Improvements of Net Cancer Survival in Taiwan
A study based on cancer registry, cause of death and health insurance database

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Cancer Surveillance

- The core functions of cancer surveillance are the measurement of cancer incidence, prevalence, survival, and mortality for persons with cancer.

- Cancer surveillance tells us where we are in the effort to reduce the cancer burden and also generates the observations that form the basis for cancer research and interventions for cancer prevention and control. (Futures Report, 2001, NCI, NCHS, CDC, ACS, NAACCR)

Socioeconomic inequalities

- In high-income countries, advances in early diagnosis and treatment have improved net cancer survival.

- But socioeconomic inequalities have persisted or even increased for some adult cancers.

- Reducing socioeconomic inequalities in net survival might be an effective way to improve net survival.

Net survival

- Net cancer survival is the probability of surviving the cancer under study in the absence of other causes of death.

- Estimates of net survival for a cancer provide useful measures for comparing cancer survival between diagnostic periods, ethnic groups, and registries.

- Two frameworks: Cause-specific survival and relative survival

Cause-specific survival

- Cause-specific survival is the survival when death due to the cancer under study is the event and death due to other causes is a censored data.

- Accuracy of the cause of death is a concern when considering a population based study. Cause of Death database from government is often used.

Relative survival

- Relative survival (RS) is the ratio of observed all cause survival rates to the all cause survival of a comparable group of cancer-free individuals.
- The latter is usually based on life table.
- RS has been in use since around 1960.

Net survival

- RS is problematic when SES is considered, because the life table is not SES specific.

- Over-estimated for SES high and under-estimated for SES low group.

- SEER cause-specific death classification variable uses death certificate, the sequence of tumor occurrence, the site of original cancer diagnosis, and comorbidities. (Howlader et al. 2010)

SEER (Surveillance, Epidemiology and End Results Program)

- Provides information on cancer statistics to reduce cancer burden in the US population.
- Cancer Registry: patient, tumor, stage, treatment, outcomes
- National Center of Health Statistics: Cause of Death Database
- Census Bureau: population data for rates
- CMMS: comorbidity

Materials

- The Taiwan Cancer Registry (TCR, 2000-2010), the Taiwan Cause of Death Database (TCOD, 2000-2011), the National Health Insurance Research Database (NHIRD, 2000-2012).

- Survival information from mainly TCR and TCOD, also use NHIRD.

- SES were decided by insurable income from NHIRD at the month or year of diagnosis. Three levels: NT$ 15,840, minimum wage; and 57,779, the highest category of insurable income. Year 2000.

- Life table was from Human Mortality Database website.

Net survival

- RS estimates were based on Ederer II, which were close to PPE in our data.

- CSS estimates were based on actuarial method.

- Comparison of RS estimates and CSS estimates in Taiwan. We have better confidence when they agree.

Results

- Number of cancer of all sites patients aged 15-94 between 2000-2010 was **724,992**. Among them, **724,770** had survival information; among them, **723,810** had SES information. **93%** of them had SES from the same month or year.

- The most common cancers: Liver (105,385), colon and rectum (95,968), lung (86,766), breast (71,352), oral cavity and pharynx (65,624). The sixth most common cancer was stomach cancer (36,302).

RS and CSS are in good agreement, especially in comparison with those in the US.

Table. Five-year relative survival (RS) and 5-year cause-specific survival (CSS) for selected cancer sites and age groups 50–64 y, 1992–2004

| Cancer site | Howlader et al. 2010 | | | Taiwan | | |
	5-y RS, % (95% CI)	5-y CSS, % (95% CI)	Dif.,† %	5-y RS, % (95% CI)	5-y CSS, % (95% CI)	Dif.,† %
Breast	91.0 (90.8 to 91.2)	90.4 (90.2 to 90.6)	0.6	78.9 (78.2,79.6)	78.0 (77.4,78.6)	0.9
Colon and rectum	68.2 (67.7 to 68.7)	69.0 (68.6 to 69.5)	-0.8	61.1 (60.4,61.8)	60.1 (59.4,60.8)	1.0
Liver and intrahepatic bile duct	11.5 (10.6 to 12.4)	14.5 (13.5 to 15.6)	-3.0†	19.4 (18.9,19.8)	19.9 (19.4,20.3)	-0.5
Lung and bronchus	17.4 (17.0 to 17.7)	19.2 (18.9 to 19.6)	-1.8	13.2 (12.7,13.7)	13.6 (13.1,14.2)	-0.4
Oral cavity and pharynx	59.4 (58.5 to 60.3)	65.0 (64.2 to 65.9)	-5.6†	52.3 (51.5,53.1)	53.2 (52.4,53.9)	-0.8

† The difference between RS and CSS within the same time period is greater than 3% and there is no overlap between their confidence intervals.

5-year RS—CSS for the 5 most common cancers in Taiwan for 2000-2010

	RS%(95%CI)	CSS%(95%CI)	RS-CSS
Lung and Bronchus			
High SES	20.87 (19.42,22.36)	20.37 (19.0,21.8)	0.5
Medium SES	12.91 (12.57,13.26)	12.94 (12.61,13.3)	-0.03
Low SES	11.32 (10.81,11.83)	11.16 (10.69,11.6)	0.16
Oral Cavity and Pharynx			
High SES	74.39 (72.43,76.26)	73.39 (71.58,75.1)	1
Medium SES	59.5 (58.99,60.01)	60.46 (59.97,60.9)	-0.96
Low SES	48.63 (47.67,49.59)	50.31 (49.39,51.2)	-1.68
Breast			
High SES	90.9 (89.82,91.89)	89.69 (88.74,90.6)	1.21
Medium SES	85.89 (85.51,86.27)	85.23 (84.87,85.6)	0.66
Low SES	81.14 (80.26,81.99)	79.77 (78.97,80.5)	1.37
Liver and Intrahepatic Bile Duct			
High SES	34.78 (33.31,36.26)	33.56 (32.19,34.9)	1.22
Medium SES	23.7 (23.34,24.06)	23.69 (23.35,24)	0.01
Low SES	19.42 (18.78,20.06)	19.37 (18.76,20)	0.05
Colon and Rectum			
High SES	67.56 (66.04,69.05)	63.19 (61.87,64.5)	4.37
Medium SES	61.27 (60.78,61.75)	58.68 (58.25,59.1)	2.59
Low SES	57.39 (56.53,58.25)	53.8 (53.08,54.5)	3.59

5-year cause-specific survival plotted against 5-year relative survival for the 20 most common cancers (and cancer of all sites, digestive system, and lymphoma) diagnosed in 2000-2004, stratified by age at diagnosis and socioeconomic status.
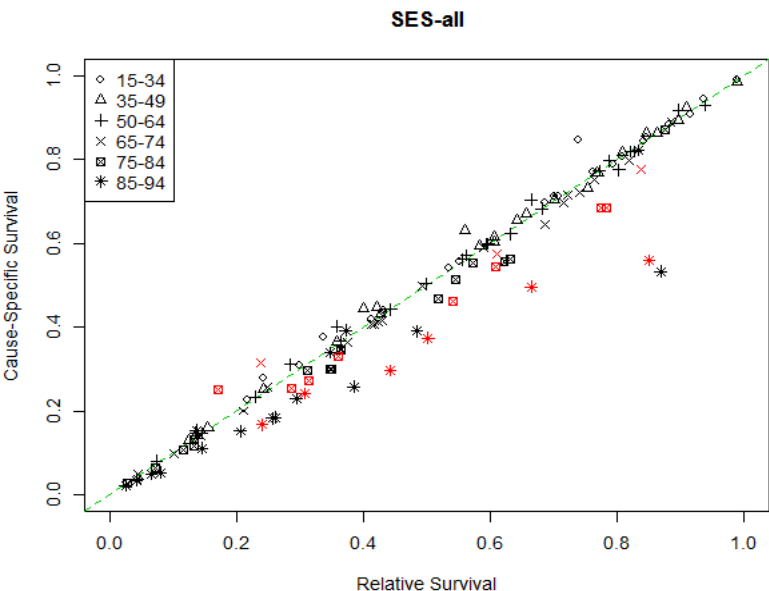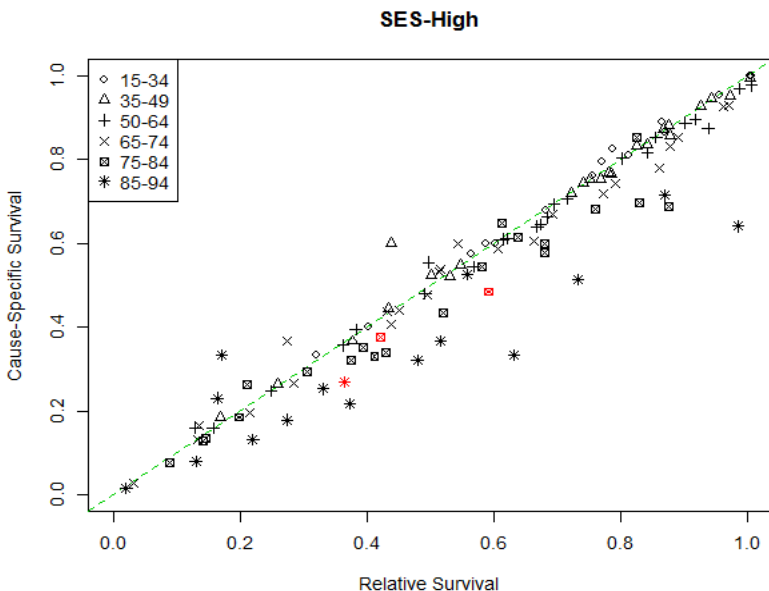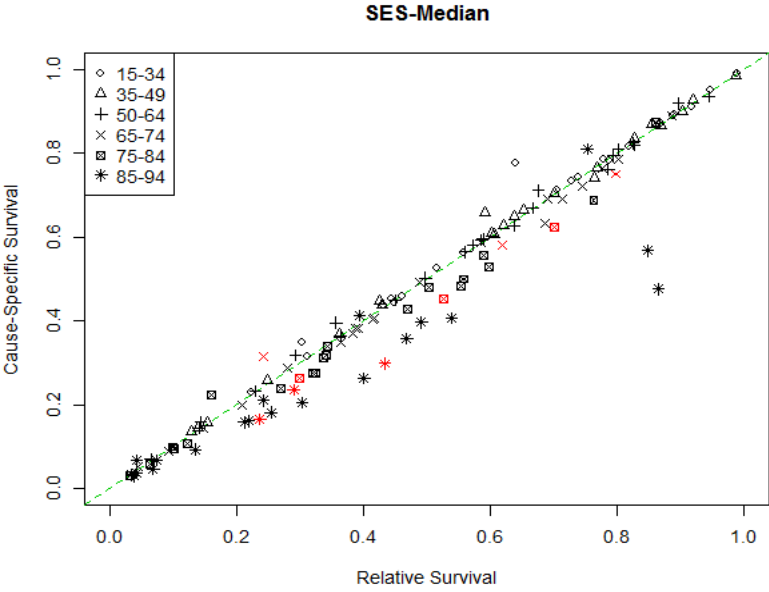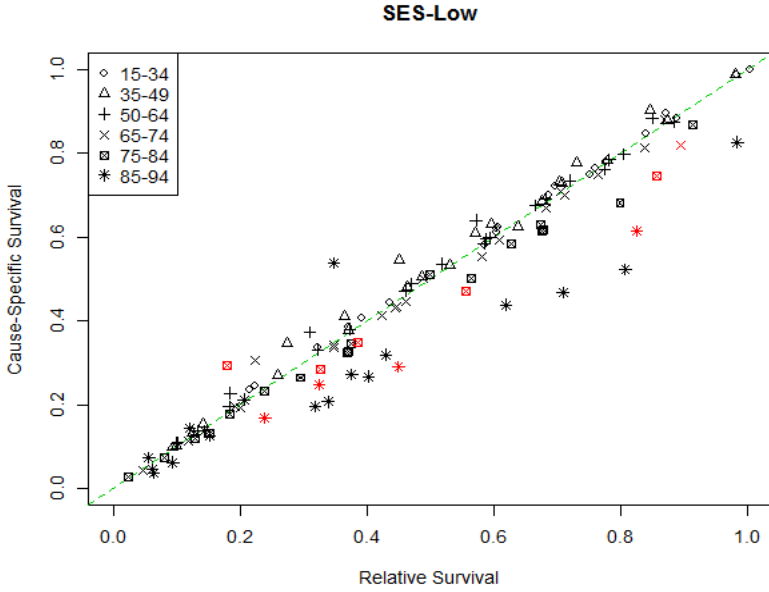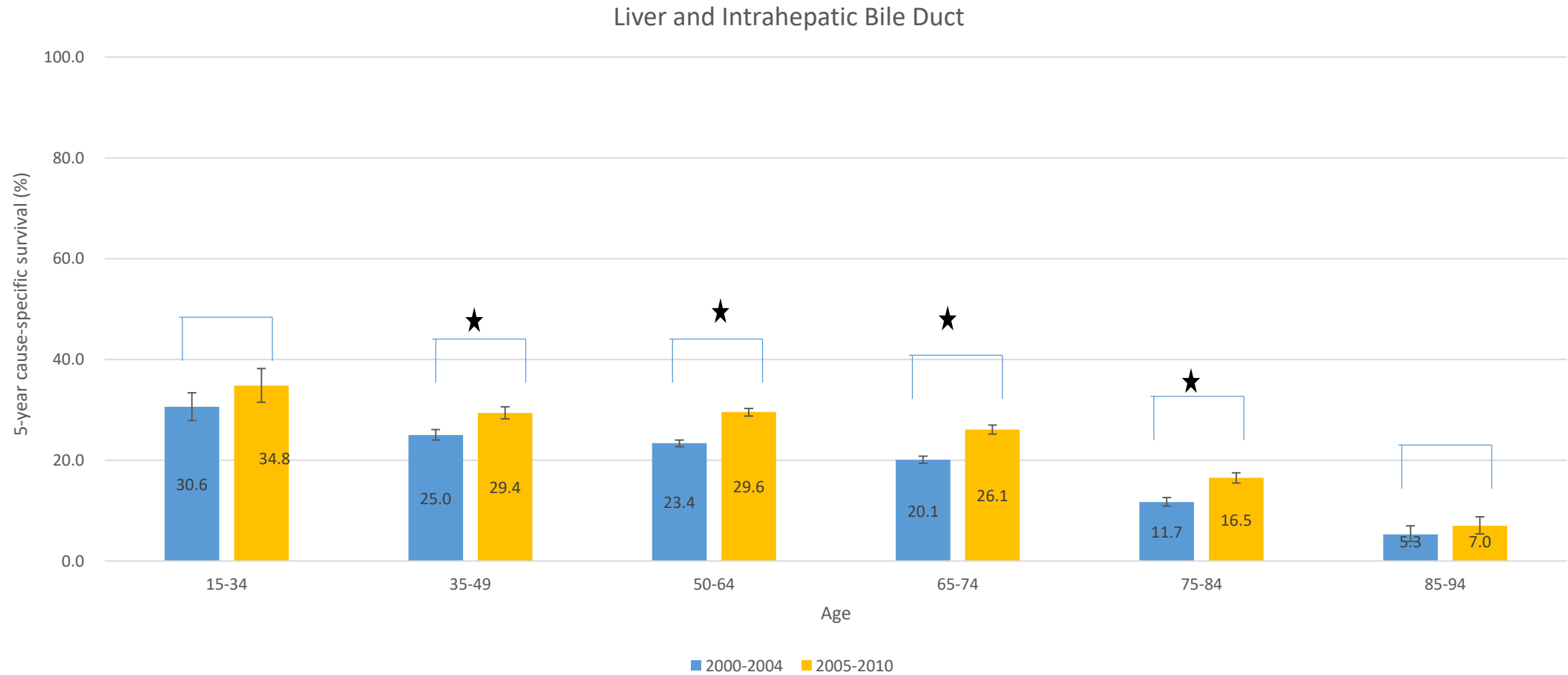
5-year cause-specific survival plotted against 5-year relative survival for the 20 most common cancers (and cancer of all sites, digestive system, and lymphoma) diagnosed in 2005-2010, stratified by age at diagnosis and socioeconomic status.
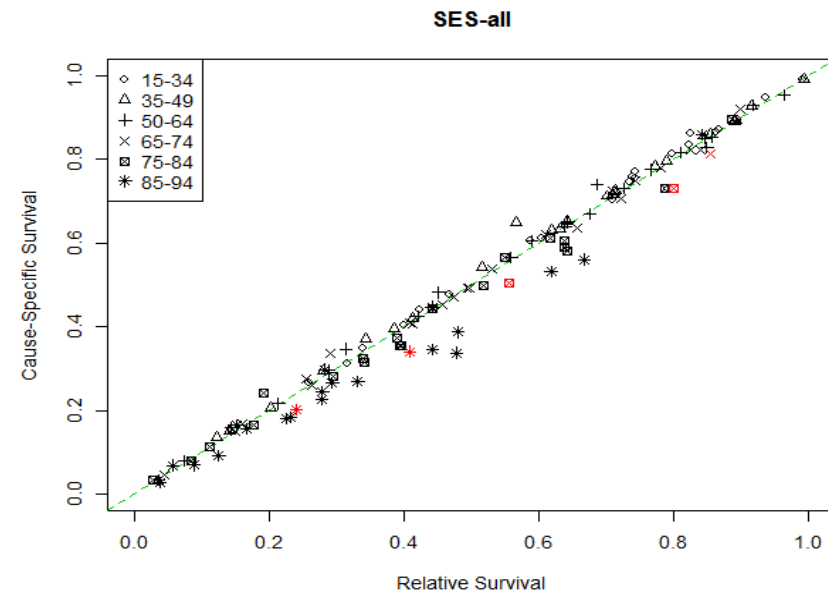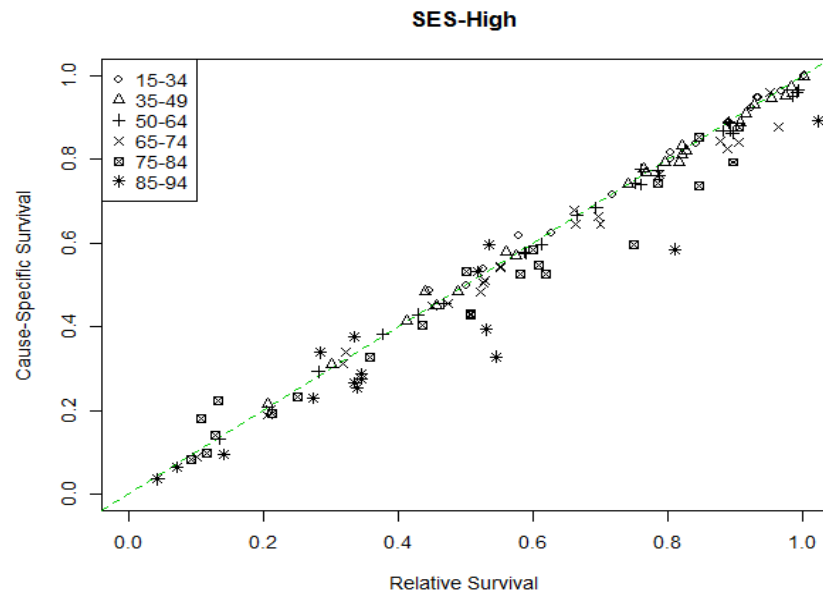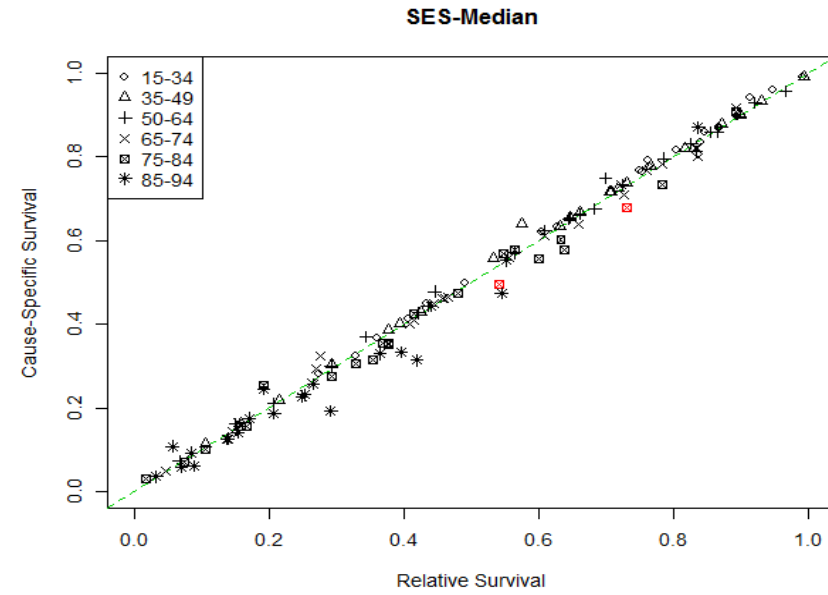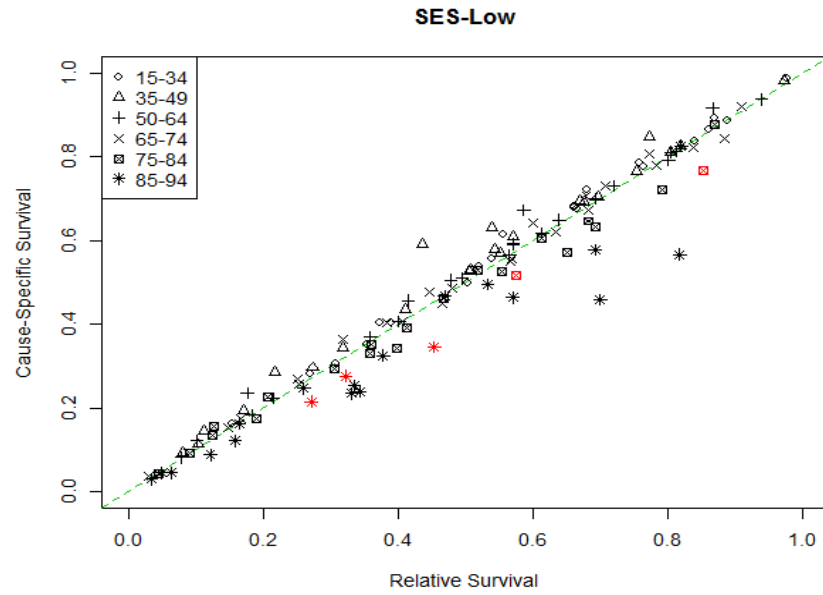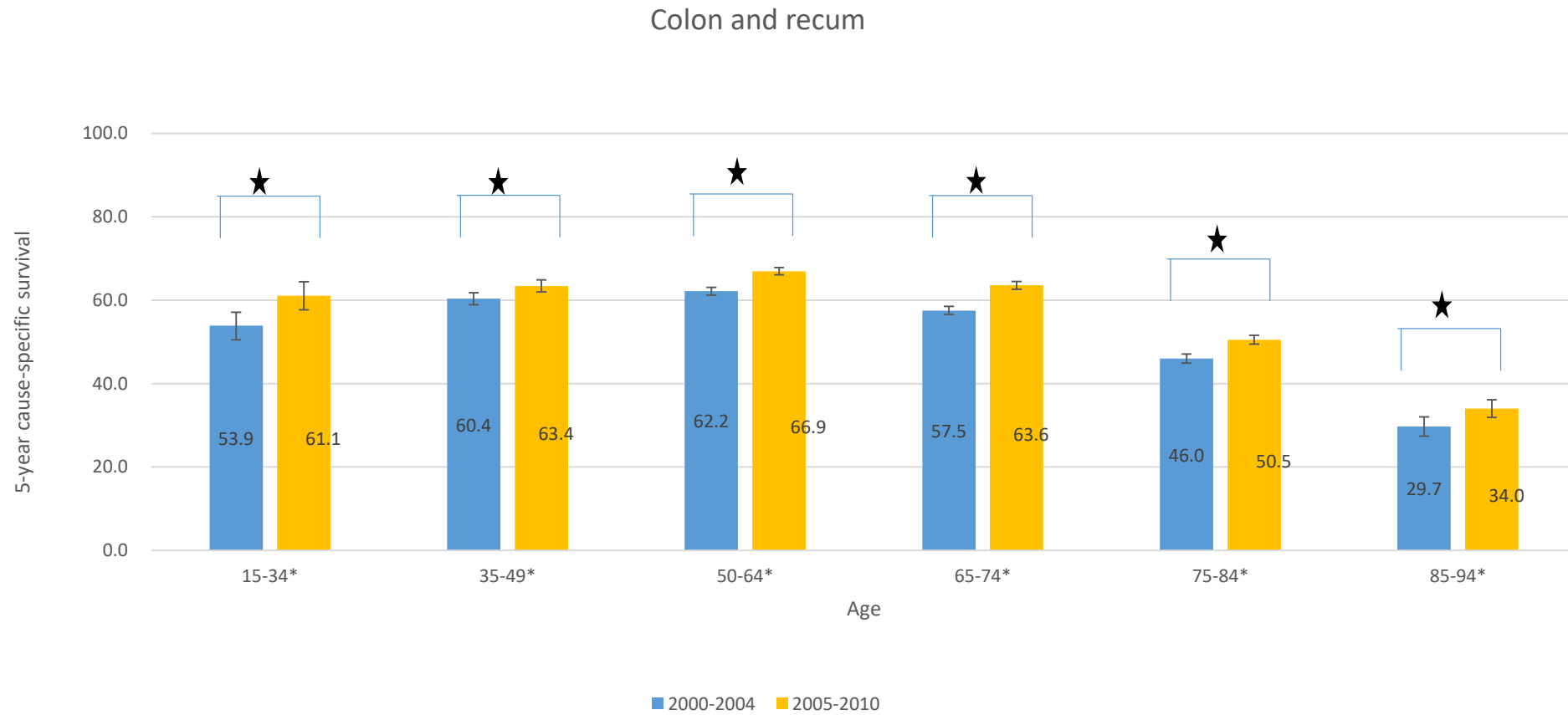
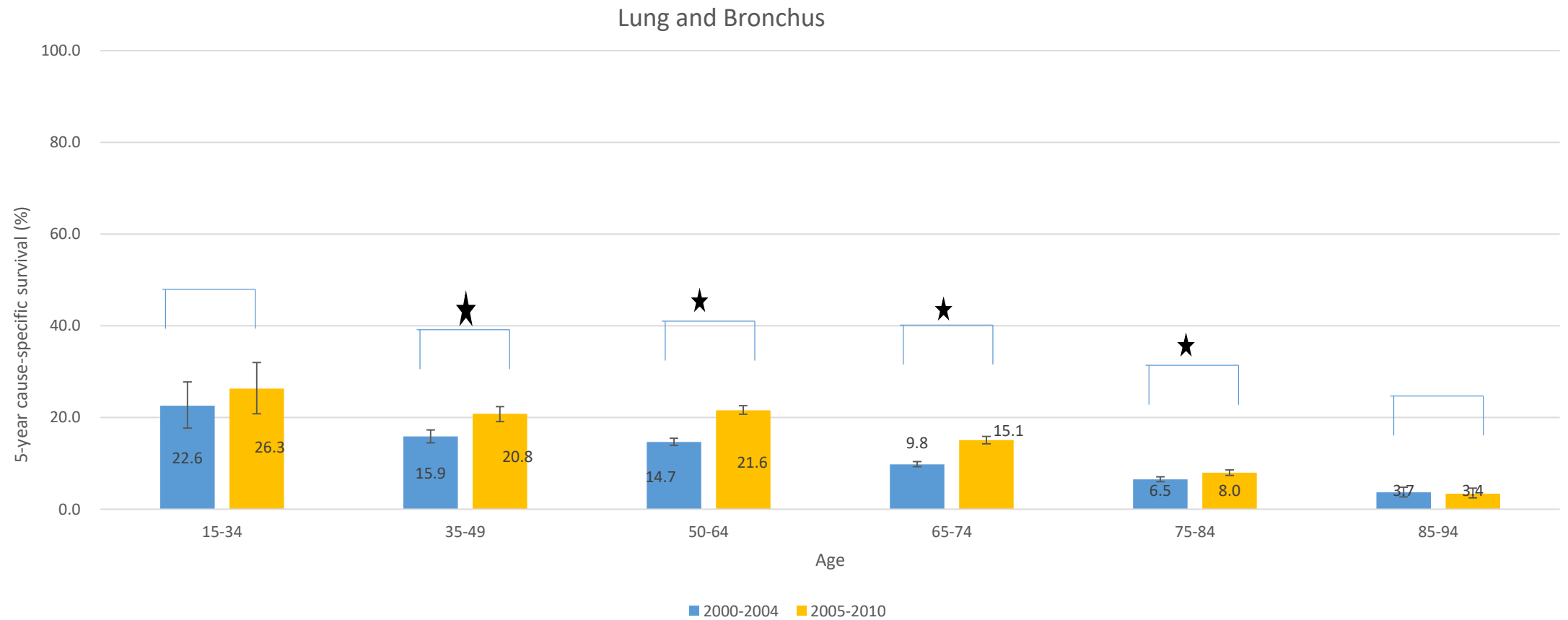# Net survival increases from 2000-2004 to 2005-2010
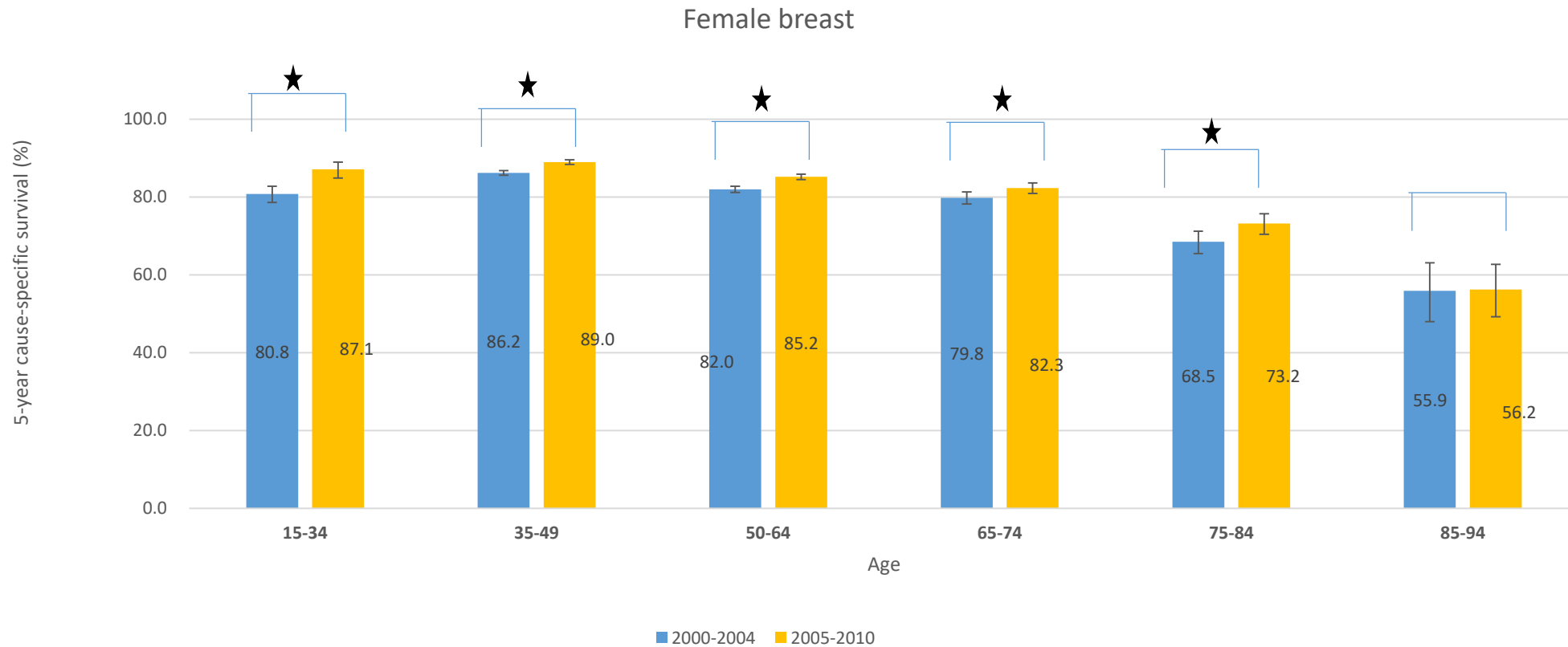
5-yr CSS-liver and intrahepatic bile duct

Liver and Intrahepatic Bile Duct

5-yr CSS-colon and rectum

Colon and recum

5-yr CSS-lung and bronchus

Lung and Bronchus

5-year cause-specific survival (%)

Age	15-34	35-49	50-64	65-74	75-84	85-94
2000-2004	22.6	15.9	14.7	9.8	6.5	3.7
2005-2010	26.3	20.8	21.6	15.1	8.0	3.4

■ 2000-2004   ■ 2005-2010

5-yr CSS-female breast

Female breast

5-yr CSS-oral cavity and pharynx

Oral Cavity and Pharynx

5-year cause-specific survival (%)

Age	2000-2004	2005-2010
15-34	71.1	75.5
35-49	59.4	63.0
50-64	57.2	60.6
65-74	49.9	53.8
75-84	34.6	44.3
85-94	22.9	30.0
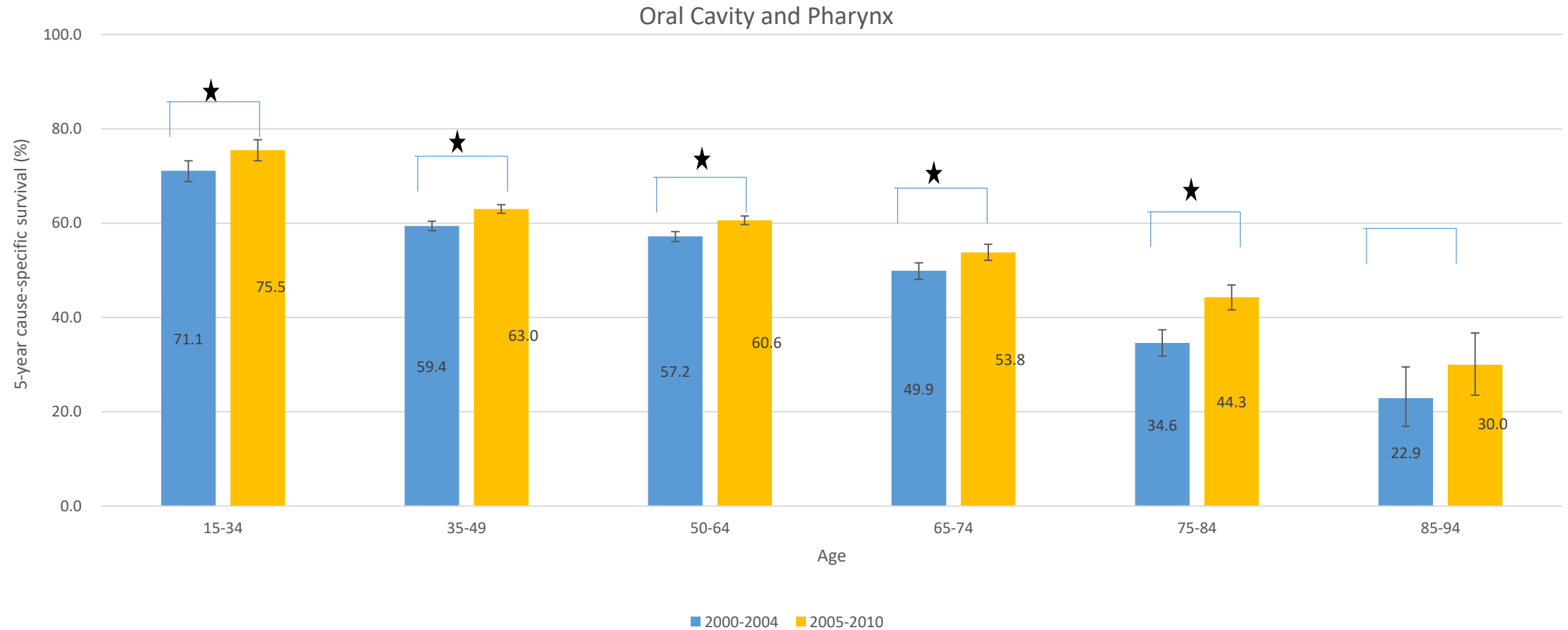
Socioeconomic inequalities for 13 of the most common 20 cancers

Socioeconomic inequalities in 5-yr survival

5-year cause-specific survival (%)

	Breast	Oral Cavity and Pharynx	Colon and Rectum	Liver and Intrahepatic Bile Duct*	Lung and Bronchus	Prostate
High	89.7	73.4	63.2	33.6	20.4	80.1
Medium	85.2	60.5	58.7	23.7	12.9	71.6
Low	79.8	50.3	53.8	19.4	11.2	76.6

■ High   ■ Medium   ■ Low
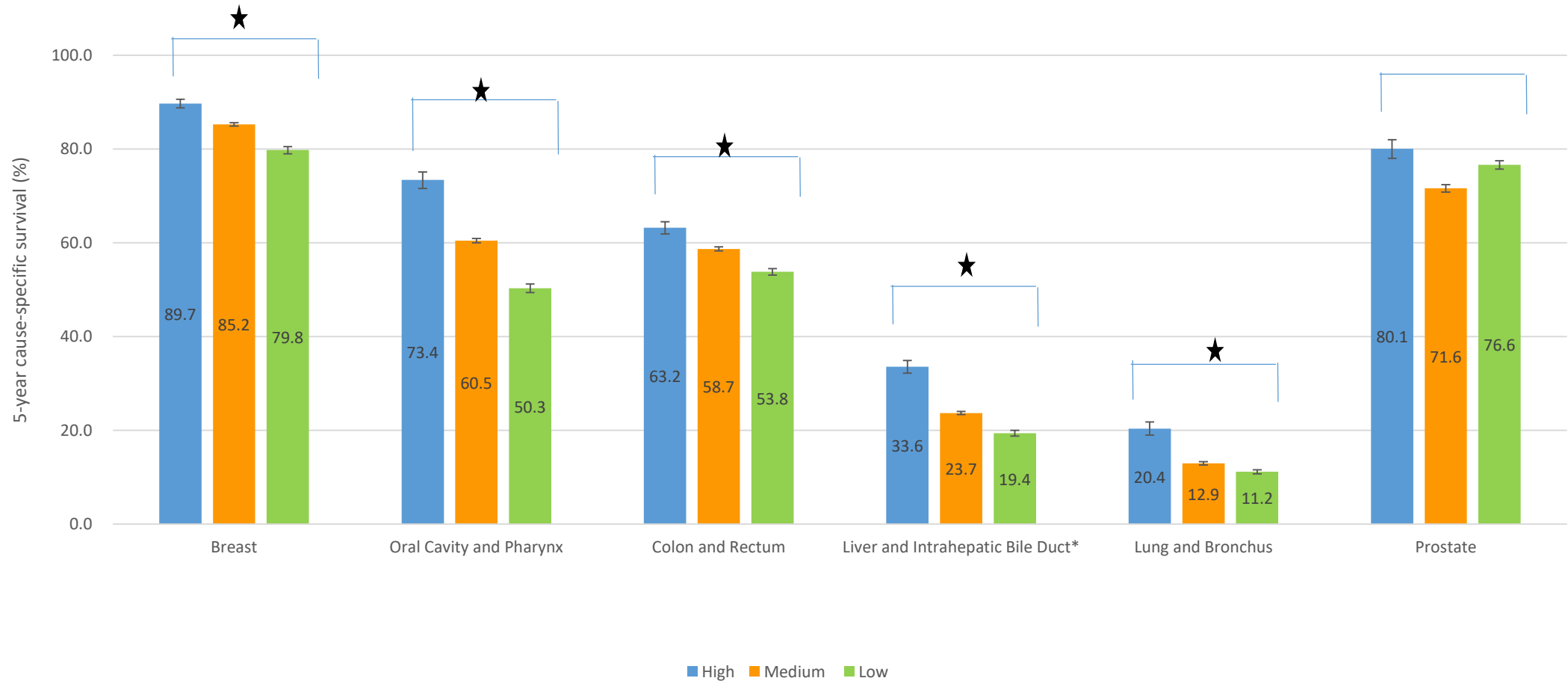
Socioeconomic inequalities in 1-yr survival
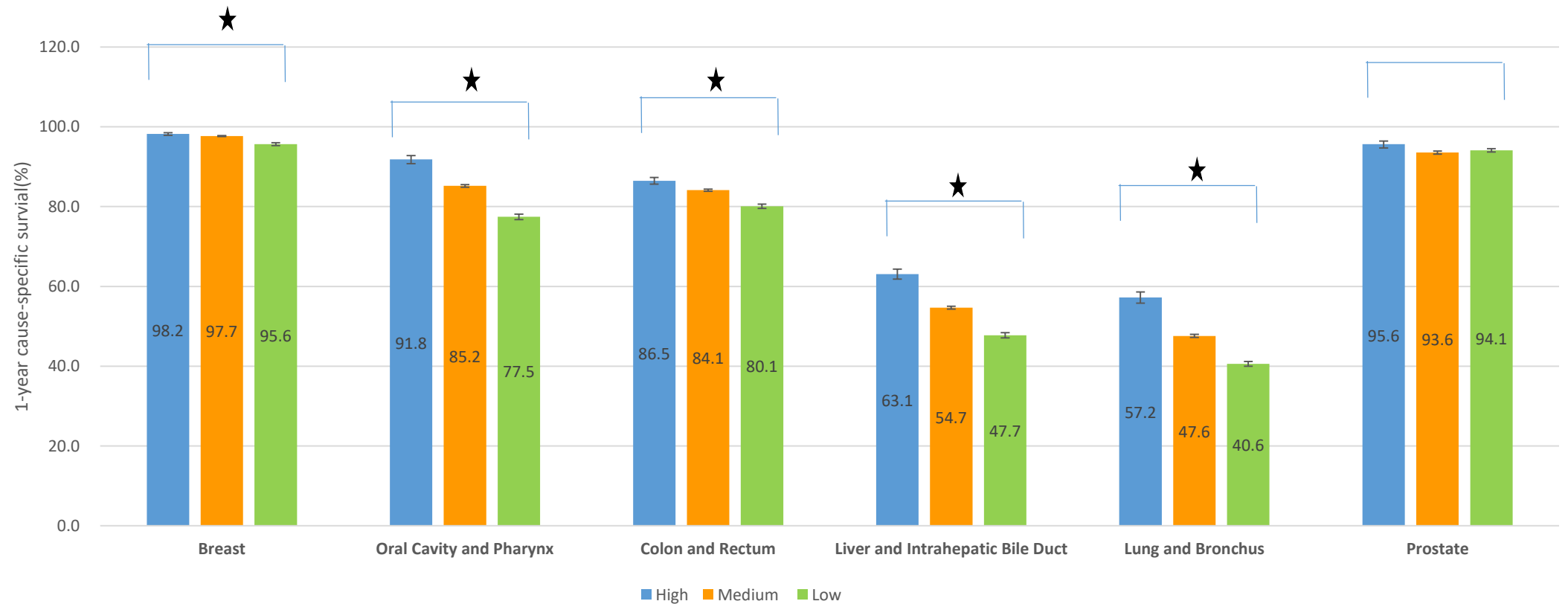
Discussion

- For each age-group and cancer site combination that showed large gap, conduct studies to decide the causes: tumor, personal, health care system and proposes intervention.

- Inequalities happened less often in older people: treatment, death cause, SES.

- Need SES group-specific life table to study RS.

When do changes in survival mean progress?

- Cho, et al. JNCI 2014
- Early detection and treatment advances
- Incidence and mortality rates
- Symptomatic, screened, incidental cancer
- Lead time bias; length bias and over-diagnosis

Lead time bias
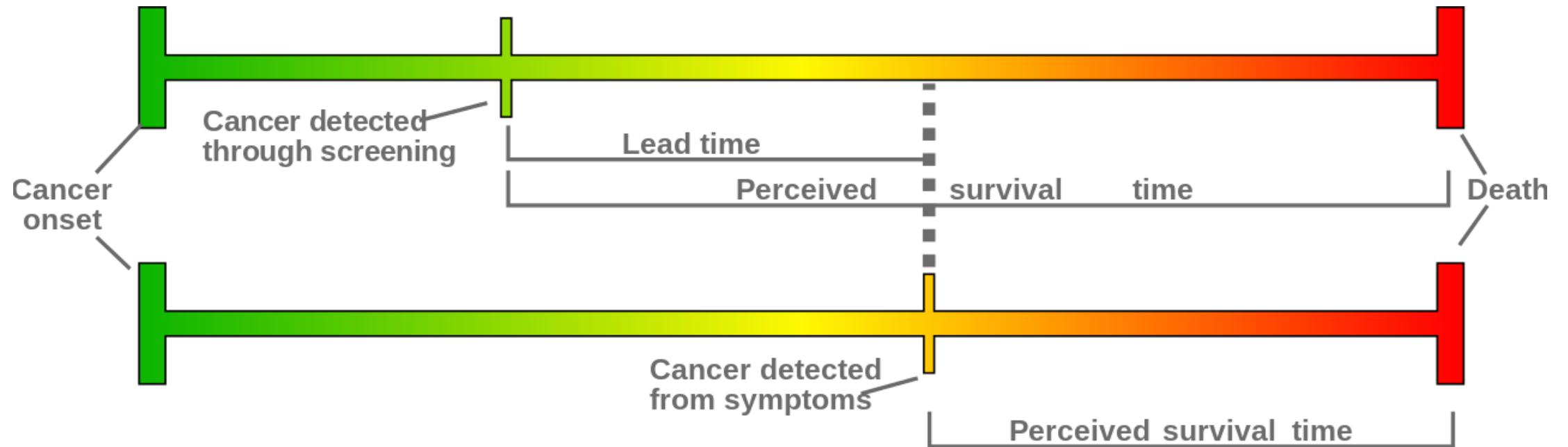
Ongoing work

- Age and SES-specific survival
- Stage-specific net survival, by CSS
- Comorbidity status
- Comorbidity among old cancer patients

Joint work with

- 簡立欣 曾子璿
- 蔡芳榆 王价輝
- 熊昭 劉滄梧

Thank you for your attention