

- Cancer registration data from 2016 was linked to hospital episodes data, with hospital episodes one year prior and post diagnosis selected for analysis.
- Common conditions considered as comorbidities included:
 - o Heart conditions, Circulatory disorders, Hypertension, Cerebrovascular disease, Chronic pulmonary disease, diabetes, liver disease, renal disease, connective tissue disease, peptic ulcer, anemia, hypothyroidism, coagulopathy, fluid and electrolyte disorders, paralysis, arthritis, alcohol or drug abuse, dementia, neurodegenerative disorders, psychosis and depression.
- Key findings from the analysis include:

Before diagnosis:

- 49% of men and 42% of women diagnosed with cancer (excluding non-melanoma skin cancer) in 2016 had a comorbidity recorded up to one year prior to their diagnosis.
- The proportion of patients with a comorbidity increased with increasing age.
- The proportion of patients with a comorbidity also varied depending upon cancer type, ranging from 21% among male melanoma patients to 75% among male liver cancer patients, and from 16% among female breast cancer patients to 76% among female liver cancer patients.
- The most common comorbidity was hypertension which was recorded for 23% of male and 20% of female cancer patients.
- Cancer survival was strongly related to the number of comorbidities recorded for a patient ranging from 83.5% one year from diagnosis among those with no comorbidity to 48.3% one year from diagnosis among those with four or more comorbidities. However, this variation will be partly related to the age of the patient and cancer type.

After diagnosis:

- 48% of men and 50% of women had a comorbidity recorded up to one year after diagnosis.
- The proportion of patients with a comorbidity after diagnosis varied depending upon cancer type, ranging from 24% among male testicular cancer patients to 71% among male oesophageal cancer patients, and from 29% among female melanoma patients to 74% among female laryngeal cancer patients.
- The most common comorbidity after diagnosis was hypertension which was recorded for 24% of male and 24% of female cancer patients.
- Many cancer types (melanoma, oral, oesophageal, rectal, breast, cervical, and uterine cancers) had more comorbidities after diagnosis, however others had fewer (stomach, liver, lung, pancreatic, kidney and brain cancers). This may be a result of patients dying after diagnosis but before comorbidities are recorded.

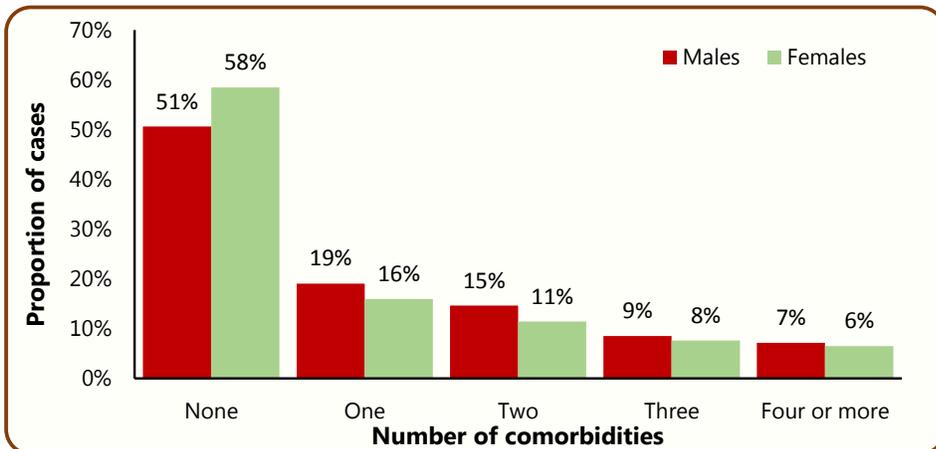
Comorbidities one year before a cancer diagnosis

Methods

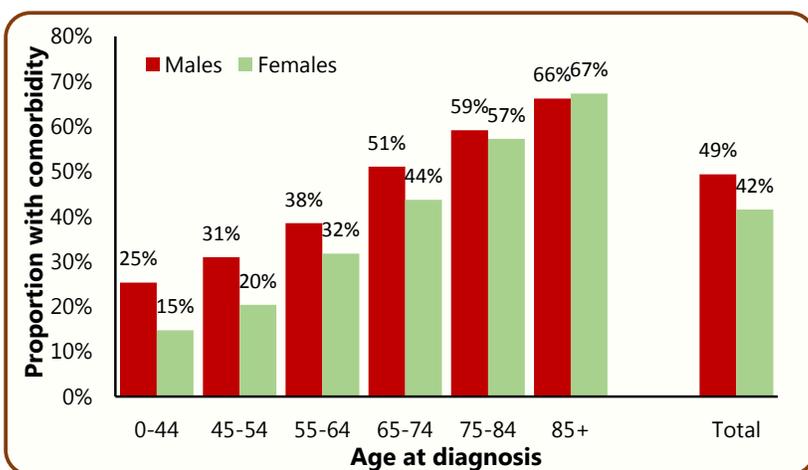
Data on all cancers (excluding non-melanoma skin cancer) which were diagnosed in 2016 were extracted from the NI Cancer Registry and linked to hospital episodes data up to one year before the date of diagnosis. Comorbidities were identified using ICD10 codes which reflect the conditions used in either the Charlson or Elixhauser classifications. The full list of comorbidities is included in the appendix.

Number of comorbidities by gender

Number of comorbidities up to one year before diagnosis	Number and proportion of cases	
	Males	Females
None	2,418	2,865
One	911	782
Two	700	561
Three	407	373
Four or more	342	318
Total	4,778	4,899



Presence of comorbidities by sex and age



Age at diagnosis	Number of cases			
	Males		Females	
	No comorbidity	With comorbidity	No comorbidity	With comorbidity
0-44	171	58	354	61
45-54	250	112	492	126
55-64	572	358	664	309
65-74	752	784	711	552
75-84	528	764	471	630
85+	145	284	173	356
Total	2,418	2,360	2,865	2,034

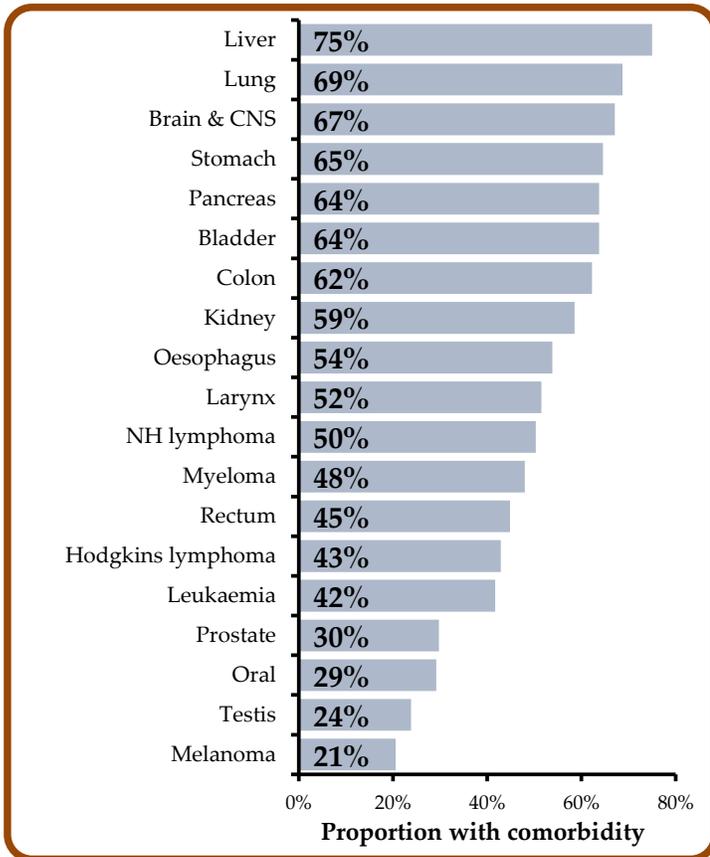
Comorbidities by sex and cancer type

Common cancer types	Number of cases				Common cancer types	Number of cases			
	Males		Females			Males		Females	
	No comorbidity	With comorbidity	No comorbidity	With comorbidity		No comorbidity	With comorbidity	No comorbidity	With comorbidity
Oral	97	40	56	22	Uterus	0	0	163	86
Oesophagus	73	85	35	36	Ovary	0	0	92	93
Stomach	50	91	27	54	Prostate	837	354	0	0
Colon	153	252	153	243	Testis	48	15	0	0
Rectum	128	104	74	61	Kidney	85	120	45	78
Liver	21	63	12	39	Bladder	58	102	24	44
Pancreas	50	88	43	72	Brain & CNS	26	53	15	39
Larynx	32	34	6	13	Hodgkins lymphoma	20	15	20	8
Lung	209	459	245	468	NH lymphoma	95	96	75	77
Melanoma	147	38	176	35	Myeloma	51	47	39	40
Breast	0	0	1,218	225	Leukaemia	77	55	51	35
Cervix	0	0	69	14					

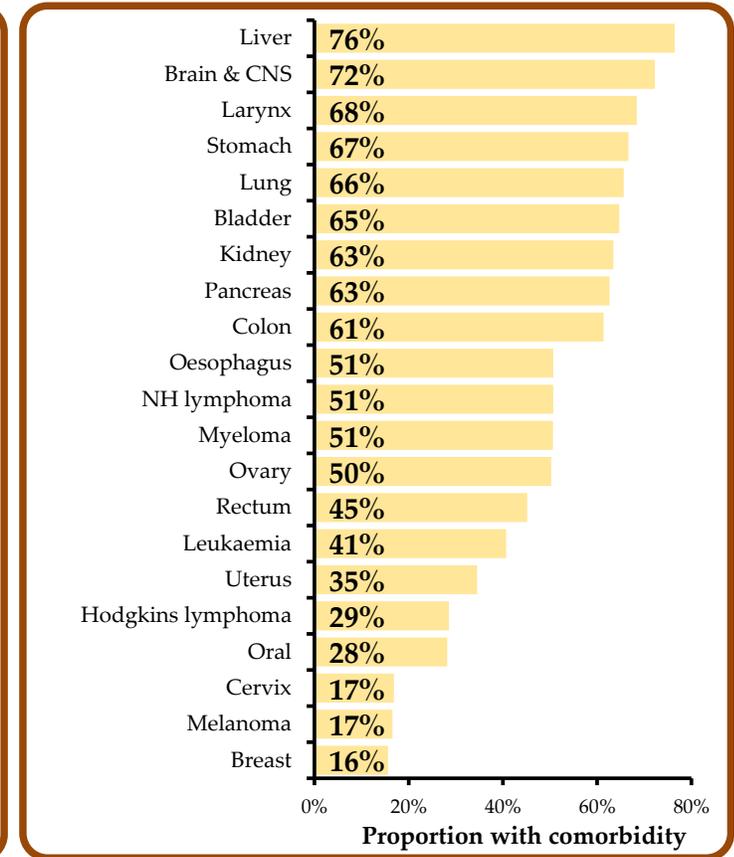
CNS: Central Nervous System, NH: Non-Hodgkins

Comorbidities by sex and cancer type (continued)

Males

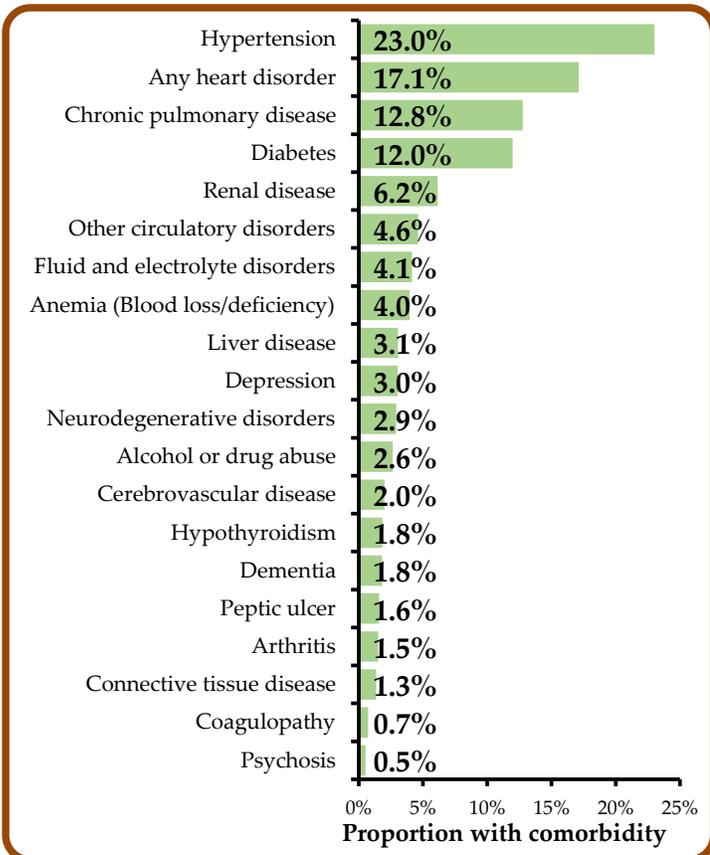


Females

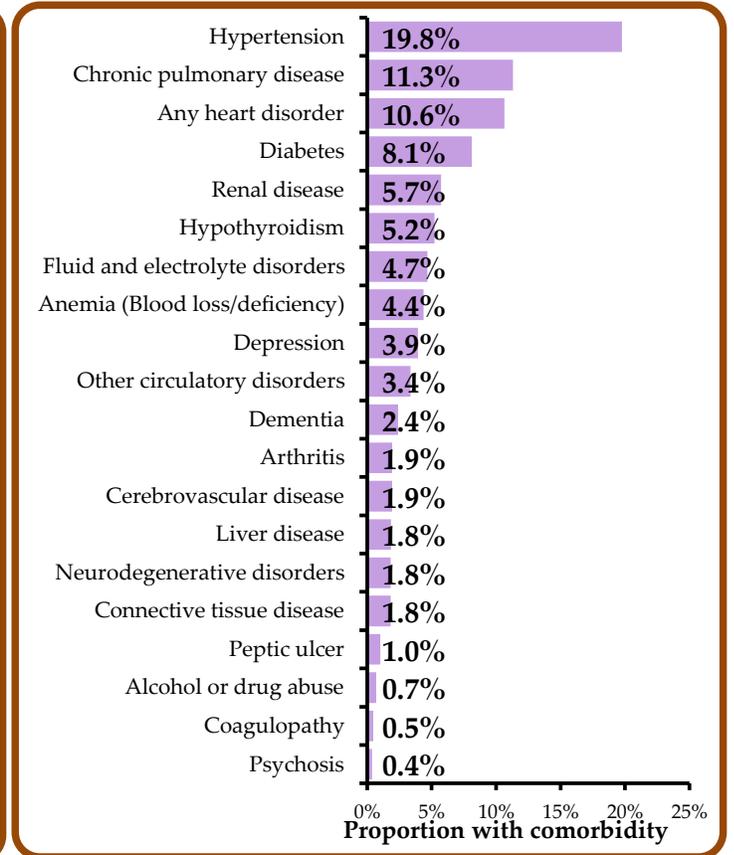


Comorbidity type by sex

Males



Females



Comorbidity type by sex (continued)

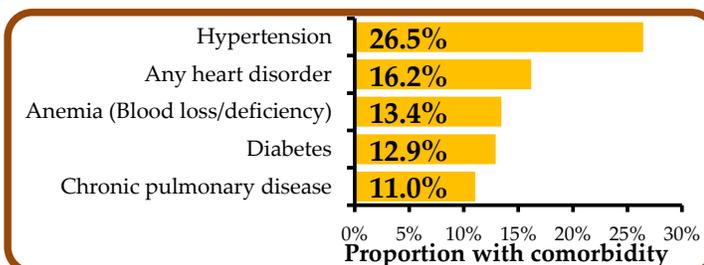
Comorbidity type	Number of cases	
	Males	Females
Any heart disorder	818	521
Congestive heart failure	156	139
Myocardial infarction	315	139
Other heart disorder	557	388
Other circulatory disorders	221	165
Hypertension	1,100	968
Cerebrovascular disease	95	95
Chronic pulmonary disease	610	554
Diabetes	572	398
Diabetes with complications	37	15
Liver disease	146	90
Severe liver disease	50	20
Renal disease	294	281

Comorbidity type	Number of cases	
	Males	Females
Peptic ulcer	75	50
Connective tissue disease	64	89
Anemia (Blood loss/deficiency)	189	214
Hypothyroidism	88	256
Coagulopathy	35	23
Fluid and electrolyte disorders	198	229
Paralysis	12	9
Arthritis	72	95
Alcohol or drug abuse	126	34
Dementia	86	117
Neurodegenerative disorders	139	89
Psychosis	25	18
Depression	145	193

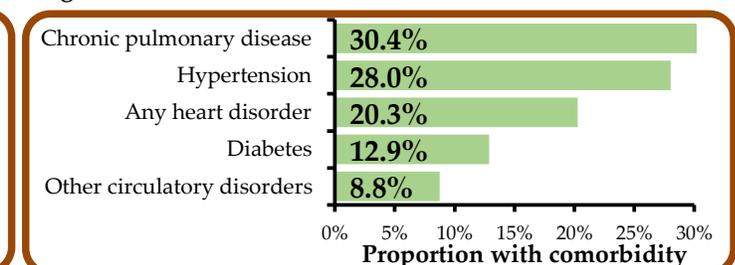
Comorbidity type by cancer type

Comorbidity type	Number and proportion with comorbidity							
	Bowel cancer		Lung cancer		Female breast cancer		Prostate cancer	
Any heart disorder	189	16.2%	280	20.3%	64	4.4%	124	10.4%
Congestive heart failure	40	3.4%	62	4.5%	18	1.2%	27	2.3%
Myocardial infarction	66	5.7%	109	7.9%	11	0.8%	45	3.8%
Other heart disorder	140	12.0%	180	13.0%	54	3.7%	89	7.5%
Other circulatory disorders	52	4.5%	121	8.8%	14	1.0%	25	2.1%
Hypertension	309	26.5%	387	28.0%	113	7.8%	190	16.0%
Cerebrovascular disease	23	2.0%	47	3.4%	13	0.9%	11	0.9%
Chronic pulmonary disease	129	11.0%	420	30.4%	50	3.4%	79	6.6%
Diabetes	151	12.9%	178	12.9%	48	3.3%	70	5.9%
Renal disease	89	7.6%	102	7.4%	27	1.9%	43	3.6%
Connective tissue disease	18	1.5%	44	3.2%	9	0.6%	11	0.9%
Anemia (Blood loss/deficiency)	157	13.4%	46	3.3%	7	0.5%	12	1.0%
Hypothyroidism	61	5.2%	55	4.0%	37	2.5%	19	1.6%
Fluid and electrolyte disorders	42	3.6%	101	7.3%	26	1.8%	24	2.0%
Arthritis	20	1.7%	49	3.5%	9	0.6%	11	0.9%
Dementia	35	3.0%	46	3.3%	11	0.8%	20	1.7%
Neurodegenerative disorders	22	1.9%	42	3.0%	15	1.0%	14	1.2%
Depression	36	3.1%	85	6.2%	23	1.6%	22	1.8%

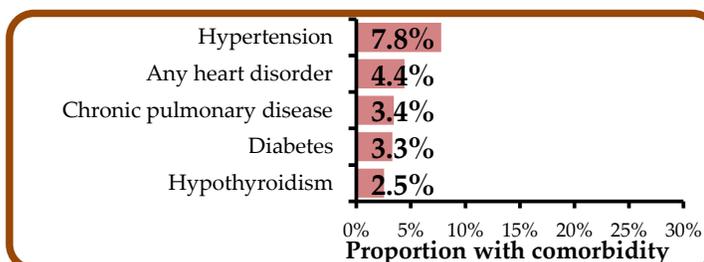
Bowel



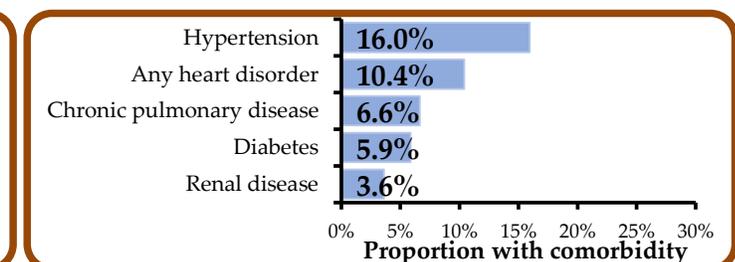
Lung



Breast

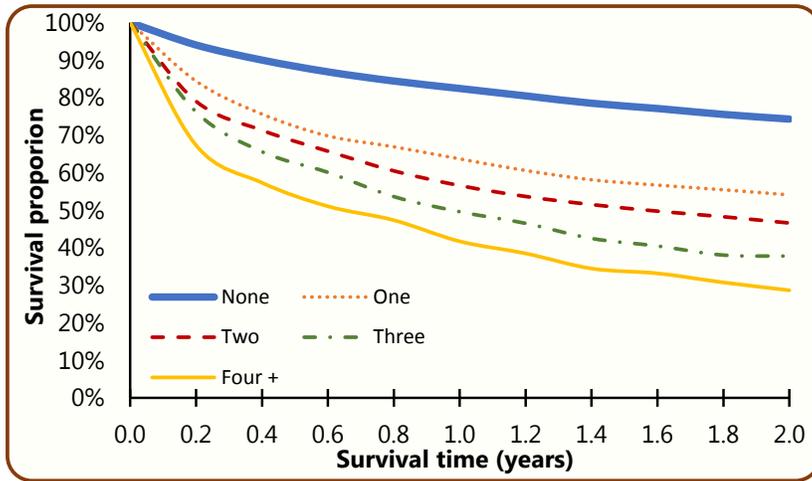


Prostate



Survival by number of comorbidities

Observed survival



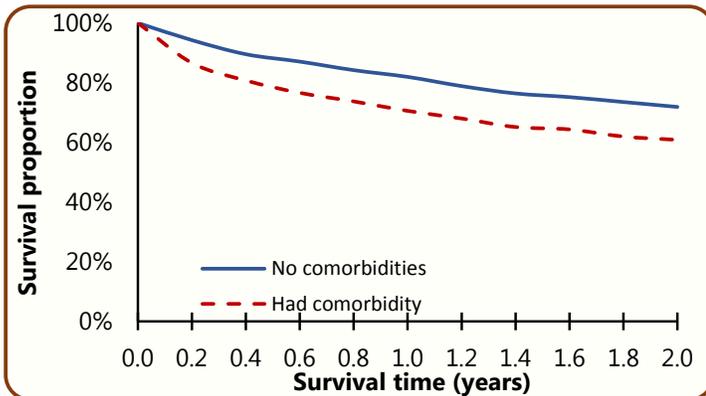
Number of comorbidities	Observed survival	
	One year	Two years
None	82.4% (81.4%, 83.5%)	74.3% (73.1%, 75.5%)
One	63.7% (61.3%, 66.0%)	54.1% (51.6%, 56.5%)
Two	56.6% (53.7%, 59.3%)	46.6% (43.7%, 49.4%)
Three	49.6% (46.0%, 53.1%)	37.8% (34.3%, 41.2%)
Four +	41.7% (37.8%, 45.6%)	28.7% (25.2%, 32.3%)

Number of comorbidities	Cause specific survival	
	One year	Two years
None	83.5% (82.5%, 84.5%)	76.5% (75.3%, 77.7%)
One	66.1% (63.7%, 68.3%)	57.2% (54.7%, 59.6%)
Two	59.9% (57.1%, 62.7%)	51.5% (48.6%, 54.4%)
Three	55.2% (51.4%, 58.8%)	44.3% (40.6%, 48.0%)
Four +	48.3% (44.1%, 52.3%)	38.8% (34.7%, 42.8%)

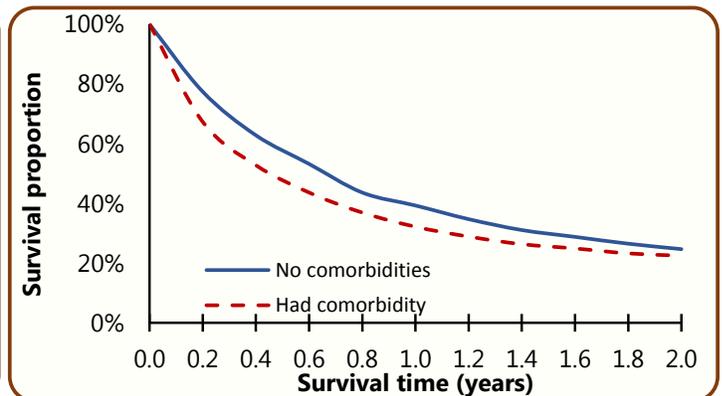
Survival by comorbidities and cancer type

Cancer type and comorbidities		Observed survival		Cause specific survival	
		One year	Two years	One year	Two years
Bowel cancer	No comorbidities	81.9% (78.2%, 85.1%)	71.9% (67.6%, 75.6%)	83.0% (79.3%, 86.1%)	73.6% (69.4%, 77.3%)
	Had comorbidity	70.5% (66.8%, 73.9%)	60.8% (56.9%, 64.5%)	75.7% (72.1%, 78.9%)	66.7% (62.8%, 70.4%)
Lung cancer	No comorbidities	39.3% (34.7%, 43.8%)	24.7% (20.7%, 28.8%)	40.9% (36.2%, 45.5%)	28.1% (23.9%, 32.5%)
	Had comorbidity	32.2% (29.1%, 35.2%)	22.5% (19.8%, 25.2%)	35.2% (32.0%, 38.4%)	25.3% (22.4%, 28.3%)
Female breast cancer	No comorbidities	96.5% (95.2%, 97.4%)	91.1% (89.3%, 92.6%)	97.0% (95.8%, 97.8%)	92.9% (91.2%, 94.2%)
	Had comorbidity	80.5% (74.4%, 85.2%)	71.4% (64.8%, 77.0%)	85.4% (79.8%, 89.6%)	78.7% (72.4%, 83.8%)
Prostate cancer	No comorbidities	95.9% (94.3%, 97.1%)	91.3% (89.2%, 93.0%)	96.6% (95.1%, 97.6%)	93.3% (91.4%, 94.8%)
	Had comorbidity	89.1% (85.2%, 91.9%)	77.5% (72.7%, 81.6%)	91.6% (88.1%, 94.1%)	85.7% (81.4%, 89.0%)

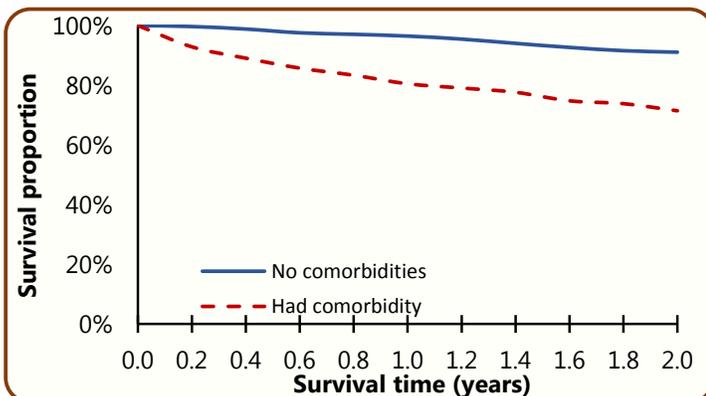
Bowel



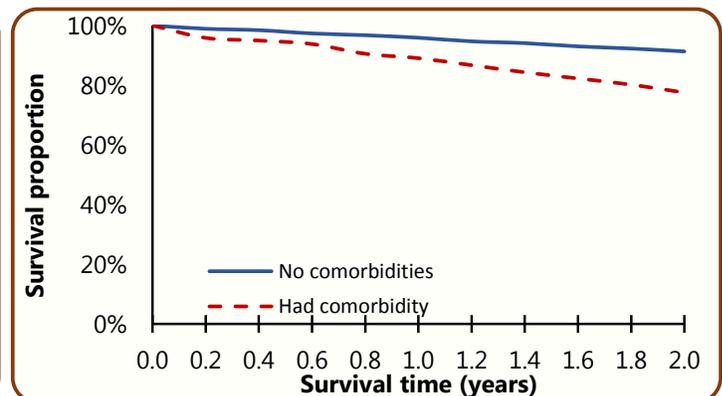
Lung



Female breast



Prostate



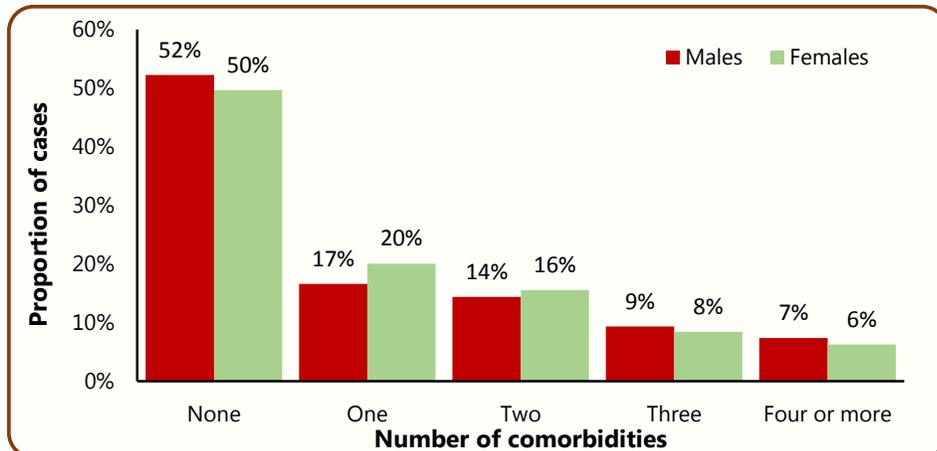
Comorbidities one year after a cancer diagnosis

Methods

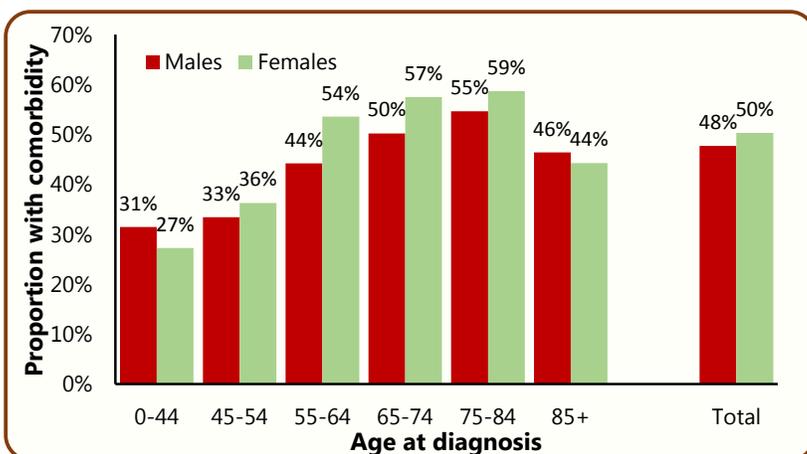
Data on all cancers (excluding non-melanoma skin cancer) which were diagnosed in 2016 were extracted from the NI Cancer Registry and linked to hospital episodes data up to one year after the date of diagnosis. Comorbidities were identified using ICD10 codes which reflect the conditions used in either the Charlson or Elixhauser classifications. The full list of comorbidities is included in the appendix.

Number of comorbidities by gender

Number of comorbidities up to one year after diagnosis	Number and proportion of cases	
	Males	Females
None	2,498	2,435
One	793	983
Two	687	761
Three	447	414
Four or more	353	306
Total	4,778	4,899



Presence of comorbidities by sex and age



Age at diagnosis	Number of cases			
	Males		Females	
	No comorbidity	With comorbidity	No comorbidity	With comorbidity
0-44	157	72	302	113
45-54	241	121	394	224
55-64	519	411	452	521
65-74	765	771	537	726
75-84	586	706	455	646
85+	230	199	295	234
Total	2,498	2,280	2,435	2,464

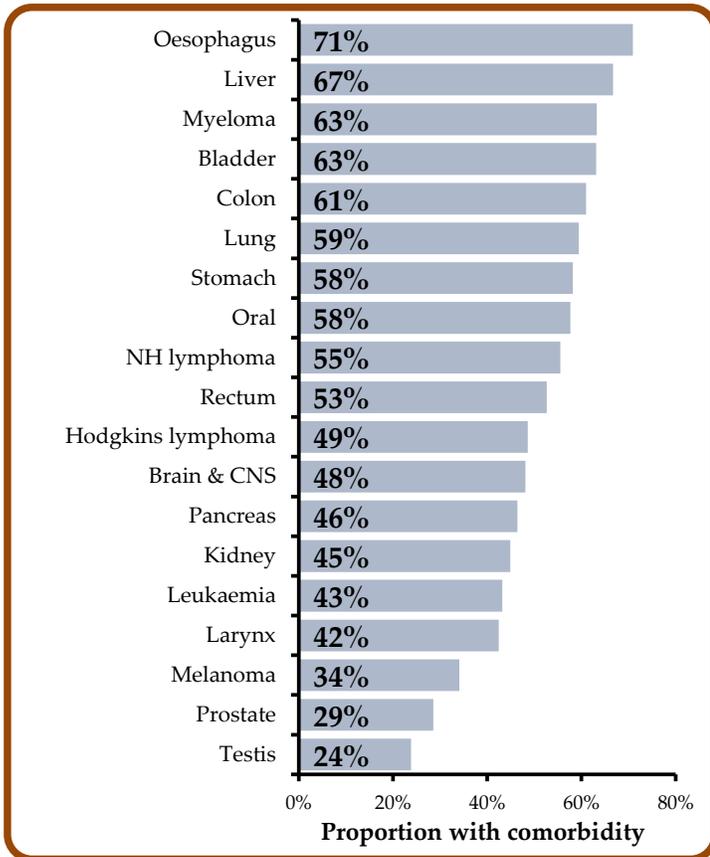
Comorbidities by sex and cancer type

Common cancer types	Number of cases				Common cancer types	Number of cases			
	Males		Females			Males		Females	
	No comorbidity	With comorbidity	No comorbidity	With comorbidity		No comorbidity	With comorbidity	No comorbidity	With comorbidity
Oral	58	79	31	47	Uterus	0	0	108	141
Oesophagus	46	112	24	47	Ovary	0	0	88	97
Stomach	59	82	37	44	Prostate	851	340	0	0
Colon	158	247	175	221	Testis	48	15	0	0
Rectum	110	122	66	69	Kidney	113	92	65	58
Liver	28	56	22	29	Bladder	59	101	22	46
Pancreas	74	64	60	55	Brain & CNS	41	38	27	27
Larynx	38	28	5	14	Hodgkins lymphoma	18	17	17	11
Lung	271	397	314	399	NH lymphoma	85	106	71	81
Melanoma	122	63	149	62	Myeloma	36	62	29	50
Breast	0	0	744	699	Leukaemia	75	57	50	36
Cervix	0	0	56	27					

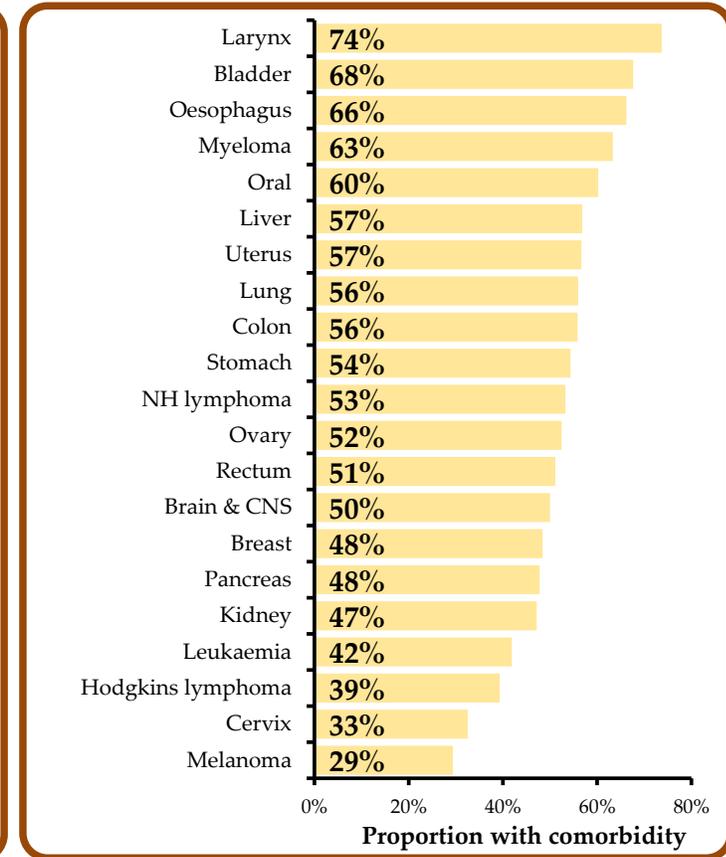
CNS: Central Nervous System, NH: Non-Hodgkins

Comorbidities by sex and cancer type (continued)

Males

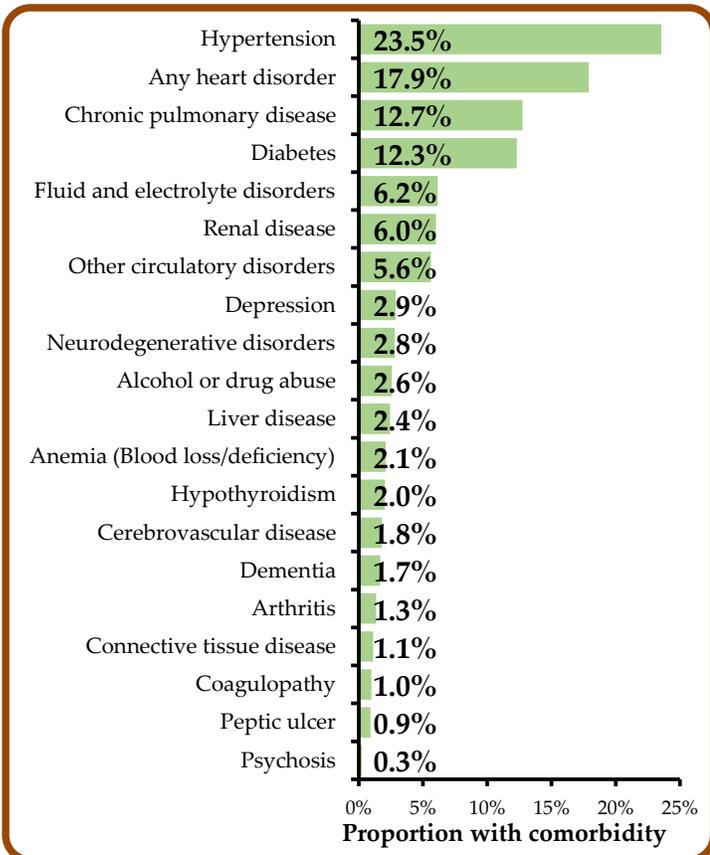


Females

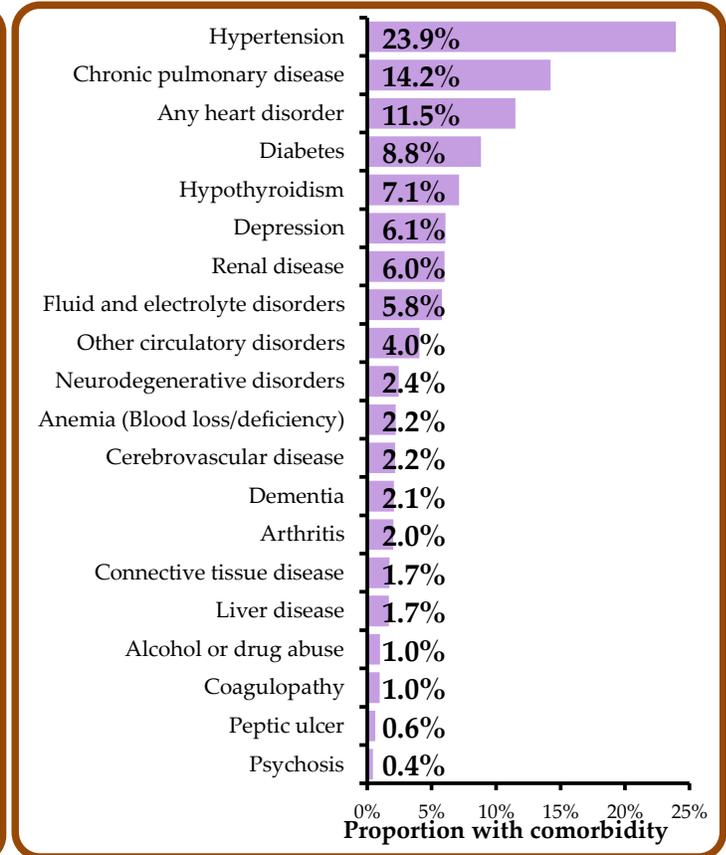


Comorbidity type by sex

Males



Females



Comorbidity type by sex (continued)

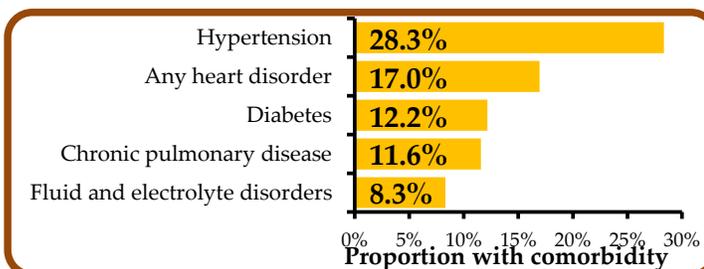
Comorbidity type	Number of cases	
	Males	Females
Any heart disorder	855	563
Congestive heart failure	207	142
Myocardial infarction	294	120
Other heart disorder	608	420
Other circulatory disorders	268	198
Hypertension	1,125	1,173
Cerebrovascular disease	85	106
Chronic pulmonary disease	609	697
Diabetes	588	432
Diabetes with complications	39	22
Liver disease	116	82
Severe liver disease	42	19
Renal disease	287	294

Comorbidity type	Number of cases	
	Males	Females
Peptic ulcer	43	30
Connective tissue disease	53	85
Anemia (Blood loss/deficiency)	100	108
Hypothyroidism	97	349
Coagulopathy	47	47
Fluid and electrolyte disorders	294	284
Paralysis	12	21
Arthritis	64	99
Alcohol or drug abuse	123	49
Dementia	80	101
Neurodegenerative disorders	134	120
Psychosis	12	21
Depression	137	297

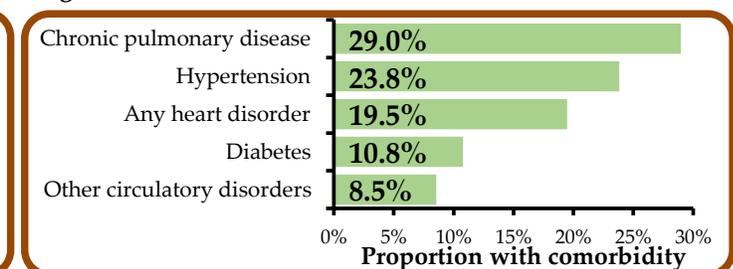
Comorbidity type by cancer type

Comorbidity type	Number and proportion with comorbidity							
	Bowel cancer		Lung cancer		Female breast cancer		Prostate cancer	
Any heart disorder	198	17.0%	269	19.5%	125	8.6%	142	11.9%
Congestive heart failure	35	3.0%	68	4.9%	36	2.5%	36	3.0%
Myocardial infarction	57	4.9%	82	5.9%	21	1.4%	56	4.7%
Other heart disorder	152	13.0%	184	13.3%	96	6.6%	100	8.4%
Other circulatory disorders	67	5.7%	118	8.5%	42	2.9%	25	2.1%
Hypertension	331	28.3%	329	23.8%	343	23.6%	185	15.5%
Cerebrovascular disease	25	2.1%	42	3.0%	20	1.4%	17	1.4%
Chronic pulmonary disease	135	11.6%	400	29.0%	172	11.8%	68	5.7%
Diabetes	142	12.2%	149	10.8%	104	7.2%	76	6.4%
Renal disease	76	6.5%	77	5.6%	71	4.9%	43	3.6%
Connective tissue disease	15	1.3%	25	1.8%	25	1.7%	9	0.8%
Anemia (Blood loss/deficiency)	59	5.1%	22	1.6%	25	1.7%	13	1.1%
Hypothyroidism	59	5.1%	52	3.8%	113	7.8%	14	1.2%
Fluid and electrolyte disorders	97	8.3%	109	7.9%	48	3.3%	42	3.5%
Arthritis	18	1.5%	30	2.2%	29	2.0%	11	0.9%
Dementia	23	2.0%	36	2.6%	21	1.4%	26	2.2%
Neurodegenerative disorders	30	2.6%	41	3.0%	40	2.8%	16	1.3%
Depression	35	3.0%	83	6.0%	105	7.2%	17	1.4%

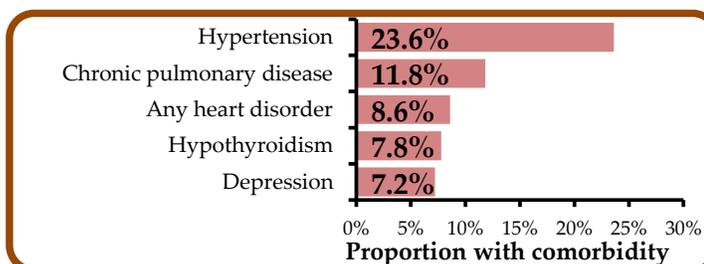
Bowel



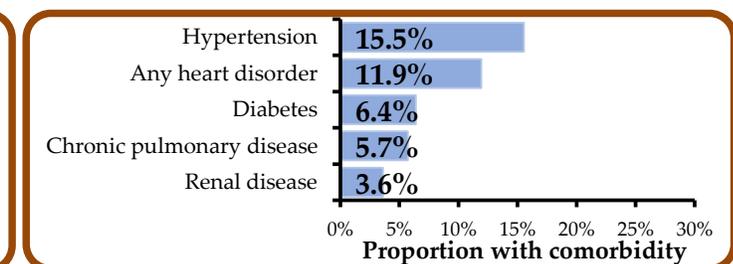
Lung



Breast

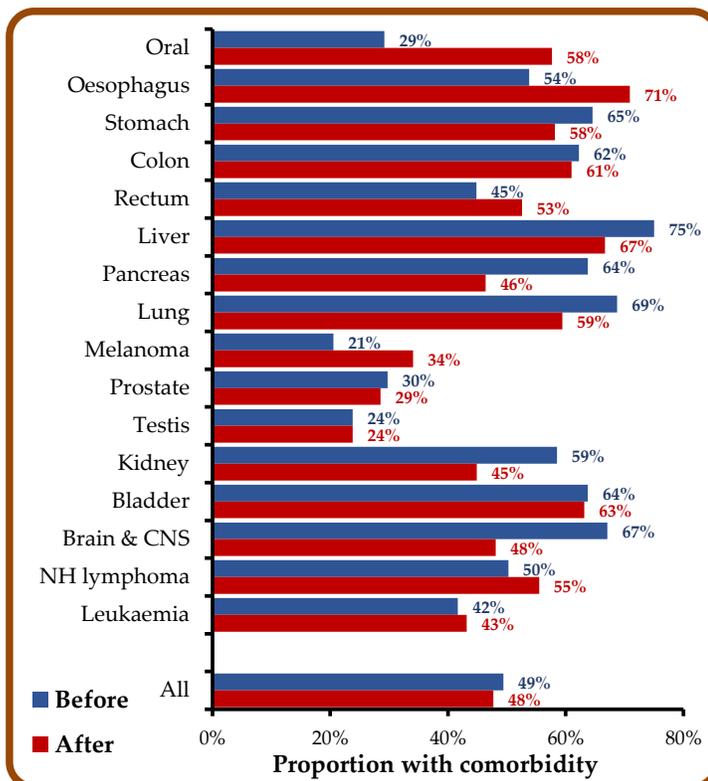


Prostate

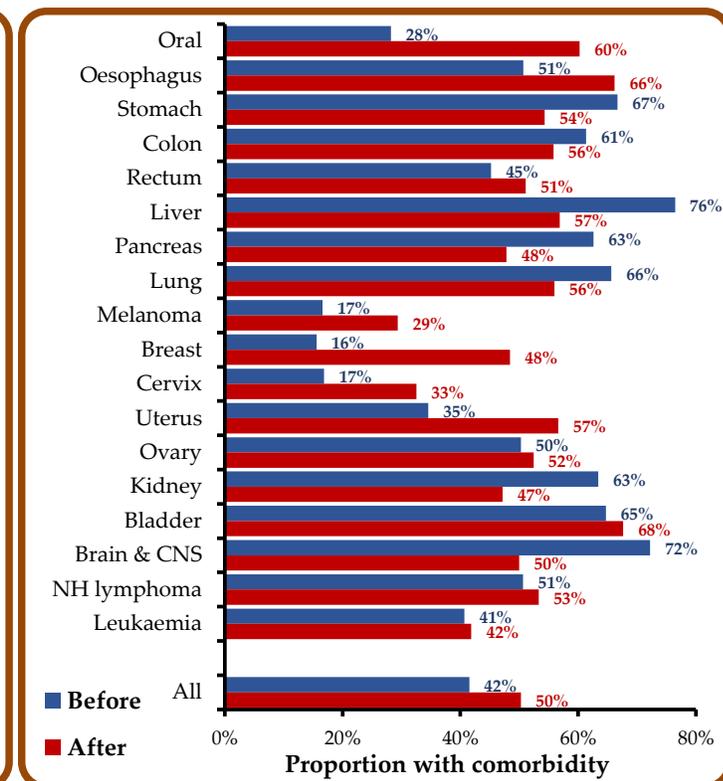


Presence of comorbidities before and after cancer diagnosis by cancer type

Males



Females



Comorbidities before and after cancer diagnosis by comorbidity type

Comorbidity type	Number of cases		Percentage change	Comorbidity type	Number of cases		Percentage change
	Before	After			Before	After	
Any heart disorder	1,339	1,418	6%	Renal disease	575	581	1%
Congestive heart failure	295	349	18%	Peptic ulcer	125	73	-42%
Myocardial infarction	454	414	-9%	Connective tissue disease	153	138	-10%
Other heart disorder	945	1,028	9%	Anemia (Blood loss/deficiency)	403	208	-48%
Other circulatory disorders	386	466	21%	Hypothyroidism	344	446	30%
Hypertension	2,068	2,298	11%	Coagulopathy	58	94	62%
Cerebrovascular disease	190	191	1%	Fluid and electrolyte disorders	427	578	35%
Chronic pulmonary disease	1,164	1,306	12%	Paralysis	167	163	-2%
Diabetes	970	1,020	5%	Arthritis	160	172	8%
Diabetes with complications	52	61	17%	Alcohol or drug abuse	203	181	-11%
Liver disease	236	198	-16%	Dementia	228	254	11%
Severe liver disease	70	61	-13%	Neurodegenerative disorders	338	434	28%

Note: The percentage change refers to the change in the overall number of cases and does not reflect the experience of individual patients. Decreases in the number of cases can be caused by patients with particular comorbidities dying after diagnosis of cancer and before any comorbidities are recorded.

Comorbidities before and after cancer diagnosis by cancer and comorbidity type

Comorbidity type	Number of cases							
	Bowel cancer		Lung cancer		Female breast cancer		Prostate cancer	
	Before	After	Before	After	Before	After	Before	After
Any heart disorder	189	198	280	269	64	125	124	142
Congestive heart failure	40	35	62	68	18	36	27	36
Myocardial infarction	66	57	109	82	11	21	45	56
Other heart disorder	140	152	180	184	54	96	89	100
Other circulatory disorders	52	67	121	118	14	42	25	25
Hypertension	309	331	387	329	113	343	190	185
Cerebrovascular disease	23	25	47	42	13	20	11	17
Chronic pulmonary disease	129	135	420	400	50	172	79	68
Renal disease	89	76	102	77	27	71	43	43
Anemia (Blood loss/deficiency)	157	59	46	22	7	25	12	13
Fluid and electrolyte disorders	42	97	101	109	26	48	24	42

Cancer type

Cancer type	ICD10 code	Notes	Cancer type	ICD10 code	Notes
Oral	C00-C14	Lip, oral cavity, pharynx	Uterus	C54-C55	
Oesophagus	C15		Ovary	C56-C57.4	& fallopian tube
Stomach	C16		Prostate	C61	
Colon	C18		Testis	C62	
Rectum	C19-C20		Kidney	C64	
Liver	C22		Bladder	C67	
Pancreas	C25		Brain & CNS	C70-C72,C75.1-C75.3	
Larynx	C32		Hodgkins lymphoma	C81	
Lung	C33-C34	& trachea	NH Lymphoma	C82-C86	
Melanoma	C43		Myeloma	C90	& plasma cell neoplasms
Breast	C50		Leukaemia	C91-C95	
Cervix	C53		<i>CNS: Central Nervous System, NH: Non-Hodgkins</i>		

Comorbidities

The following comorbidities contribute to the comorbidity count. They were chosen based upon the comorbidities listed in the Charlson and Elixhauser indices, with assignment based upon ICD10 codes.

Note: While cancer is included as part of the Charlson and Elixhauser indices, it is not included as a comorbidity in this analysis, even if the patient has had a previous malignancy.

Comorbidity type	Notes
Any heart disorder	Includes Myocardial infarction, Congestive heart failure, Cardiac arrhythmias and Valvular disease
Other circulatory disorders	Includes Pulmonary circulation disorders and Peripheral vascular disorders
Hypertension	
Cerebrovascular disease	
Chronic pulmonary disease	
Diabetes	Includes diabetes with complications
Liver disease	Includes severe liver disease
Renal disease	
Peptic ulcer	
Connective tissue disease	
Anemia (Blood loss/deficiency)	
Hypothyroidism	
Coagulopathy	
Fluid and electrolyte disorders	
Paralysis	Includes Hemiplegia or Paraplegia
Arthritis	
Alcohol or drug abuse	
Dementia	
Neurodegenerative disorders	
Psychosis	
Depression	

Survival

Observed survival is the proportion of people who are still alive a specified amount of time after their first diagnosis of cancer (in 2016). This measure considers death from any cause.

Cause specific survival is the proportion of people who did not die from cancer a specified amount of time after their first diagnosis of cancer (in 2016). This measure considers death from cancer only.

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