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Geographic and socioeconomic variation in breast
cancer treatment in Scotland: an empirical analysis
using linked patient-level data

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Smarter Health Care
National Research Programme



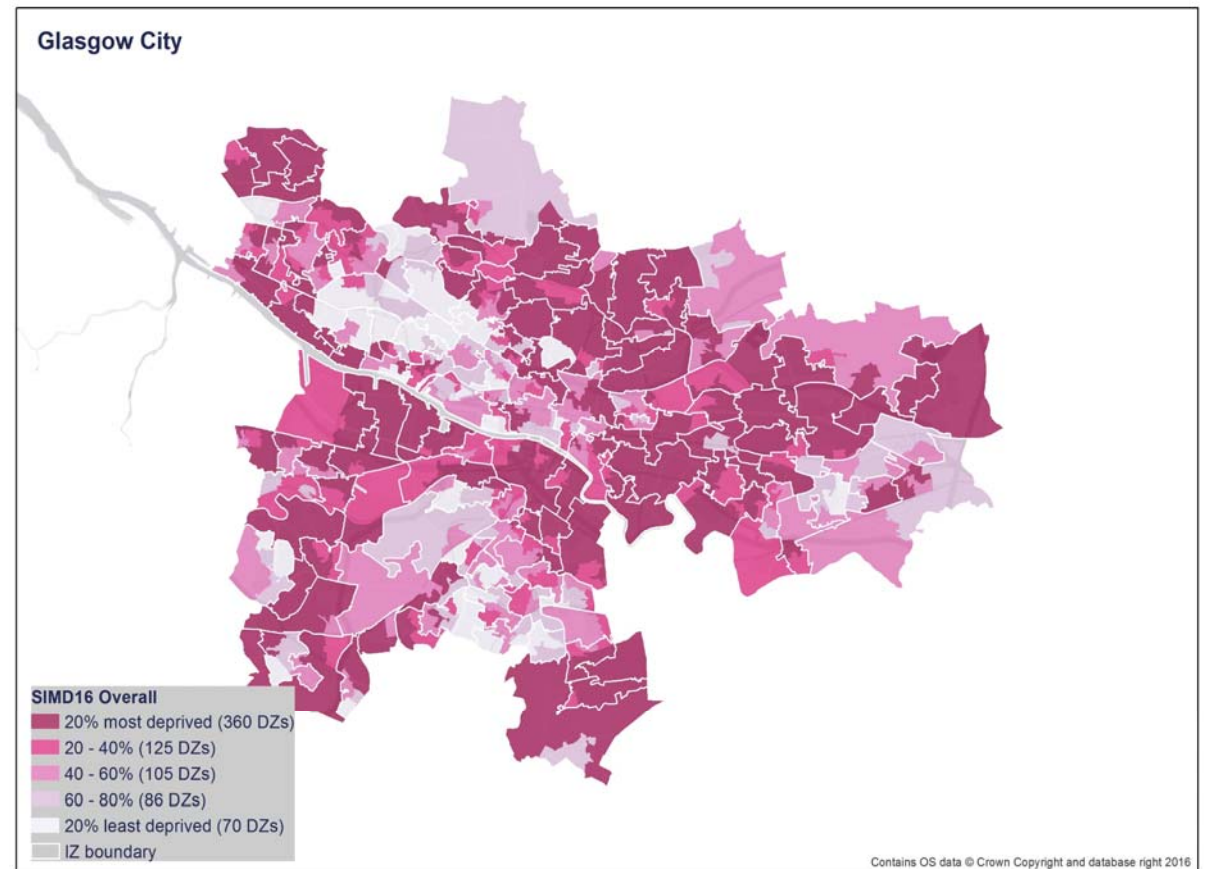
David Brewster and Peter Hall

Introduction

- Socioeconomic status is known to be associated with survival of patients with many types of cancer in many countries
 - Breast cancer patient survival in Scotland has a strong socioeconomic gradient
- Several factors are thought to contribute to this gradient:
 - Differences in treatment access and/or use
 - Differences in stage at diagnosis – and related mode of diagnosis (screening)
 - Differences in comorbidities prevalence
- This study examined the role of these three putative mediators of the effect of socioeconomic status on mortality of breast cancer patients

Scottish Index of Multiple Deprivation (SIMD)

- Ranking of local areas, 'data zones' on multi-item deprivation index
- Index contains items related to: Income, Employment, Health, Education, Skills and Training, Geographic Access to Services, Crime and Housing
- Census data, also tax records, police statistics and other
- 6976 data zones
- Average of 760 people per zone
- 2/3 of people in most deprived 15% of areas would qualify as income deprived



Previous research – Cancer patients in Scotland

- Shack et al 2007 – All cancers diagnosed between 1986 and 2000 in national registry
 - Survival to 2004, adjusted for age, sex and calendar year.
 - 20 most common cancers
 - Breast cancer: ‘Deprivation gap’, Difference in relative* survival between most deprived and least deprived quintile = -4.1% points (approx. 80 to 84.1%), or 26% increase in mortality...
 - All except bladder cancer had socioeconomic gradient for survival

*relative to general population \approx inverse of cancer specific mortality

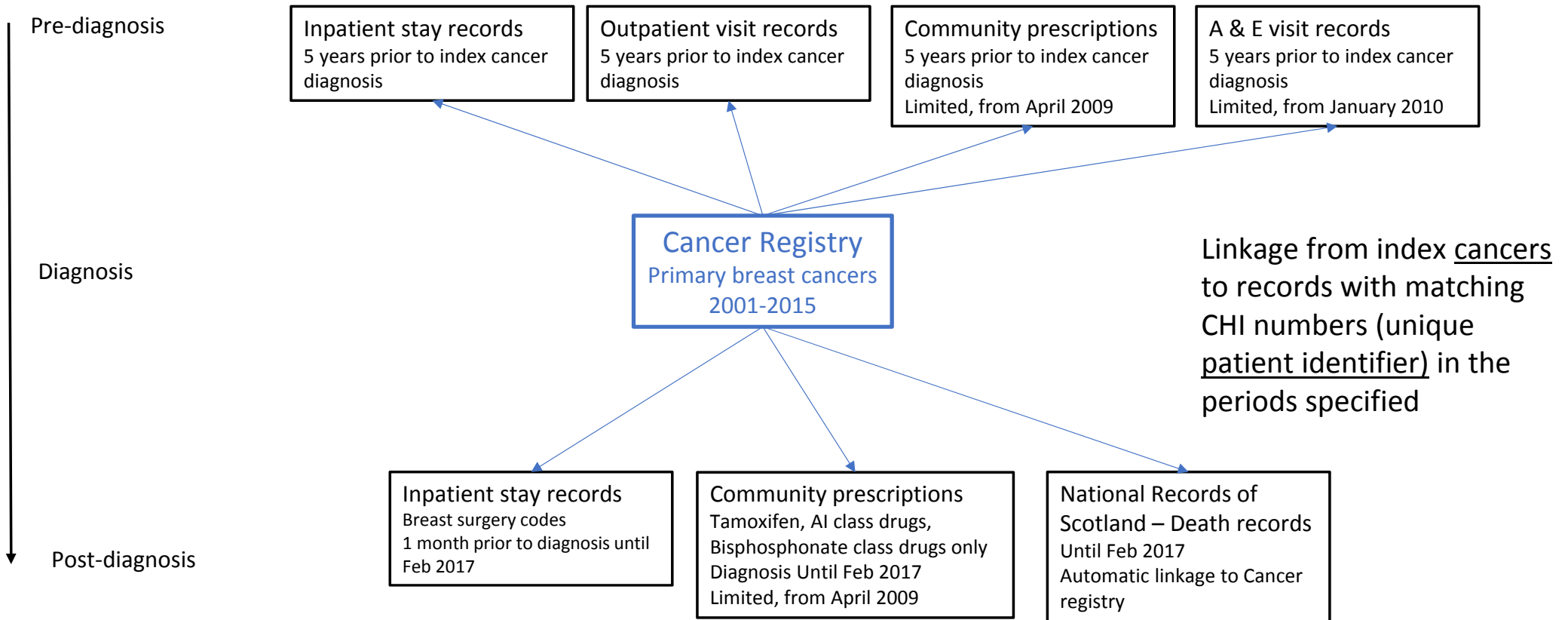
Previous research - international

- Several other countries/cancers: all find some degree of socioeconomic gradient
- Booth et al 2010, Cancer registry of Ontario:
 - 6 cancer types, diagnosed 2003-2007
 - Postcode level income quintiles
 - Socioeconomic gradients observed for all cancer types only partially reduced by adjustment for age and stage
- Kumachev et al 2016, Cancer registry of Ontario:
 - Breast cancer cases only, diagnosed 2004-2009, all cases (early, advanced, DCIS?)
 - Q5 vs Q1: 5.7% difference in 5 year survival (80 vs 85.7)
 - Adjuvant chemotherapy: Q5 vs Q1: OR, 1.18; 95% CI, 1.10-1.26
 - Also more likely to get radiotherapy and be diagnosed at earlier stage
 - Socioeconomic gradient only partially reduced by adjustment for age, stage, comorbidities (Charlson-Deyo index, binary), rural residence and treatments

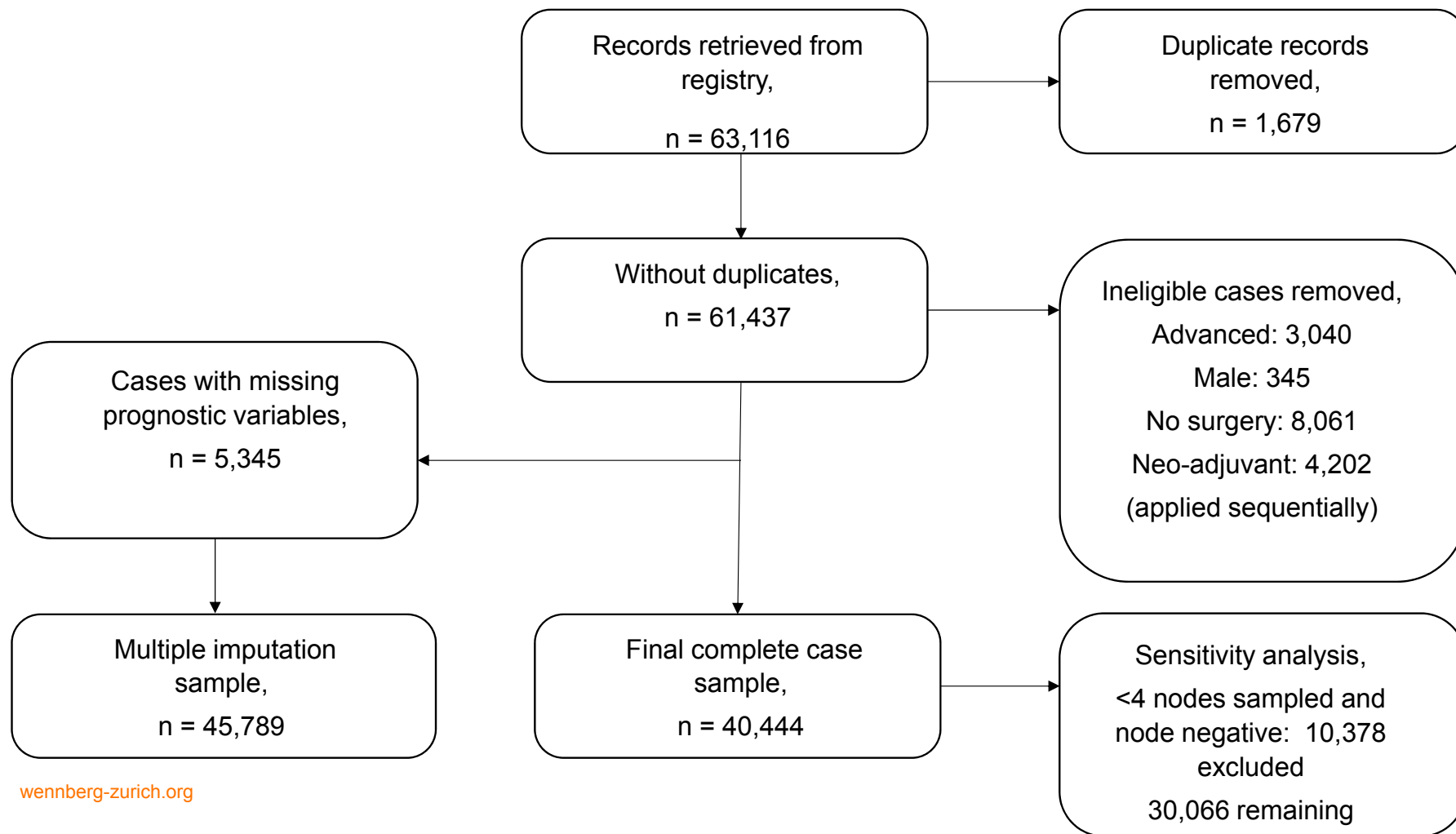
What this study adds

- Estimates specific to Scottish context
- Addresses important limitations noted by Kumachev et al and others:
 - More detailed estimates of comorbidities based on routine medical record linkage to cancer registry
 - More detailed information on cancer prognostic variables (e.g. tumour size) – combined into a single score using validated prognostic model, PREDICT.
 - Includes: Age, nodal status, tumour size, grade, ER status, HER2 status and if screen detected. Defines important interactions and nonlinearities.
- Area level multi-attribute deprivation rather than area level household income

Data linkage



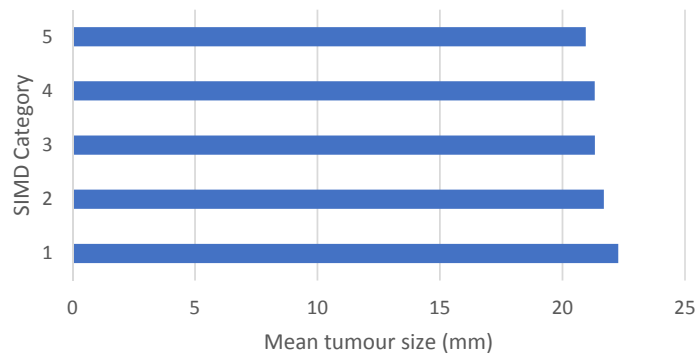
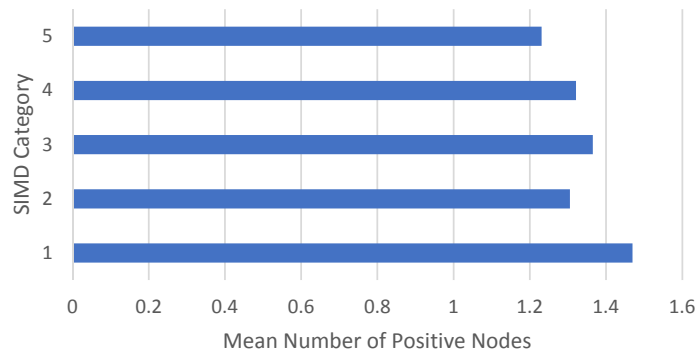
Complete case early breast cancer only



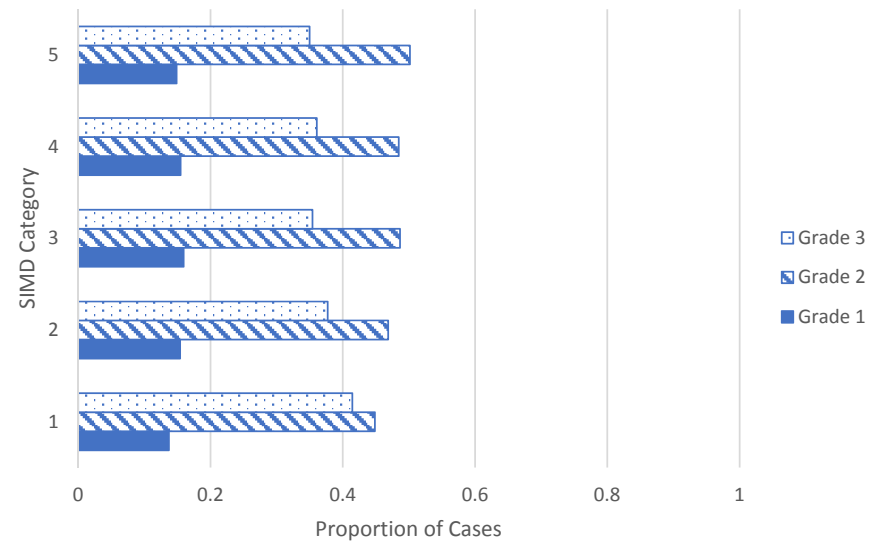
Survival differences – Standardised Mortality Ratios

SIMD Quintile	Standardised Mortality Rate (age-standardised)	95% Confidence Interval
1 = most deprived	1.302	1.248, 1.358
2	1.178	1.131, 1.228
3	1.078	1.034, 1.124
4	0.901	0.86, 0.943
5 = least deprived	0.86	0.821, 0.901

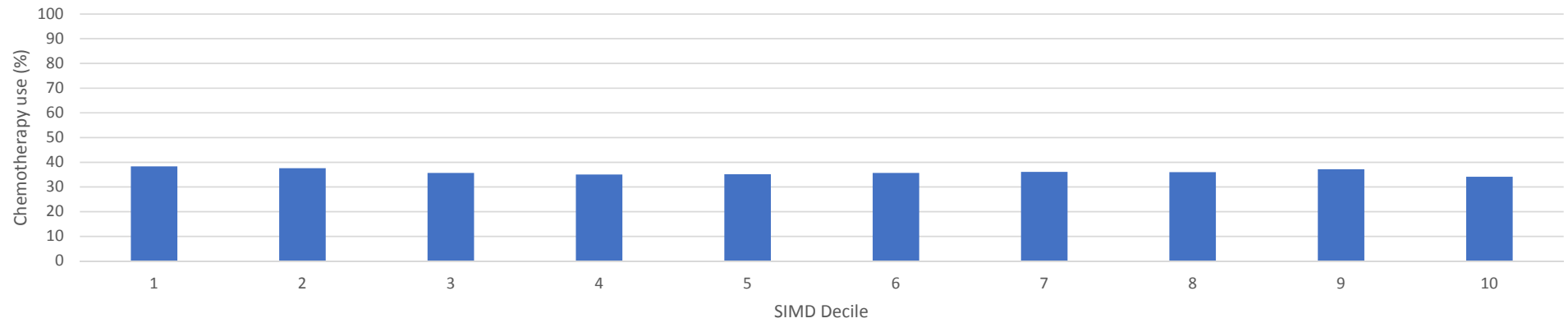
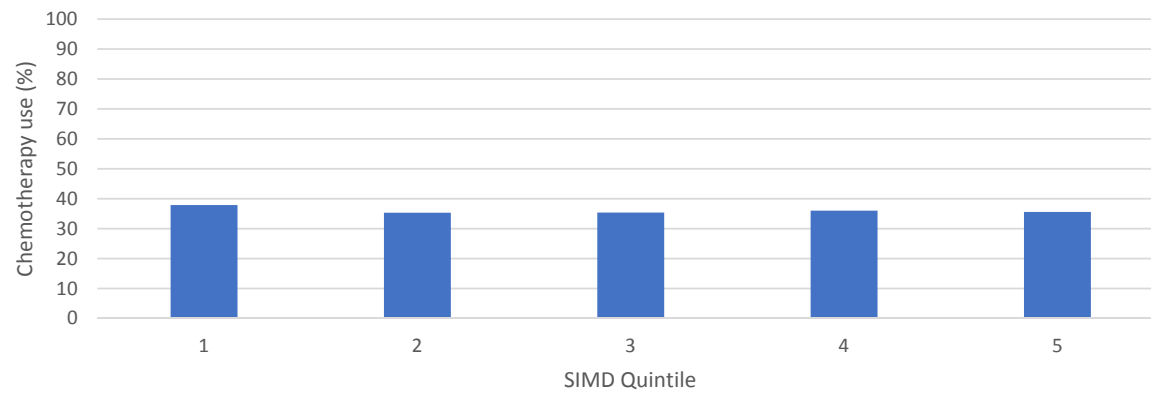
Some differences in prognostic markers at diagnosis



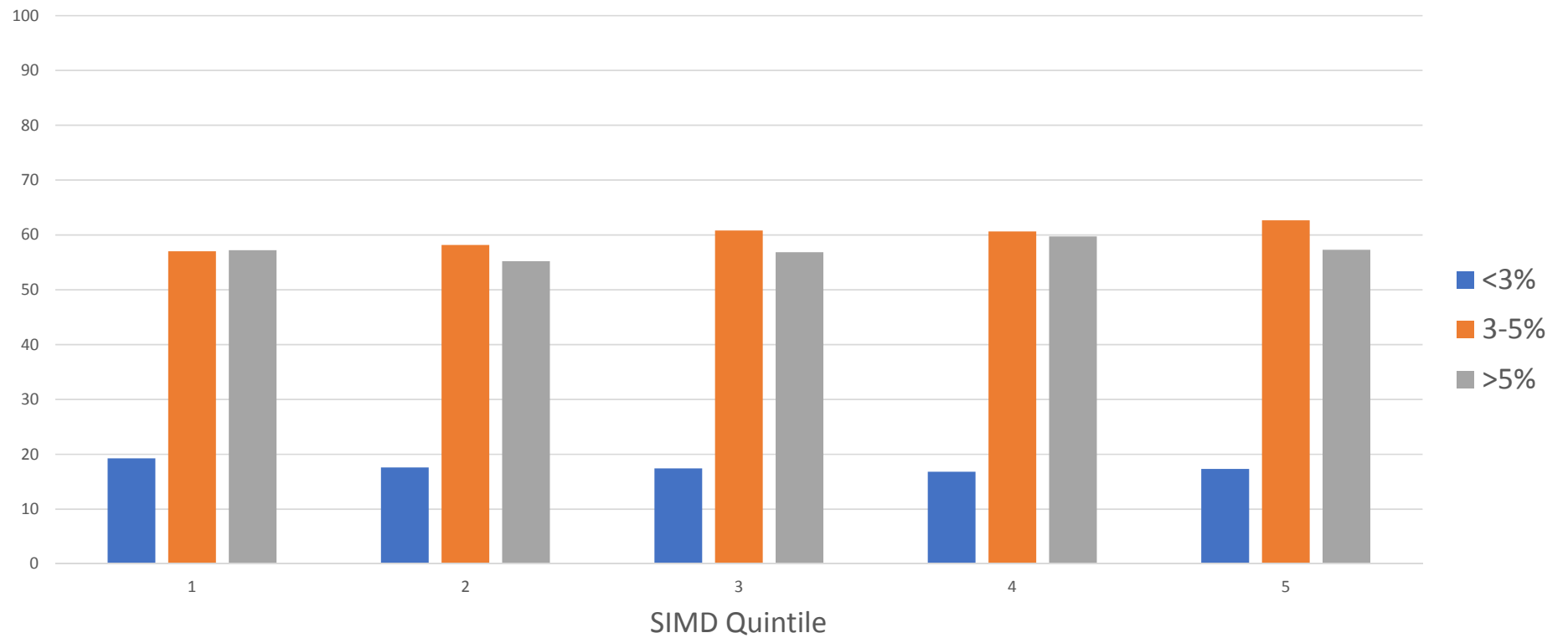
- Trend of worse prognosis for higher deprivation categories.
- Both for individual markers and overall prognostic score



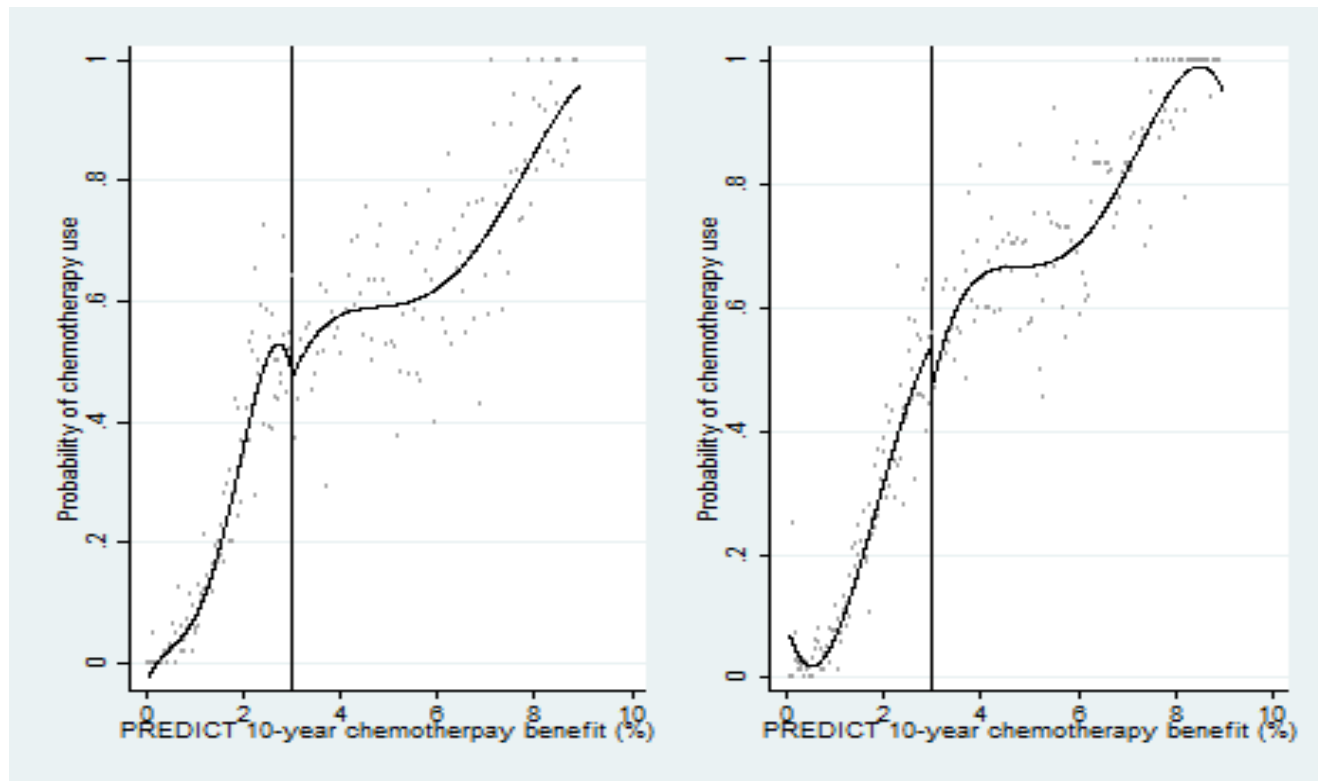
Chemotherapy use – no trend



Chemotherapy use within prognostic groups



Thresholds for chemotherapy use in top and bottom quintiles



L: Quintile 1, R: Quintile 5

Radiotherapy, hormone therapy

- Odds ratios, Q5 vs Q1, from logistic regression, adjusting for prognostic group
 - Radiotherapy: 1.15 (95%CI: 1.07, 1.24)
 - Hormone therapy 1.00 (95%CI: 0.87, 1.15)
 - Chemotherapy 0.95 (95%CI: 0.89, 1.02)
- Approx. 70% receive radiotherapy and 92% (ER+) receive hormone therapy in Q5
- Some evidence of greater use of radiotherapy
- Could be due to higher use of breast conserving surgery rather than mastectomy – to be investigated

Adjusted Survival

- Cox regression
- Proportional hazards assumption
- Hazard ratios relative to SIMD=1, most deprived category

	Hazard ratio	P	95% CI L	95% CI U
Unadjusted				
SIMD Category 2	0.9	0.001	0.85	0.96
3	0.83	<0.001	0.78	0.88
4	0.69	<0.001	0.65	0.73
5	0.66	<0.001	0.62	0.7

	Hazard ratio	P	95% CI L	95% CI U
Adjusted, PREDICT and comorbidities				
SIMD Category 2	1	0.974	0.9	1.11
3	0.93	0.203	0.84	1.04
4*	0.77	<0.001	0.68	0.86
5*	0.77	<0.001	0.68	0.86
PREDICT 10 – year mortality	1.03	<0.001	1.03	1.03
Charlson comorbidity (binary)	1.55	<0.001	1.43	1.69
Log total inpatient days, 5 years	1.21	<0.001	1.18	1.25

*Not a mistake! Identical to 2 decimal places but not to 3. Further adjustments for outpatient visits, treatments received and rural residence, HR of Q5 vs Q1 = 0.78 (95%CI: 0.69, 0.90)

Conclusions

- Still exploring all dimensions of the data – geographical health boards, other possible measures of comorbidity and types of surgery
- Socioeconomic (deprivation) gradient in survival for early stage breast cancer patients in Scotland.
- Appears to be largely unexplained by differences in cancer prognostic factors at diagnosis, comorbidity at diagnosis or differences in treatment.
- Remaining explanations:
 - Limitation: May not be perfectly measuring the presumed mediating or confounding factors
 - Socioeconomic differences cause post-diagnosis divergence in rate of other health conditions
 - Socioeconomic differences cause post-diagnosis divergence in cancer recurrence/progression - ‘host environment’ differences



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