal or gastroesophageal junction carcinoma
A. Esfahani	2016	prospective cohort	Iran	1	71	62.13±14.39	15 (21.1)	gastric cancer
Z. Fan	2022	prospective cohort	China	NA	279	51 (19-81)	NA	hepatocellular carcinoma
P. Fang	2022	retrospective cohort	China	1	373	NA	68 (18.2)	esophageal cancer
P. Fang	2024	retropective cohort	China	1	314	NA	62 (19.7)	esophageal squamous cell carcinoma
J. Feng	2013	retrospective cohort	China	1	375	59.1±7.8	49 (13.1)	esophageal cancer
J. Feng	2022	retrospective cohort	China	NA	216	63.2±6.6; **(47-75)	13 (6)	esophageal cancer
J. Feng	2024	retropective cohort	China	1	224	NA	17 (7.6)	esophageal squamous cell carcinoma
M. Findlay	2020	retrospective audit	Australia	1	37	64 (41-82)	6 (16.2)	esophageal cancer
A. V. G. Fruchtenicht	2018	prospective cohort	Brazil	1	41	59±12	20 (48.8)	gastrointestinal cancer
K. Fu	2017	prospective cohort	China	1	310	56.3 (41-71)	123 (39.7)	colorectal cancer
L. Fu	2024	cross sectional	China	1	418	NA	124 (29.7)	gastric cancer

Y. Fugane	2025	retropective cohort	China	1	332	NA	104 (31.3)	biliary and pancreatic cancer
H. Fujii	2020	retrospective cohort	Japan	1	44	NA	21 (47.7)	gastric cancer
A. Fujio	2022	retrospective cohort	Japan	1	61	NA	10 (16.4)	hepatocellular carcinoma
Y. Fujiwara	2014	prospective cohort	Japan	1	21	NA	5 (23.8)	PDAC
Y. Fujiwara	2021	retrospective cohort	Japan	1	111	NA	18 (16.2)	esophageal cancer
Y. Fujiwara	2022	retropective cohort	Japan	1	118	66.16±8.08	18 (15.3)	esophageal squamous cell carcinoma
K. Fujiya	2018	prospective cohort	Japan	1	760	NA	239 (31.4)	gastric cancer
Y. Fukuda	2015	retrospective cohort	Japan	1	800	NA	237 (29.6)	gastric cancer
A. Fukuta	2019	prospective cohort	Japan	1	98	NA	63 (64.3)	gastrointestinal cancer
N. Funamizu	2025	retropective cohort	Japan	1	141	68 (43-84)	64 (45.4)	PDAC
N. Funamizu	2022	retropective cohort	Japan	1	139	NA	85 (61.2)	PDAC
H. Furuke	2021	retrospective cohort	Japan	1	795	68 (29-89)	262 (33)	gastric cancer
D. K. Gabrielson	2021	prospective cohort	Canada	1	41	58.5±11.3	18 (43.9)	gastrointestinal cancer
J. M. Gallardo-Valverde	2005	cross-sectional	Spain	1	43	¶ 67 **(46-84)	10 (23.3	colorectal cancer

J. Gao	2019	retrospective cohort	China	1	374	56.8±10.8	75 (20.1)	gastric cancer
A. K. Garth	2010	retrospective cohort	Australia	1	95	66.3±13; **(18-NA)	33 (34.7)	gastrointestinal cancer
C. Gavazzi	2011	prospective cohort	Italy	NA	100	64±13.5	40 (40)	gastric cancer
K. Ge	2021	retrospective cohort	China	1	420	66 (43-86)	112 (26.7)	esophageal junction cancer
Y. Geng	2015	retrospective cohort	China	1	211	NA	77 (36.5)	PDAC
C. Gillis	2021	cross-sectional	Canada	1	266	71±11	112 (42.1)	colorectal cancer
L. A. Gilmore	2022	retrospective cohort	USA	1	879	66.4±12	384 (43.7)	gastrointestinal cancer
B. K. P. Goh	2016	retrospective cohort	Singapore	1	166	66 (21-85)	24 (14.5)	hepatocellular carcinoma
M. J. Goh	2022	retrospective cohort	South Korea	1	116	60 (52-67)	18 (15.5)	hepatocellular carcinoma
M. B. Gómez Sánchez	2010	prospective randomized controlled trial	Spain	1	82	NA	48 (58.5)	gastrointestinal cancer
C. Gong	2022	retrospective cohort	China	1	324	NA	107 (33)	gastric cancer
C. Grinstead	2025	retropective cohort	USA	1	314	70.5±NA; §71**(30-98)	140 (44.6)	PDAC
X. W. Guo	2018	retrospective cohort	China	1	277	62 (40-82)	62 (22.4)	esophageal cancer
Z. Q. Guo	2020	cross-sectional	China	several tertiary public	2322	¶ 62 **(18-90)	694 (29.9)	gastric cancer

				hospitals in China				
H. Guo	2025	retropective cohort	China	1	395	68 (63-74)	208 (52.7)	gastric cancer
M.C. Gül	2025	retropective cohort	Turkey	1	301	NA	87 (28.9)	gastric cancer
R. Hamura	2022	retrospective cohort	Japan	1	124	§70 ††(61-74)	30 (24.2)	biliary tract cancer
J. Han	2021	cross-sectional	China	1	1627	NA	558 (34.3)	gastrointestinal cancer
L. Han	2016	retrospective cohort	China	1	206	60 (32-84)	41 (19.9)	esophageal squamous cell carcinoma
Y. Han	2023	retropective cohort	China	2	650	NA	173 (26.6)	gastric cancer
R. Haneda	2022	retrospective cohort	Japan	1	158	67 (40-82)	18 (11.4)	esophageal squamous cell carcinoma
N. Harimoto	2017	retrospective cohort	Japan	1	357	NA	87 (24.4)	hepatocellular carcinoma
N. Harimoto	2018	retrospective cohort	Japan	13	2461	NA	676 (27.5)	hepatocellular carcinoma
N. Harimoto	2023	retropective cohort	Japan	1	174	NA	31 (17.8)	hepatocellular carcinoma
I. Hashimoto	2024	retropective cohort	Japan	1	203	NA	37 (18.2)	esophageal squamous cell carcinoma
T. Hatada	2000	prospective cohort	Japan	1	100	NA	38 (38)	colorectal cancer

T. Hatanaka	2019	retrospective cohort	Japan	1	178	NA	35 (19.7)	hepatocellular carcinoma
H. Hauner	2020	cross-sectional	Germany	17	192	NA	100 (52.1)	gastrointestinal cancer
T. Hayama	2022	retrospective cohort	Japan	1	259	74.2 (65-93)	115 (44.4)	colorectal cancer
T. Hayama	2020	retrospective cohort	Japan	1	301	67.74 (22-93)	121 (40.2)	colorectal cancer
H. Hayashi	2023	retrospective cohort	Japan	1	303	NA	82 (27.1)	hepatocellular carcinoma
Y. He	2023	retropective cohort	China	1	365	§73	80 (21.9)	esophageal cancer
Y. He	2023	retropective cohort	China	1	148	**(28-78)	60 (40.5)	distal cholangiocarcinoma
A. E. Hendifar	2018	retrospective cohort	USA	1	977	NA	472 (48.3)	PDAC
A. Hiraoka	2023	retropective cohort	Japan	1	525	74 (68-80)	105 (20)	hepatocellular carcinoma
N. Hirahara	2018	retrospective cohort	Japan	1	148	NA	16 (10.8)	esophageal squamous cell carcinoma
N. Hirahara	2018	retrospective cohort	Japan	1	169	NA	19 (11.2)	esophageal squamous cell carcinoma
N. Hirahara	2019	retrospective cohort	Japan	1	210	NA	64 (30.5)	gastric cancer
N. Hirahara	2020	retrospective cohort	Japan	1	297	NA	92 (31	gastric adenocarcinoma

N. Hirahara	2020	retrospective cohort	Japan	1	191	NA	22 (11.5)	esophageal squamous cell carcinoma
K. Hiramatsu	2021	retrospective cohort	Japan	1	821	65 (27-98)	360 (43.8)	colorectal cancer
Ch.-T. Ho	2024	retropective cohort	Taiwan	1	446	65 (58-74)	173 (38.8)	hepatocellular carcinoma
T. H. Hoc	2021	cross-sectional	Vietnam	1	76	56.7±13.2; **(27-79)	23 (30.3)	esophageal, gastric cancer
Z. Hu	2020	retropective cohort	China	1	361	NA	142 (39.3)	colorectal cancer
S. P. Hu	2020	retrospective cohort	China	1	282	58.7±13.5	117 (41.5)	PDAC
Y. Hu	2023	retropective cohort	China	1	282		39 (13.8)	hepatocellular carcinoma
X. H. Hua	2022	prospective cohort	China	1	219	§66 ††(60-70)	73 (33.3)	esophageal squamous cell carcinoma
D. Huang	2021	prospective cohort	China	1	597	72 (65-NA)	134 (22.5)	gastric cancer
D. D. Huang	2022	prospective cohort	China	1	1359	§ 66	359 (26.4)	gastric cancer
D. D. Huang	2021	prospective cohort	China	1	587	§65	155 (26.4)	gastric cancer
P. Y. Huang	2019	retrospective cohort	Taiwan	1	891	58.54±11.6	197 (22.1)	hepatocellular carcinoma
S. Huang	2021	cross-sectional	China	1	60	NA	32 (53.3)	hepatocellular carcinoma
T. H. Huang	2019	retrospective cohort	Taiwan	1	287	§63 ††(56-70)	72 (25.1)	hepatocellular carcinoma

Y. Huang	2019	prospective cohort	China	1	357	73.29±5.24	82 (23)	gastric cancer
W.Huang	2024	retropective cohort	China	1	312	54.1±12.8	113 (36.2)	gastric cancer
Y. Huang	2025	cross sectional	China	1	431	§68**(62-72)	122 (28.3)	gastric cancer
S. Ide	2021	retrospective cohort	Japan	1	93	63 (32-83)	25 (26.9)	rectal cancer
T. Igarashi	2024	retropective cohort	Japan	1	114	NA	43 (37.7)	biliary tract cancer
T. Iguchi	2020	retropective cohort	Japan	1	80	63.6±NA; **(30-86)	36 (45)	colorectal cancer
T. Ikeya	2015	retrospective cohort	Japan	1	80	63 (36-80)	36 (45)	colorectal cancer
S. Ikuta	2023	retropective cohort	Japan	1	213	§72**(39-88)	95 (44.6)	biliary tract cancer
Y. Imaoka	2023	retropective cohort	Japan	multicenter (381 hospital)	1494	NA	332 (22.2)	hepatocellular carcinoma
Y. Iseki	2015	retrospective cohort	Japan	1	204	NA	92 (45.1)	colorectal cancer
M. Ishizuka	2014	retrospective cohort	Japan	1	154	NA	36 (23.4)	gastric cancer
S. Itoh	2021	retropective cohort	Japan	multicenter	589	71 (63-77)	263 (44.7)	PDAC
C. H. Jeon	2020	retrospective cohort	Republic of Korea	1	1307	NA	445 (34)	gastric cancer
H. Jeong	2021	retrospective cohort	Korea	1	130	NA	19 (14.6)	hepatocellular carcinoma
F. Ji	2017	prospective cohort	China	1	322	¶ 51 **(21-79)	36 (11.2)	hepatocellular carcinoma

P.Jia	2024	prospective cohort	China	multicenter	2177	66 (58-73)	789 (36.1)	gastric, colorectal
N. Jiang	2014	retrospective cohort	China	1	386	60 (20-80)	127 (33)	gastric cancer
Y. Jiang	2014	retrospective cohort	China	1	126	NA	65 (51.6)	gastric cancer
C. Jian-Hui	2016	retrospective cohort	China	1	1321	57.5 (18-91)	544 (41.2)	colorectal cancer
H. Jin	2021	retrospective cohort	China	1	272	61 (32-80)	71 (26.1)	gastric adenocarcinoma
J. Jin	2021	retrospective cohort	China	1	511	§58 ††(49-66)	213 (41.7)	ampulla of Vater cancer
Y. Jing	2024	retropective cohort	China	1	490	58.9±NA	134 (27.3)	gastric cancer
N. Johns	2014	cross-sectional	UK	1	41	65±2	11 (26.8)	gastrointestinal cancer
T. Kamada	2023	retrospective cohort	Japan	1	306	71.5 (39-96)	114 (37.3)	colorectal cancer
M. Kanda	2016	retrospective cohort	Japan	1	260	66 (20-96)	68 (26.2)	gastric cancer
G. Kaner	2018	cross-sectional	Turkey	1	119	NA	50 (42)	gastrointestinal cancer
J. Kang	2022	retrospective cohort	China	1	1332	62 (34-90)	244 (18.3)	esophageal cancer
H. Kanno	2021	retrospective cohort	Japan	1	528	NA	93 (17.6)	hepatocellular carcinoma
T. Kapagan	2025	prospective cohort	Finland	1	150	NA	59 (39.3)	colorectal cancer
M. Kataoka	2021	retropective cohort	Japan	1	904	NA	368 (40.7)	colorectal cancer

Y. Kato	2018	retrospective cohort	Japan	1	344	64.8±9.9	137 (39.8)	PDAC
S. Kawahara	2024	retropective cohort	Japan	1	123	NA	58 (47.2)	PDAC
A. Ş. Kaya	2020	cross-sectional	Turkey	1	110	54±8.5	76 (41.8)	gastrointestinal cancer
E. Kazlow	2025	cross sectional	Israel	1	136	66.4±11.7	53 (39)	pancreatic head adenocarcinoma
M. Ke	2016	retrospective cohort	China	1	372	51.74±10.87	74 (19.9)	hepatocellular carcinoma
M. Keskinkilic	2024	cross sectional	Turkey	1	253	61**(27.1-88.6)	97 (38.3)	colorectal cancer
Y.Kim	2024	cross sectional	Republic of Korea	1	162	64.7±8.5	32 (19.8)	hepatocellular carcinoma
Y-J.Kim	2025	retropective cohort	Republic of Korea	1	718	NA	429 (59.7)	Pancreatic, periampullary
E. Kim	2018	prospective cohort	South Korea	1	355	61.8±11.2	145 (40.8)	periampullary neoplasms
E. Kim	2019	prospective cohort	South Korea	1	154	71±4.5	74 (48.1)	periampullary neoplasms
J. R. Kim	2017	conference abstract	Korea	1	117	62.8±NA	NA	PDAC
A. Kinoshita	2022	retrospective cohort	Japan	1	61	NA	8 (13.1)	hepatocellular carcinoma
R. Konaka	2025	retropective cohort	Japan	1	58	NA	22 (37.9)	biliary tract cancer
X. Kong	2025	cross sectional	China	1	160	NA	43 (26.9)	esophageal cancer
M. Korkmaz	2023	prospective cohort	Turkey	1	168	NA	55 (32.7)	gastric cancer

T. Kosuga	2019	retropective cohort	Japan	1	167	67.7±11.6; §69**(29-87)	56 (33.5)	gastric cancer
K. Kouzu	2020	cross-sectional	Japan	1	128	73.2±5.5	15 (11.7)	esophageal cancer
N. Kubo	2017	retrospective cohort	Japan	1	202	63.73±7.93	40 (19.8)	esophageal squamous cell carcinoma
N. Kubo	2018	cross-sectional	Japan	1	240	63.4±7.8; **(66-113)	44 (18.3)	esophageal cancer
D. Kuroda	2018	retrospective cohort	Japan	1	416	¶ 67.2 **(25-94)	149 (35.8)	gastric cancer
N. Kurtul	2017	retrospective cohort	Turkey	1	65	63 (28-81)	22 (33.8)	rectal cancer
A. E. J. Latenstein	2020	prospective cohort	Netherlands	18	94	§70 ††(62-74)	22 (44.7)	PDAC
S. H. Lee	2016	retrospective cohort	Korea	1	499	62.1±10.2	210 (42.1)	PDAC
J. Y. Lee	2016	retrospective cohort	Korea	1	7781	57.1±11.9	2631 (33.8)	gastric adenocarcinoma
S. Y. Lee	2018	retrospective cohort	South Korea	1	1063	NA	357 (33.6)	colon cancer
S. Y. Lee	2019	conference abstract	NA	NA	404	NA	NA	colon cancer
S. Y. Lee	2020	retrospective cohort	South Korea	1	404	NA	188 (46.5)	colon cancer
S. Lee	2023	retropective cohort	Korea	1	131	70.1±10.7	38 (29.0)	rectal cancer
G. Li	2023	prospective cohort	China	1	415	60.83±10.42	47 (11.32)	gastric cancer
H. Li	2024	retropective cohort	China	1	278	§60**(34-80)	33 (11.9)	esophageal cancer

J. Li	2024	retropective cohort	China	1	360	60.54±9.82	90 (25)	hepatocellular carcinoma
J. Li	2023	retropective cohort	China	1	100	NA	30 (30)	hepatocellular carcinoma
J. Li	2023	retropective cohort	China	2	511	NA	154 (30.1)	colorectal cancer
K. Li	2024	retropective cohort	China	1	470	NA	191 (40.6)	colorectal cancer
X.-X. Li	2024	retropective cohort	China	2	228	NA	42 (18.4)	hepatocellular carcinoma
Y. Li	2025	retropective cohort	China	1	2553	NA	1003 (39.3)	colorectal cancer
L. Li	2018	retrospective cohort	China	1	1334	§50 ††(41-60)	198 (14.8)	hepatocellular carcinoma
S. Li	2021	retrospective cohort	China	1	285	59 (31-80)	53 (18.6)	hepatocellular carcinoma
X. Liang	2021	prospective cohort	China	1	868	50.53±12.04; **(12-81)	141 (16.2)	hepatocellular carcinoma
C. K. Liao	2021	retrospective cohort	Taiwan	1	1206	80.45±4.42	573 (47.5)	colorectal cancer
W.-Ch. Liao	2020	prospective cohort	Taiwan	1	176	NA	74 (42.0)	PDAC
Z. X. Lin	2020	retrospective cohort	China	1	380	50 (19-80)	47 (12.4)	hepatocellular carcinoma
Shuxiang Lin	2025	retropective cohort	China	1	491	NA	108 (22)	gastric cancer
Bao Liu	2024	retropective cohort	China	1	146	58.05±9.84	44 (30.1)	gastric cancer
Jianwei Liu	2025	retropective cohort	China	1	234	62.0 (54-68)	85 (35.5)	hepatocellular carcinoma

Jiang Liu	2022	retropective cohort	China	1	158	§67**(52-87)	57 (36.1)	esophageal squamous cell carcinoma
Jiawei Liu	2024	retropective cohort	China	1	1281	§57**(25-88)	533 (41.6)	gastric cancer
Li-Xiang Liu	2024	retropective cohort	China	2	217	58.4±12.7	92 (42.4)	colorectal cancer
Yali Liu	2023	prospective cohort	China	1	182	NA	38 (20.9)	esophageal squamous cell carcinoma
J. Y. Liu	2021	retrospective cohort	China	1	191	56 (26-79)	63 (33)	gastric adenocarcinoma
X. Liu	2018	retrospective cohort	China	1	697	57 (21-86); ††(41-89)	240 (34.4)	gastric cancer
Li LiYa	2024	cross sectional	China	1	80	62.1±7.56	16 (20)	esophageal cancer
K. W. Loh	2012	cross-sectional	Netherlands	1	104	64.7±10.8	41 (39.4)	gastrointestinal cancer
V. Lohsiriwat	2014	prospective cohort	Thailand	1	149	NA	73 (49)	colorectal cancer
S. Lu	2023	retrospective cohort	China	1	172	67 (63-73)	59 (34.3)	rectal cancer
Y. Lu	2019	cross-sectional	China	1	182	NA	87 (47.8)	colorectal cancer
Z. Luo	2019	retrospective cohort	China	multicenter	230	54±12.3	47 (20.4)	gastric adenocarcinoma
Xi Luo	2024	retropective cohort	China	1	301	NA	90 (30)	gastric cancer
Hui Ma	2024	retropective cohort	China	1	246	65.5±7.4	65 (26.4)	esophageal cancer
Huaixing Ma	2025	retropective cohort	China	1	140	NA	38 (27.1)	gastrointestinal

X. Ma	2025	retropective cohort	China	1	404	68 (63-74)	110 (27.2)	gastric cancer
Xinghao Ma	2024	retropective cohort	China	1	404	68 (63-74)	110 (27.2)	gastric cancer
K. Maeda	2014	retrospective cohort	Japan	1	100	60.4±10.6; **(39-87)	45 (45)	colorectal cancer
Y. S. Mao	2020	retrospective cohort	China	1	144	NA	75 (52.1)	PDAC
C. Martínez-Escribano	2022	cross-sectional	Spain	1	325	NA	150 (46.2)	colorectal cancer
T. Matsuda	2021	retropective cohort	Japan	17	316	71 (63-76)	129 (40.8)	Intrahepatic cholangiocarcinoma
R. Matsui	2022	retrospective cohort	Japan	1	512	67.93±11.1	NA	gastric cancer
R. Matsui	2022	retrospective cohort	Japan	1	512	NA	NA	gastric cancer
R. Matsui	2023	retrospective cohort	Japan	1	281	65.03±10.17	87 (31)	gastric cancer
R. Matsui	2023	retrospective cohort	Japan	1	457	67.88±11	156 (34.1)	gastric cancer
Y. Matsumoto	2018	retrospective cohort	Japan	1	191	66 (39-82)	33 (17.3)	esophageal cancer
T. Matsunaga	2022	retrospective cohort	Japan	14	497	80.6±NA	164 (33)	gastric cancer
T. Matsunaga	2024	retropective cohort	Japan	10	105	NA	18 (17.1)	gastric cancer
T. Matsunaga	2024	retropective cohort	Japan	1	102	65.9±12.2	31 (30.4)	gastric cancer

S. F. Maurício	2013	cross-sectional	Brazil	1	70	60.4±14.3	39 (55.7)	colorectal cancer
K. Migita	2013	retrospective cohort	Japan	1	548	67 (24-89)	146 (26.6)	gastric cancer
K. Migita	2018	retrospective cohort	Japan	1	137	NA	21 (15.3)	esophageal squamous cell carcinoma
K. Migita	2018	retrospective cohort	Japan	1	167	67.6±11.3	43 (25.7)	gastric cancer
J. Miller	2020	cross-sectional	UK	1	16	NA	5 (31.3)	gastrointestinal cancer
K. Mimatsu	2017	retrospective cohort	Japan	1	33	NA	6 (18.2)	gastric cancer
M. Mito	2022	retrospective cohort	Japan	1	224	72 (31-90)	72 (32.1)	hepatobiliary cancer
H. Miyamoto	2024	retropective cohort	Japan	1	197	NA	66 (33.5)	gastric cancer
T. Miyazaki	2016	retrospective cohort	Japan	1	192	¶ 65.8 **(42-86)	19 (9.9)	esophageal cancer
Y. Mohri	2013	retrospective cohort	Japan	1	365	NA	142 (38.9)	colorectal cancer
A. Molfino	2021	case-control	Italy	1	31	71±12	15 (48.4)	gastrointestinal cancer
M. Momokita	2022	cross-sectional	Japan	1	217	70.7±10.4 §72	55 (25.3)	gastric cancer
T. Mracek	2011	cross-sectional	UK	1	25	NA	10 (40)	gastrointestinal cancer
F. Mülküt	2025	retropective cohort	Turkey	1	220	60.63±1056	59 (26.8)	gastric cancer

S. Nagata	2021	retrospective cohort	Japan	1	510	NA	124 (24.3)	hepatocellular carcinoma
S. Naghashi	2022	cross-sectional	Iran	1	299	67.39±12.04	91 (30.4)	gastric cancer
S. Nakagawa	2018	retrospective cohort	Japan	1	151	§70 ††(61-75)	72 (47.7)	PDAC
T. Nakagoe	2003	retrospective cohort	Japan	1	62	67 (29-90)	26 (41.9)	colorectal cancer
Y. Nakamura	2022	retrospective cohort	Japan	1	433	§72 ††(65-78)	172 (39.7)	colorectal cancer
Y. Nakamura	2023	retropective cohort	Japan	1	601	71 (64-78)	240 (40)	colorectal cancer
Y. Nakamura	2025	retropective cohort	Japan	1	105	74 (70-80)	51 (48.6)	colorectal cancer
M. Nakatani	2018	retrospective cohort	Japan	1	76	64.2±7.1	10 (13.2)	esophageal squamous cell carcinoma
K. Nakashima1	2022	retropective cohort	Japan	1	175	70 (38-92)	56 (32)	gastric cancer
A. Narasimhan	2018	cross-sectional	Canada	1	42	NA	23 (54.8)	PDAC
S. Negrichi	2020	cross-sectional	Algeria	1	90	NA	37 (41.1)	colorectal cancer
N. I. P. Neto	2018	cross-sectional	Brazil	1	16	NA	6 (37.5)	colorectal cancer
L. T. Ngoc Anh	2024	cross sectional	Vietnam	1	388	60 (51-66)	164 (42.3)	colorectal cancer
X. Nie	2025	retropective cohort	China	1	274	§83**(41-80)	42 (15.3)	eophageal squamous cell carcinoma
R. Nie	2016	retrospective cohort	China	1	660	NA	299 (45.3)	gastric adenocarcinoma

K. Nishibeppu	2024	retropective cohort	Japan	1	69	NA	33 (47.8)	gastric cancer
T. Nishiyama	2025	retropective cohort	Japan	1	291	NA	124 (42.6)	gastrointestinal
J. Nogueiro	2022	retrospective cohort	Portugal	1	203	66.09±12.45; **(54-78)	82 (40.4)	gastric cancer
I. Nonogaki	2023	retrospective cohort	Japan	1	464	62.2±8.2	70 (15.1)	esophageal squamous cell carcinoma
T. Nozoe	2010	retrospective cohort	Japan	1	219	NA (24-90)	93 (42.5)	colorectal cancer
R. Obaid	2025	cross sectional	Kuwait	1	65	NA	28 (43.1)	colorectal cancer
T. Nozoe	2010	cross-sectional	Japan	1	248	NA (27-89)	70 (28.2)	gastric adenocarcinoma
T. Ogata	2022	retrospective cohort	Japan	1	346	70.5 (29-103)	147 (42.5)	colorectal cancer
D. Ogawa	2023	retropective cohort	Japan	1	123	§70	82 (66.6)	Intrahepatic cholangiocarcinoma
C. A. Oh	2012	cross-sectional	South Korea	1	669	56.77±11.44	237 (35.4)	gastric adenocarcinoma
S. E. Oh	2022	cross-sectional	Korea	1	601	67 (30-91)	252 (42)	hepatobiliary cancer
H. Ohama	2025	retropective cohort	Japan	multicenter	484	73 (67-78)	100 (20.6)	hepatocellular carcinoma
T. Ohara	2025	retropective cohort	Japan	1	54	72 (45-96)	34 (63)	gastrointestinal
G. Okada	2021	retrospective randomized controlled trial	Japan	1	117	NA	29 (24.8)	esophageal cancer

A. Okamoto	2023	retropective cohort	Japan	1	145	65 (58-72)	36 (24.8)	colorectal cancer
K. Okadome	2020	retrospective cohort	Japan	1	337	65.9±9.2	37 (11)	esophageal cancer
Y. Okamura	2017	retrospective cohort	Japan	1	375	70 (30-87)	69 (18.4)	hepatocellular carcinoma
K. Okubo	2021	retrospective cohort	Japan	1	90	NA	27 (30)	gastric adenocarcinoma
S. Olaechea	2021	retrospective cohort	USA	1	126	63 (38-86)	26 (20.6)	gastrointestinal cancer
S. Olaechea	2023	retropective cohort	USA	1	882	61 (53-70)	334 (37.9)	colorectal, gastric, esophageal
Satoshi Omiya	2023	retropective cohort	Japan	1	293	70±NA	48 (16.4)	hepatocellular carcinoma
Shizune Onuma	2023	retropective cohort	Japan	1	483	NA	163 (33.7)	gastric cancer
S. Onishi	2020	retrospective cohort	Japan	1	207	68.9±5.4; **(60-81)	38 (18.4)	esophageal squamous cell carcinoma
Í.D. Onur	2024	retropective cohort	Turkey	1	68	NA	41 (60.3)	Gallbladder and cholangiocarcinoma
J. Ose	2019	prospective cohort	Germany	1	52	NA	16 (30.8)	colorectal cancer
Pırıltı Özcan	2024	retropective cohort	Turkey	2	270	61.45±12.27; §63**(23-90)	84 (31.1)	gastric cancer
E. Paillaud	2014	prospective cohort survey - cross sectional analysis	France	2	248	80.5±5.7	122 (49.2)	gastrointestinal cancer

P. Pan	2015	prospective cohort	China	1	154	NA (18-70)	27 (17.5)	esophageal cancer
Yuting Pan	2023	retropective cohort	China	1	268	§59**(18-86)	69 (25.7)	gastric cancer
J. H. Park	2021	retrospective cohort	Korea	1	1281	NA	487 (38)	gastric adenocarcinoma
J. S. Park	2019	retrospective cohort	Korea	1	412	NA	209 (50.7)	PDAC
S. H. Park	2019	retrospective cohort	Republic of Korea	1	1868	57.8±12.5	614 (32.9)	gastric cancer
P. S. Patil	2017	prospective cohort	India	1	600	NA	NA	gastric adenocarcinoma
P. S. Patil	2017	prospective cohort	India	1	600	NA	NA	gastric cancer
J. Peng	2017	retrospective cohort	China	1	274	55 (22-85)	118 (43.1)	colon cancer
W. Peng	2021	retrospective cohort	China	1	266	NA	44 (16.5)	hepatocellular carcinoma
E. Pérez-Cruz	2017	retrospective cohort	Mexico	1	57	57.8±14.5	26 (46)	gastrointestinal cancer
Jennifer B. Permuth	2024	prospective cohort	United States	1	309	NA	156 (50.5)	PDAC
Mara Persano	2023	retropective cohort	Italy	1	773	NA	151 (19.5)	hepatocellular carcinoma
G. Pian	2022	retrospective cohort	China	1	305	¶ 63 **(25-87)	122 (40)	colorectal cancer
M. Piciucchi	2013	retrospective cohort	Italy	NA	291	NA	NA	PDAC
M. Piciucchi	2013	retrospective cohort	Italy	NA	237	NA	NA	PDAC

M. Piciucchi	2013	retrospective cohort	Italy	NA	291	NA	NA	PDAC
Q. Qi	2021	cross-sectional	China	1	407	§ 65	83 (20.4)	esophageal cancer
Y. Qian	2021	retrospective cohort	China	1	309	63.4±0.6	81 (26.2)	gastric cancer
L. Qin	2021	cross-sectional	China	1	217	§60 ††(50-67)	93 (42.9)	gastric cancer
Y. Qin	2024	prospective cohort	China	1	656	61 (53-66)	261 (39.8)	colon cancer
M. Qiu	2015	prospective cohort	China	1	830	59±NA	282 (34)	gastric cancer
Z. Qu	2022	retropective cohort	China	1	215	59±10.49	37 (17.2)	hepatocellular carcinoma
H. Ræder	2018	cross-sectional	Norway	1	97	NA (50-80)	46 (47.4)	colorectal cancer
Wenzhen Ren	2023	retropective cohort	China	1	108	54.83±19.93; §55**(32-76)	42 (38.9)	gastric cancer
A. Riad	2023	retropective cohort	75 countries	multicenter (381 hospital)	5709	64.8±13.5	2432 (42.6)	colorectal, gastric
N. E. Rich	2022	retrospective cohort	US	1	604	§ 60.9	168 (27.8)	hepatocellular carcinoma
M. Rivelsrud	2021	prevalence survey	Norway	1	149	66.6±12.1	70 (47)	PDAC
Guo-Tian Ruan	2023	prospective cohort	China	1	905	59.3±11.5	377 (41.7)	colorectal cancer
S. Ryo	2018	retrospective cohort	Japan	9	626	NA	191 (30.5)	gastric cancer
T. Ryu	2022	retrospective cohort	Japan	1	341	70 (38-91)	134 (39.3)	hepatocellular carcinoma

M. Sachlova	2014	prospective cohort	Czech Republic	1	91	NA	42 (46.2)	gastric cancer
H. Saito	2017	retrospective cohort	Japan	1	453	NA	122 (26.9)	gastric adenocarcinoma
Y. Saito	2017	retrospective cohort	Japan	1	162	NA	43 (26.5)	hepatocellular carcinoma
Y. Saito	2021	retrospective cohort	Japan	1	162	NA	43 (26.5)	hepatocellular carcinoma
T. Sakamoto	2021	retrospective cohort	Japan	1	105	NA	46 (43.8)	PDAC
K. Sakanaka	2019	retrospective cohort	Japan	1	44	66 (55-84)	7 (15.9)	esophageal cancer
Katsuya Sakashita	2025	retropective cohort	Japan	1	236	NA	74 (31.4)	perihilar cholangiocarcinoma
K. Sakurai	2015	retrospective cohort	Japan	1	594	65.9±11	166 (27.9)	gastric cancer
K. Sakurai	2016	retrospective cohort	Japan	1	147	79±3.4	52 (35.4)	gastric cancer
C. A. Santos	2021	cross-sectional	Portugal	1	155	NA	NA	gastric cancer
I. Santos	2021	retrospective cohort	Portugal	1	41	69±11; **(40-87)	18 (43.9)	PDAC
M. Sasahara	2020	retrospective cohort	Japan	9	842	68.6±10.6	259 (30.8)	gastric cancer
M. Sasaki	2019	retrospective cohort	Japan	1	149	64 (26-87)	56 (37.6)	colorectal cancer
M. Sasaki	2020	retrospective cohort	Japan	1	313	73 (65-94)	112 (35.8)	colorectal cancer
R. Sato	2020	retrospective cohort	Japan	1	72	71±11.4; **(37-90)	31 (43.1)	colorectal cancer

R. Sato	2021	retrospective cohort	Japan	1	75	72.2±11.8; **(37-90)	23 (30.6)	colorectal cancer
Ryuichiro Sato	2022	retropective cohort	Japan	1	61	§75**(65-93)	26 (42.6)	colorectal cancer
K. Schütte	2015	cross-sectional	Germany	1	51	66.18±9.82	7 (13.7)	hepatocellular carcinoma
A. S. Senger	2022	retrospective cohort	Turkey	1	314	NA	89 (28.3)	colorectal cancer
M. G. Serna Thomé	2020	prospective cohort	Mexico	1	354	NA	NA	gastrointestinal cancer
Ningzhe Shen	2023	prospective cohort	China	1	385	73±11	154 (40)	colorectal cancer
M. Shibutani	2023	retropective cohort	Japan	1	529	§71**(21-100)	216 (40.8)	colorectal cancer
M. Shibutani	2015	retrospective cohort	Japan	1	32	69 (42-86)	12 (37.5)	colorectal cancer
H. Shim	2013	prospective cohort	Korea	1	435	58.5±11.9; ** (20-80)	192 (44.1)	gastrointestinal cancer
T. Shimagaki	2025	retrospective analyzed from propectively maintained database	Japan	1	128	70.3±0.9	48 (37.5)	biliary tract cancer
A. Shimizu	2024	retropective cohort	Japan	1	59	NA	19 (32.2)	colorectal cancer
Y. Shimizu	2022	retrospective cohort	Japan	1	91	70 (40-84)	43 (47.3)	ampulla of Vater cancer
Y. Si	2022	retrospective cohort	China	1	235	NA	45 (19.1)	hepatocellular carcinoma

J. H. Sim	2021	retropective cohort	Korea	1	1065	NA	209 (19.6)	hepatocellular carcinoma
E. Simoes	2025	case-control	Brazil	2	38	NA	18 (47.4)	colorectal cancer
J. D. P. Soares	2020	cross-sectional	Brazil	1	106	NA (29-83)	21 (19.8)	gastrointestinal cancer
B. Song	2009	cross-sectional	China	1	125	NA	42 (33.6)	gastric cancer
H. Song	2022	retrospective cohort	China	1	202	61 (28-83); ††(52-66)	70 (34.7)	gastric cancer
H. N. Song	2022	prospective cohort	China	1	918	§ 66	363 (39.5)	colorectal cancer
M. Sonoi	2025	retropective cohort	Japan	1	81	68.5±5.3	12 (14.8)	esophageal cancer
V. Soria-Utrilla	2024	retropective cohort	Spain	3	586	68.4±10.2	221 (37.7)	colorectal cancer
B. U. Souza	2018	cross-sectional	Brazil	1	197	60±11.4	85 (43)	colorectal cancer
N. C. Souza	2020	cross-sectional	Brazil	1	188	61±11.4	80 (42.6)	colorectal cancer
N. C. Souza	2021	cross-sectional	Brazil	1	190	60.5±11.3	81 (42.6)	colorectal cancer
N. A. Stephens	2015	prospective cohort	UK	1	92	65±10	26 (28.3)	gastrointestinal cancer
K. Sugawara	2020	retrospective cohort	Japan	1	309	NA	91 (29.4)	gastric cancer
K. Sugawara	2021	retrospective cohort	Japan	1	1166	NA	350 (30)	gastric cancer
F. Sun	2010	cross-sectional	China	1	223	NA	73 (32.7)	gastric cancer
F. Sun	2010	cross-sectional	China	1	190	NA	57 (30)	gastric cancer
F. Sun	2021	retrospective cohort	China	1	1479	60.4±17.3	396 (26.8)	gastric cancer

H. Sun	2022	retrospective cohort	China	1	146	§ 59	44 (30.1)	gastric cancer
J. Sun	2016	retrospective cohort	China	1	117	59 (34-78)	31 (26.5)	gastric cancer
K. Sun	2015	retrospective cohort	China	1	632	¶ 57 **(19-89)	219 (34.7)	gastric cancer
L. Sun	2021	retrospective cohort	China	1	371	61.5±10.4; **(23-88)	172 (46.4)	biliary tract cancer
Y. Sun	2014	cross-sectional	China	1	5118	60±11; **(23-80)	1453 (28.4)	gastrointestinal cancer
C. Sun	2024	retropective cohort	China	1	233	57 (14-78)	100 (42.9)	ampullary adenocarcinoma
D. Sun	2024	prospective cohort	China	1	770	NA	257 (33.4)	gastric cancer
S. Sun	2024	retropective cohort	China	1	49	57 (37–77)	7 (14.3)	hepatocellular carcinoma
Y. Sun	2025	cross-sectional	China	1	1894	63.77±7.86; **(38-87)	295 (15.6)	esophageal cancer
H. Suzuki	2021	retrospective cohort	Japan	1	99	66.2 (39-85)	38 (38.4)	PDAC
S. Suzuki	2019	retrospective cohort	Japan	1	211	NA	70 (33.2)	gastric cancer
J. Szefel	2020	prospective cohort	Poland	1	70	NA	36 (51.4)	colorectal cancer
K. Takagi	2017	retrospective cohort	Japan	1	295	65.8±10.4	54 (18.3)	hepatocellular carcinoma
T. Takahashi	2020	retrospective cohort	Japan	1	86	84±2.7	28 (32.6)	gastric cancer
T. Takahashi	2024	retropective cohort	Japan	1	80	¶83	26 (32.5)	gastric cancer

Y. Takamizawa	2020	retrospective cohort	Japan	1	996	61 (20-91)	423 (42.5)	colorectal cancer
K. Takao	2020	retrospective cohort	Japan	1	263	NA	46 (17.5)	esophageal squamous cell carcinoma
Y. Takano	2023	retropective cohort	Japan	2	396	**(23-93)	1164 (41.4)	colorectal cancer
H. Takechi	2020	retrospective cohort	Japan	1	182	70 (38-90)	52 (28.6)	gastric cancer
T. Takeda	2021	retrospective cohort	Japan	1	80	77 (75-87)	NA	PDAC
E. E. Talbert	2018	prospective cohort	USA	1	70	NA	37 (52.9)	PDAC
M. Tamai	2021	retrospective cohort	Japan	1	227	NA	26 (11.5)	colorectal cancer
Y. Tamai	2022	retrospective cohort	Japan	1	181	71.4±7.9	52 (28.7)	hepatocellular carcinoma
F. Tambaro	2024	prospective cohort	Italy	1	23	72.1±11.6	12 (52.2)	gastrointestinal
S. Tan	2024	cross-sectional	China	1	207	56.6±11.3	37 (17.9)	hepatocellular carcinoma
S. Tan	2022	prospective cohort	China	1	1115	62.6±10.8	370 (33.2)	gastrointestinal cancer
M. Tanabe	2025	retropective cohort	Japan	1	940	§69**(27-90)	325 (34.6)	gastric cancer
K. Tanaka	2021	cross-sectional	Japan	1	127	§71 ††(63-76)	59 (46.5)	colorectal cancer
H. Tanda	2025	retropective cohort	Japan	1	298	§71**(27-100)	121 (40.6)	colorectal cancer
A. Tanemura	2020	retropective cohort	Japan	1	189	§70**(41-85)	36 (19.0)	hepatocellular carcinoma

M. Tang	2025	retropective cohort	China	1	389	NA	157 (40.4)	rectal cancer
J. Tang	2021	retrospective cohort	USA	1	506	58.85±12.98; § 59	242 (47.8)	colorectal cancer
M. Tang	2021	prospective cohort	China	4	527	59.56±11.58	129 (24.5)	gastrointestinal cancer
Y. Tanji	2022	retropective cohort	Japan	1	118	§66**(60-75)	37 (31.6)	colorectal cancer
Z. Tao	2024	cross-sectional	China	1	98	62±13	36 (36.7)	gastrointestinal
S. Tekin	2023	retropective cohort	Turkey	1	124	58.16±11.04	41 (33.1)	gastric cancer
F. Teraishi	2025	prospective cohort	Japan	1	24	89 (86-91)	14 (58.3)	colorectal cancer
F. Teraishi	2024	prospective cohort	Japan	1	71	78 (75-92)	37 (52.1)	colorectal cancer
F. Terasaki	2020	retrospective cohort	Japan	1	149	NA	34 (22.8)	distal cholangiocarcinoma
F. Terasaki	2021	retrospective cohort	Japan	1	307	NA	125 (40.7)	PDAC
I. Tirnova	2025	retropective cohort	Turkey	1	68	66.1±13.3	28 (41.2)	gastric cancer
S. Tohme	2017	editor letter	USA	1	176	NA	53 (30.1)	hepatocellular carcinoma
R. Tokunaga	2015	retrospective cohort	Japan	1	556	68 (19-93)	226 (40.6)	colorectal cancer
R. Tokunaga	2016	retrospective cohort	Japan	1	417	68 (19-93)	170 (40.8)	colorectal cancer
T. Tominaga	2019	retrospective cohort	Japan	1	250	NA	122 (48.8)	colorectal cancer

T. Tominaga	2020	retrospective cohort	Japan	1	896	65 (28-93)	492 (55)	colon cancer
A. Topçu	2022	retrospective cohort	Turkey	1	77	58.7±13.6	24 (31.2)	gastric cancer
T. Toyokawa	2016	retrospective cohort	Japan	1	185	§64 ††(59-70)	33 (17.8)	esophageal squamous cell carcinoma
I. Trestini	2020	retrospective cohort	Italy	1	73	65±11	32 (43.8)	PDAC
M. Tsunematsu	2021	retrospective cohort	Japan	1	111	NA	19 (17.1)	hepatocellular carcinoma
M. Tsukagoshi	2024	retropective cohort	Japan	1	203	NA	37 (18.2)	hepatocellular carcinoma
M. Y. Tu	2012	prospective cohort	China Taiwan	1	45	62±11.5	20 (44.4)	colorectal cancer
F. Tustumi	2024	retropective cohort	Brazil	1	529	62.8±NA; **(22-94)	214 (40.5)	gastric cancer
G. Ucar	2020	retrospective cohort	Turkey	1	308	57.5 (25-83)	114 (37)	colorectal cancer
S. Uemura	2022	retrospective cohort	Japan	1	110	66 (38-84)	40 (44)	PDAC
R. Umino	2022	retrospective cohort	Japan	1	1272	66 (28-89)	316 (24.8)	hepatocellular carcinoma
S. Unome	2025	retropective cohort	Japan	1	200	73 (66-79)	40 (20)	hepatocellular carcinoma
M. Urabe	2021	retrospective cohort	Japan	1	224	NA	41 (18.3)	esophageal cancer
G. van der Kroft	2018	prospective cohort	the Netherlands	1	63	69±10.5	23 (36)	colorectal cancer

A. van der Werf	2018	randomized controlled trial	the Netherlands	1	69	65±11	23 (33)	colorectal cancer
P. Vashi	2017	cross-sectional	US	1	84	54.5 (31-73) ¶ 53.4	36 (42.9)	gastrointestinal cancer
P. G. Vashi	2019	retrospective cohort	USA	1	112	53.3 (18-NA)	49 (43.8)	colorectal cancer
R. N. Velasco	2022	cross-sectional	Philippines	1	292	57±11.8	140 (47.9)	colorectal cancer
E. Vieira Maroun	2024	cross-sectional	Spain	1	35	62.8±8.8	9 (25.7)	esophageal, gastric cancer
Q. Wan	2022	retrospective cohort	China	1	379	60.42±11.06	145 (38.3)	colorectal cancer
C. Wang	2019	retrospective cohort	China	1	95	NA	7 (7.4)	esophageal cancer
P. Wang	2021	prospective cohort	China	1	189	65.1±7.2	59 (31.2)	esophageal cancer
P. Y. Wang	2021	cross-sectional	China	1	192	65.1±7.2	61 (31.8)	esophageal cancer
H. X. Wang	2018	retrospective cohort	China	1	274	61±3.2	82 (29.9)	gastric cancer
J. Wang	2018	prospective cohort	China	1	97	NA	14 (14.4)	esophageal cancer
J. Wang	2021	retrospective cohort	China	1	430	62.5±10.9	229 (53.3)	biliary tract cancer
J. Wang	2023	prospective cohort	China	1	1513	63±10.9	509 (33.6)	gastrointestinal cancer
L. Wang	2020	retrospective cohort	China	1	170	61.14±11.47	43 (25.4)	gastric cancer
W. J. Wang	2020	retrospective cohort	China	1	131	NA	54 (41.2)	colorectal cancer

X. Wang	2020	retrospective cohort	China	1	281	55.9±12.1	96 (34.2)	rectal cancer
X. Wang	2020	retrospective cohort	China	1	120	NA	50 (41.7)	colorectal cancer
X. B. Wang	2019	retrospective cohort	China	1	209	NA (18-75)	37 (17.7)	hepatocellular carcinoma
Y. Wang	2018	prospective cohort	China	1	264	NA	76 (28.8)	colorectal cancer
Y. Wang	2020	retrospective cohort	China	2	52	74 (70-83)	18 (34.6)	esophageal squamous cell carcinoma
L.-J. Wang	2025	retropective cohort	China	1	803	**(22-87)	260 (32.4)	gastric cancer
S. Wang	2025	retropective cohort	China	2	157	70.1±4.2	83 (52.9)	Intrahepatic cholangiocarcinoma
X. Wang	2023	retropective cohort	China	1	195	NA	60 (30.8)	gastric cancer
X. Wang	2024	retropective cohort	China	1	391	64.7±11.72	150 (38.4)	colorectal cancer
A. Wang	2021	retropective cohort	China	1	94	54.5±8.6	31 (33)	hilar cholangiocarcinoma
Y. Wang	2022	prospective cohort	China	2	1637	57.7±10.6; **(18-85)	705 (43.1)	colorectal cancer
H. Watanabe	2021	retrospective cohort	Japan	1	110	NA	31 (282)	gastrointestinal cancer
M. Watanabe	2012	retrospective cohort	Japan	1	99	NA (75-79)	23 (23.2)	gastric cancer
A. G. Wijma	2024	prospective cohort	The Netherlands	multicenter	30	NA	17 (56.6)	PDAC

M. Wobith	2022	cross-sectional	Germany	1	260	70.15 (37-92)	113 (43.5)	gastrointestinal cancer
J. H. Wolf	2020	retrospective cohort	US and Canada	700	9289	NA	3595 (38.7)	rectal cancer
G. Wong	2021	prospective cohort	US	1	333	NA	157 (47.1)	colorectal cancer
S. J. Wu	2016	retrospective cohort	China	1	450	¶ 49.63 **(17-81)	59 (13.1)	hepatocellular carcinoma
T. Wu	2022	prospective cohort	China	multicenter	3621	64.09±12.45	1439 (39,7)	colorectal cancer
Q. Wu	2025	retropective cohort	China	multicenter	350	69.6±NA	54 (15.4)	hepatocellular carcinoma
T. Wu	2024	retropective cohort	China	multicenter	4487	64.18±12.42	1799 (40.1)	colorectal cancer
X. Xi	2022	retrospective cohort	China	1	812	63.6±9.2	269 (33.1)	gastric cancer
L. J. Xia	2020	retrospective cohort	China	1	154	¶ 63.7 **(32-90)	64 (41.6)	rectal cancer
S. Xiang	2023	retropective cohort	China	1	236	45 (39-48)	93 (39.4)	colorectal cancer
A. T. Xiao	2020	retrospective cohort	China	1	202	52.6±10.8	76 (37.6)	gastric cancer
Y. Xiao	2022	retropective cohort	China	1	2352	NA	789 (33,5)	gastric cancer
F. K. Xiao	2021	retrospective cohort	China	1	4146	61±8.9	1523 (36.7)	esophageal squamous cell carcinoma
L. Xiao	2021	retrospective cohort	China	1	193	64 (34-86)	44 (22.8)	esophageal squamous cell carcinoma

Q. Xiao	2022	cross-sectional	China	1	106	67 (43-85); ¶ 64	22 (20.8)	gastric cancer
H. Xie	2020	retrospective cohort	China	1	512	58.48±13.22	188 (36.7)	colorectal cancer
H. Xie	2022	retrospective cohort	China	1	1014	57.33±13.34	375 (37)	colorectal cancer
H. Xie	2022	retrospective cohort	China	1	1014	57.33±13.34	375 (37)	colorectal cancer
Z. Xishan	2020	retrospective cohort	China	1	245	NA	66 (26.9)	gastric cancer
L. B. Xu	2022	retrospective cohort	China	1	895	NA	233 (26)	gastric cancer
L. B. Xu	2022	retrospective cohort	China	1	1188	§66 ††(58-73)	319 (26.9)	gastric cancer
S. Xu	2018	cross-sectional	China	1	258	NA (46-80)	76 (29.5)	esophageal cancer
X. Xu	2022	retrospective cohort	China	1	370	61 (40-81)	125 (33.8)	esophageal squamous cell carcinoma
Y. S. Xu	2021	retrospective cohort	China	1	413	NA	153 (37)	colon cancer
Z. Xu	2022	retrospective cohort	China	1	771	§ 58.2	165 (21.4)	gastric mucosal adenocarcinoma
S. Xu	2023	retropective cohort	China	1	263	43.63±4.62; **(33-72)	65 (24.7)	Gastroesophageal Junction Adenocarcinoma
Y. Xu	2024	retropective cohort	China	1	146	NA	44 (30.1)	gastric cancer
T. Yagyu	2022	retrospective cohort	Japan	11	348	NA	187 (53.7)	colorectal cancer

M. Yamamoto	2019	retrospective cohort	Japan	1	522	NA	231 (44.3)	colorectal cancer
M. Yamamoto	2025	retropective cohort	Japan	1	1635	§67**(25-93)	520 (31.8)	gastric cancer
I. Yamana	2015	retrospective cohort	Japan	1	122	63.9±9.1; **(43-83)	21 (17.2)	esophageal cancer
R. Yamanaka-Kohno	2021	retrospective case-control	Japan	1	73	65 (60-71.5)	5 (6.8)	esophageal cancer
K. Yan	2022	retrospective cohort	China	1	192	73 (65-88)	81 (42.2)	esophageal squamous cell carcinoma
X. Yan	2024	prospective cohort	China	1	983	NA	358 (36.4)	colorectal cancer
Ch.-K. Yang	2024	retropective cohort	China	1	1666	NA	247 (14.8)	hepatocellular carcinoma
J.-Y- Yang	2024	retropective cohort	China	1	121	69.07±5.51	77 (63.6)	gastrointestinal
Y. Yang	2024	prospective cohort	China	1	100	NA	49 (49)	gastric cancer
Y. Yang	2020	retrospective cohort	China	1	403	NA	74 (18.4)	hepatocellular carcinoma
S. Yasui-Yamada	2020	retrospective cohort	Japan	1	501	§70 ††(63-76)	185 (36.9)	gastrointestinal cancer
X. J. Ye	2018	cross-sectional	China	2	255	76.5±4.8	95 (37.3)	gastrointestinal cancer
I. Yildirim	2021	retrospective cohort	Turkey	1	219	66.6±11.7	80 (36.5)	PDAC
T.N. Yildiz Kopur	2024	prospective cohort	Turkey	1	121	62.3±12.08	45 (37.2)	colorectal cancer

L. Yin	2021	prospective cohort	China	1	360	64.08±7.74	69 (19.2)	esophageal cancer
Y. J. Yoo	2020	retrospective cohort	South Korea	1	118	61.1±10.2	54 (45.8)	ampulla of Vater cancer
N. Yoshida	2017	retropective cohort	Japan	1	373	NA	41 (11)	esophageal cancer
K. Yoshimatsu	2017	retrospective cohort	Japan	1	351	68 (29-92)	145 (41.3)	colorectal cancer
Y. Yu	2022	retropective cohort	China	1	1068	NA	299 (28)	esophageal cancer
J. H. Yun	2024	retropective cohort	Republic of Korea	1	116	59.35±10.98	28 (24.1)	gastric cancer
J. Zhang	2024	cross-sectional	China	1	226	60.16±10.47; **(34-87)	35 (15.5)	hepatocellular carcinoma
L. Zhang	2023	prospective cohort	China	1	955	NA	310 (32.5)	rectal cancer
X. Zhang	2025	prospective cohort	China	multicenter	3158	67 (58-74)	980 (31.0)	gastric cancer
Y. Zhang	2023	retropective cohort	China	2	54	§70.5**(39-87)	12 (22.2)	gastric cancer
C. Zhang	2016	retrospective cohort	China	1	173	NA	66 (38.2)	hepatobiliary cancer
C. Zhang	2021	cross-sectional	China	1	249	70.29±3.92; **(60-79)	135 (54.2)	gastric cancer
D. Zhang	2007	prospective cohort	China	1	214	NA	87 (40.7)	gastric cancer
D. Zhang	2008	prospective cohort	China	1	126	NA	53 (42.1)	PDAC
F. M. Zhang	2021	prospective cohort	China	1	1056	NA	278 (26.3)	gastric adenocarcinoma

H. Zhang	2018	retrospective cohort	China	1	655	61 (27-88)	118 (1)	esophageal squamous cell carcinoma
Q. Zhang	2022	cross-sectional	China	1	265	70 (66-74)	7 (27.2)	gastrointestinal cancer
X. Zhang	2020	retrospective cohort	China	1	274	62.2 (27-83)	92 (33.6)	gastric cancer
X. Zhang	2021	retrospective cohort	China	1	454	§ 71	109 (24)	gastric cancer
Y. Zhang	2020	prospective cohort	China	1	273	69 (26-87)	82 (30)	gastric cancer
Y. X. Zhang	2022	retrospective cohort	The United States	more than 1000	12785	NA	5979 (46.8)	PDAC
X. Zhao	2022	retrospective cohort	China	1	783	70 (65-86); ††(67-74)	199 (25.4)	gastric cancer
Y. Zhao	2018	retrospective cohort	China	1	243	56 (25-82)	92 (37.9)	colorectal cancer
Y. Zhao	2022	retrospective cohort	China	1	354	67 (41-90)	148 (41.8)	esophageal squamous cell carcinoma
X.-H. Zhao	2023	retropective cohort	China	1	48	§65	16 (33.3)	esophageal squamous cell carcinoma
X.-N. Zhao	2024	prospective collected, retrospectively analyzed	China	1	783	§70**(65-86)	199 (25.4)	gastric cancer
H.-I. Zheng	2023	prospective collected, retrospectively analyzed	China	1	1121	NA	267 (23.8)	gastric cancer

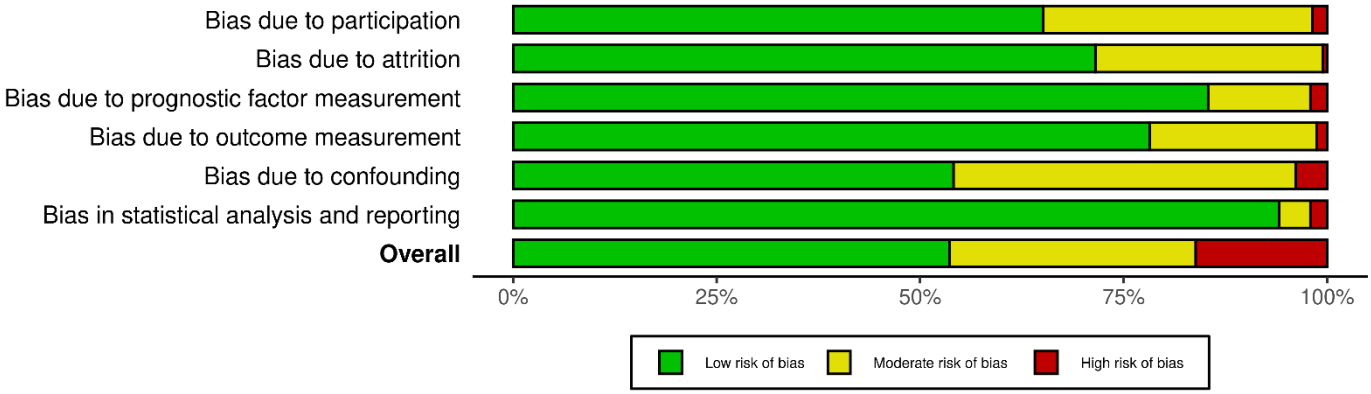
J. Zheng	2025	cross-sectional	China	multicenter (25 hospitals)	1406	59 (51-65)	398 (28.3)	gastric cancer
J. Zheng	2020	retrospective cohort	China	1	154	71 (67-74)	37 (24)	hepatocellular carcinoma
Z. Zheng	2022	retrospective cohort	China	1	165	62.67±7.95; **(44-85)	34 (20.6)	esophageal squamous cell carcinoma
Z. F. Zheng	2018	retrospective cohort	China	1	532	61.1±11.5	129 (24.2)	gastric cancer
C. J. Zhou	2020	retrospective cohort	China	1	381	65±16	147 (38.6)	rectal cancer
J. Zhou	2022	retrospective cohort	China	1	69	NA	22 (31.9)	colorectal cancer
L. P. Zhou	2021	prospective cohort	China	1	768	NA	269 (35)	gastrointestinal cancer
H. Zhou	2020	retropective cohort	China	1	400	NA	157 (39.3)	colorectal cancer
X. Zhou	2017	retrospective cohort	China	1	187	61 (38-78)	72 (38.5)	esophageal squamous cell carcinoma
C. Zhu	2020	retrospective cohort	China	1	243	NA	9 (20.2)	gastric cancer
X. Zhu	2021	retrospective cohort	China	1	245	NA	66 (26.9)	gastric cancer
Y. Zhu	2021	retrospective cohort	China	1	196	NA	78 (39.8)	colorectal cancer
X. Zhu	2025	retropective cohort	China	1	212	66 (57-74)	82 (38.7)	colorectal cancer

C. L. Zhuang	2022	prospective cohort	China	1	1215	§ 65	329 (27.1)	gastric adenocarcinoma
Y. Zou	2025	retropective cohort	China	1	578	60 (52-64)	217 (37.5)	gastric cancer
W. Zou	2024	retropective cohort	China	1	77	§62**(41-79)	15 (19.5)	esophageal squamous cell carcinoma
J. Zuo	2024	cross-sectional	China	1	302	68 (62-73)	89 (29.5)	gastric cancer
J. Zuo	2024	cross-sectional	China	1	311	66.1±8.9	90 (29)	gastric cancer
J. Zuo	2024	cross-sectional	China	1	316	68 (62-72,25)	92 (29.1)	gastric cancer
J. Zuo	2023	prospective cohort	China	1	248	68 (61-72)	71 (28.6)	gastric cancer

PDAC= Pancreatic ductal adenocarcinoma; NA= not available; §= median; ¶= mean; **=range; ††=interquartile range

Data reported as mean with standard deviation or median with interquartile range, unless otherwise specified.

Supplementary Table S3.: Summary plot of the risk of bias assessment



McGuinness, LA, Higgins, JPT. Risk-of-bias VISualization (robvis): An R package and Shiny web app for visualizing risk-of-bias assessments. Res Syn Meth. 2020; 1- 7. https://doi.org/10.1002/jrsm.1411

The risk of bias for study participation, attrition, prognostic factor measurement, outcome measurement, study confounding, and statistical analysis reporting was low.