

## Risk of malignant lymphomas in patients with inflammatory bowel disease: A population-based cohort study

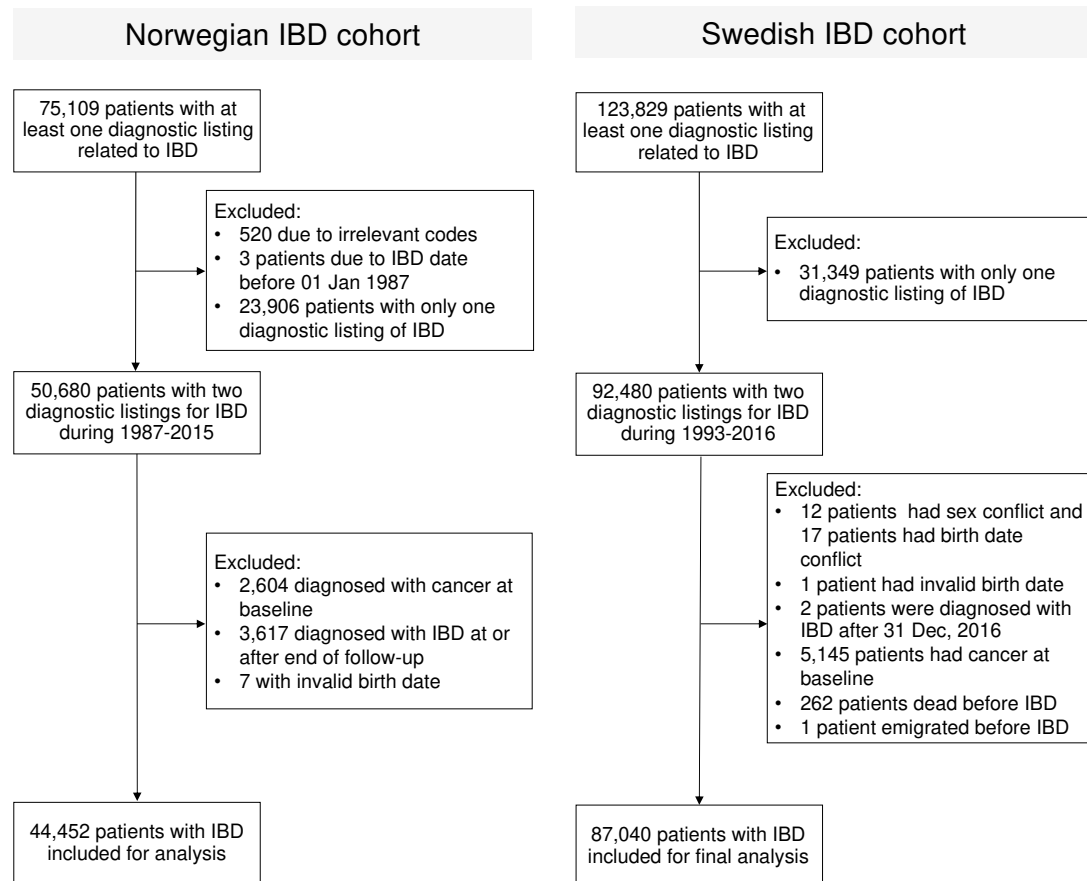
### Supplementary Appendix

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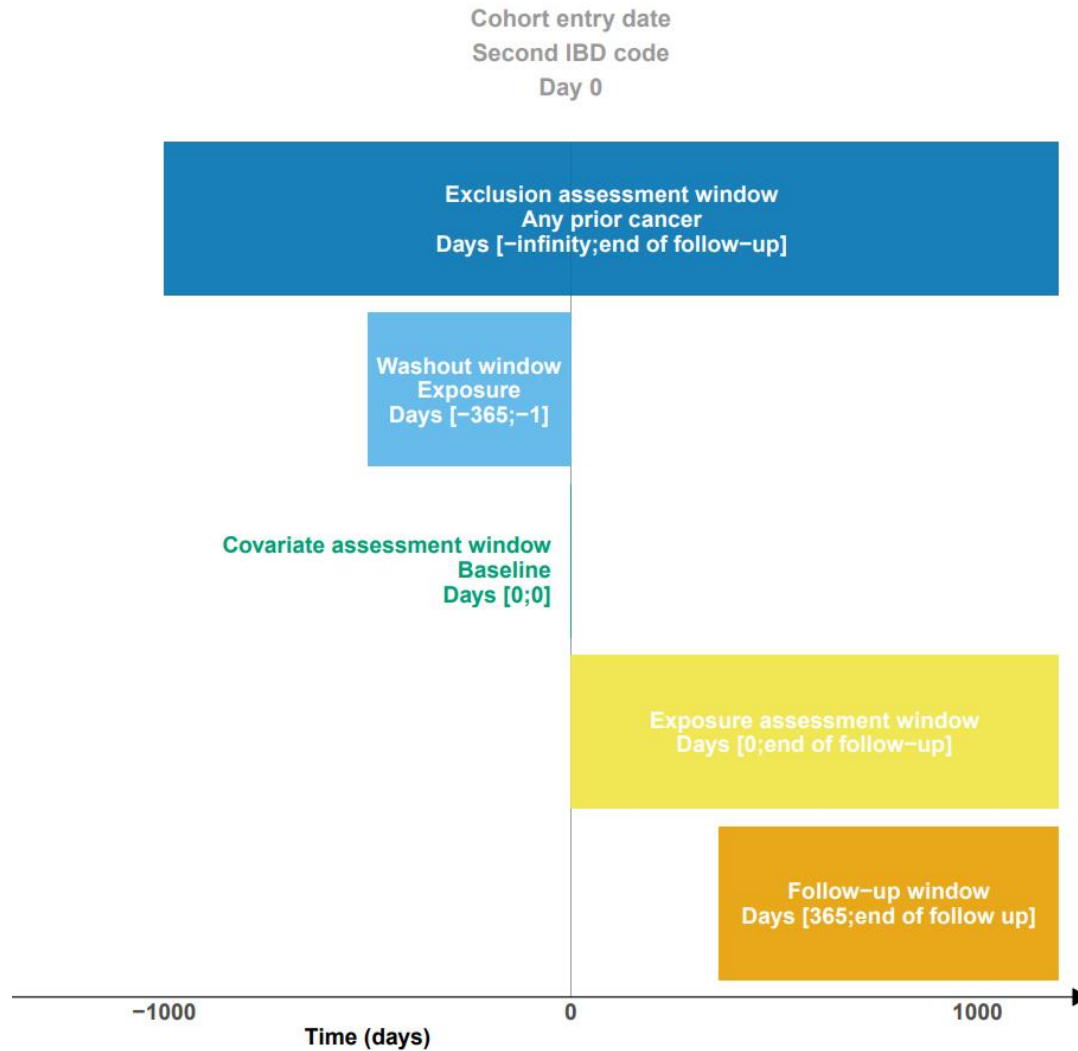
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**Fig. S1. Overview of cohort members included in analysis.**

**Fig. S2. Design diagram of analyses on pharmacotherapy in the Swedish cohort.**

Diagram inspired by the work of Schneeweiss et al.,<sup>1</sup> made using template available at <https://presc.sdu.dk/repeat-diagrams/>



**Table S1. ICD codes used to define patients with inflammatory bowel disease (IBD) from national patient registry and hospital databases.**

<b>IBD subtype</b>	<b>ICD-9</b>	<b>ICD-10</b>
Ulcerative colitis (UC)	556	K51
Crohn's disease (CD)	555	K50
Unclassified (IBD-U)	UC+CD	UC+CD or K523

Classification of IBD subtypes is based on the two first diagnostic codes:

Ulcerative colitis, 1st code UC, 2nd code UC;

Crohn's disease, 1st code CD, 2nd code CD;

Unclassified, 1st code IBD-U, 2nd code IBD-U, or any combination of codes for UC, CD, and IBD-U.

ICD-9 was implemented in Sweden in 1987, and in Norway in 1986. ICD-10 was implemented in Sweden 1997, and in Norway in 1999.

**Table S2. Definitions and diagnostic codes used to define ulcerative colitis (UC) and Crohn's disease (CD) according to the Montreal classification.**

Ulcerative colitis	Extent	Diagnostic codes	
		Norway	Sweden
E1	Ulcerative proctitis	ICD-10=K512; ICD-9=5561	ICD-10=K512
E2	Left-sided UC	ICD-10=K513, K515; ICD-9=5565	ICD-10=K513, K515
E3	Extensive UC	ICD-10=K510, K511; ICD-9=5562	ICD-10=K510, K511
Ex	Extent not defined	ICD-10=K51, K514, K518, K519; ICD-9=5560, 55606, 5564, 5569	ICD-10=K514, K518, K519
Crohn's disease	Location	Diagnostic codes	
		Norway	Sweden
L1	Small bowel disease or terminal ileitis	ICD-10=K500; ICD-9=5550	ICD-10=K500; ICD-9=555A
L2	Colon	ICD-10=K501; ICD-9=5551, 55506	ICD-10=K501; ICD-9=555B
L3	Ileocecal Crohn's disease	ICD-10=K508; ICD-9=5552	ICD-10=K508; ICD-9=555C, 555AB
Lx	Location not defined	ICD-10=K509; ICD-9=555, 5559, 55502, 56301	ICD-10=K509; ICD-9=555X, 555
Crohn's disease	Behaviour	Diagnostic codes	
		Norway	Sweden
B1	Non-stricturing, non-penetrating	None of the ICD-codes for B2 or B3	None of the ICD-codes for B2 or B3
B2	Stricturing	Crohn's disease AND any of the following codes: ICD-10=K565, K566, K567, K624; ICD-9=5608, 5609	Crohn's disease AND any of the following codes: IC10=K565, K566, K567, K624; ICD-9=560W, 560X
B3	Penetrating	Crohn's disease AND any of the following diagnostic codes: ICD-10=K630, K632, K316, N823, N824; ICD-9=5374, 5696, 5961, 6191, 6298, OR any of the following surgical procedure codes (JHD20, JHD30, JHD33, JHD50, JHD60, JHD63, JFA76, JFA86, 4603, 4962)	Crohn's disease AND any of the following diagnostic codes: IC10=K630, K632, K316, N823, N824; ICD-9=569F, 537E, 596B, 619B, OR any of the following surgical procedure codes (JHD20, JHD30, JHD33, JHD50, JHD60, JHD63, JFA76, JFA86, no 4603 or 2#GH 4962)
B2B3	Stricturing and penetrating	Both of the ICD codes for B2 and B3	Both of the ICD codes for B2 and B3
P	Perianal disease modifier	Crohn's disease AND any of the following diagnostic codes: K603, K604, K605, K610, K611, K612, K613, K614, K624; ICD-9=565, 5650, 5651, OR any of the following surgical procedure codes: (JHD20, JHD30, JHD33, JHD50, JHD60, JHD63, JHA00, JHA20, JHW96)	Crohn's disease AND any of the following diagnostic codes: K603, K604, K605, K610, K611, K612, K613, K614, K624; ICD-9=565B, 566, 569C, OR any of the following surgical procedure codes: (JHD20, JHD30, JHD33, JHD50, JHD60, JHD63, JHA00, JHA20, JHW96)

ICD-9 was implemented in Sweden in 1987, and in Norway in 1986. Swedish ICD-9 codes do not discriminate between different levels of extent of ulcerative colitis. ICD-10 was implemented in Sweden 1997, and in

Norway in 1999. All codes were captured in the Swedish National Patient Register and Norwegian hospital databases.

**Table S3: Definition of IBD-related bowel surgeries in Norway and Sweden.<sup>2</sup>**

	Norway		Sweden	
	SIFF codes (1980-1998)	NCSP-N codes (1999- present)	5/6 <sup>th</sup> revision (1963-1996)	7 <sup>th</sup> revision (1997-present)
Small bowel resection	4620, 4621, 4722, 4672	JFB00, JFB01, JFC00, JFC01, JFA60	4630, 4631	JFB00-01
Colon resection	464, 4723, 4673	JFB4, JFB50, JFB51, JFB6	464, 4713	JFB2-JFB6
Rectum resection	482	JGB	482	JGB
Other or combinations	4724	JFB20, JFB21, JFB33, JFB34, JFB53, JFB54, JFB96, JFB97		
Total colectomy	465	JFH	465	JFH

SIFF: Statens Institutt for Folkehelse; Norwegian Institute of Public Health classification of surgeries.

NCSP: Nordic Medico-Statistical Committee (NOMESCO) Classification of Surgical Procedures. NCSP was introduced in Norway in 1999, and in Sweden in 1997.

**Table S4: Definition of biologic drugs and thiopurines according to Anatomical Therapeutic Chemical (ATC) codes in the Swedish Prescribed Drug Register.**

<b>Medication</b>	<b>ATC code</b>
Thiopurines (mixed with Allopurinol or not)	
Azathioprine	L04AX01
Mercaptopurine	L01BB02
Anti-TNF agents	
Etanercept	L04AB01
Infliximab	L04AA12, L04AB02
Adalimumab	L04AB04
Certolizumab pegol	L04AB05
Golimumab	L04AB06



**Table S5: Definition of cancer outcomes in Norway and Sweden.**<sup>3,4</sup>**Table S5A:** Outcome definitions in Norwegian data, using ICD-10 and ICD-O-3 codes.

Outcome	ICD-10	ICD-O-3 topography	ICD-O-3 morphology
Hodgkin's lymphoma	C81	C77	965-966
Non-Hodgkin's lymphoma			
	B-cell C82, C83, C85:	C77	967-969, 9728, 973, 9761-9767, 9769, 9823, 9826, 9833, 9836, 9940
	CLL* C91.1	C421	9823
	T/NK-cell C84, C86	C77	970, 971, 9729, 9827, 9831, 9834, 9837, 9948

\*C91.1. CLL, leukemic presentation, morphology code 9823; C42.1. CLL, lymphoma presentation, morphology code 9823.

**Table S5B.** ICD-O-2 and SNOMED codes for leukemia and lymphomas in Sweden.

Outcome	ICD-O2	SNOMED
Non-Hodgkin's lymphoma (NHL)	C82-C85	Any code starting with 95, 96, 97,98
Hodgkin's lymphoma (HL)	C81	Any code starting with 95, 96, 97,98
Chronic lymphocytic leukemia	C91.1	Any code starting with C98

**Table S6: Number of cases, standardized incidence ratio, and crude incidence rates per 100,000 person-years for non-Hodgkin lymphoma, Norway and Sweden.**

Parameters	Norway 1987-2015			Sweden 1993-2016		
	IR (95% CI)	O/E	SIR (95% CI)	IR (95% CI)	O/E	SIR (95% CI)
Total	20,4 (16,6 to 25,1)	90/69,1	1,3 (1,1 to 1,6)	36,9 (32,8 to 41,5)	279/208,7	1,3 (1,2 to 1,5)
Sex						
Female	16,8 (12,1 to 23,3)	36/27	1,3 (1,0 to 1,8)	29,4 (24,4 to 35,5)	109/82,4	1,3 (1,1 to 1,6)
Male	23,8 (18,3 to 31,1)	54/42,1	1,3 (1,0 to 1,7)	44,1 (37,9 to 51,3)	170/126,3	1,3 (1,2 to 1,6)
Age at IBD diagnosis						
<20	1,9 (0,3 to 13,6)	1/0,6	1,8 (0,3 to 12,9)	8,5 (4,0 to 17,8)	7/1,5	4,6 (2,2 to 9,7)
20-39	6,5 (3,7 to 11,1)	13/10,3	1,3 (0,7 to 2,2)	12,2 (8,8 to 17)	35/18,4	1,9 (1,4 to 2,6)
40-59	32,8 (24,4 to 44,1)	44/32,6	1,3 (1,0 to 1,8)	42,7 (35,7 to 51,2)	117/90,2	1,3 (1,1 to 1,6)
60+	60,8 (43 to 85,9)	32/25,7	1,2 (0,9 to 1,8)	107 (89,5 to 127,9)	120/98,5	1,2 (1,0 to 1,5)
Calendar year of IBD diagnosis <sup>a</sup>						
1987/93-2002	19,3 (15,1 to 24,7)	63/51,4	1,2 (1,0 to 1,6)	40,4 (35,2 to 46,3)	205/147	1,4 (1,2 to 1,6)
2003-2015/6	23,7 (16,3 to 34,6)	27/17,8	1,5 (1,0 to 2,2)	29,8 (23,7 to 37,4)	74/61,7	1,2 (1,0 to 1,5)
IBD subtype						
Ulcerative colitis	14,8 (9,6 to 23,0)	20/15,7	1,3 (0,8 to 2,0)	36,9 (30,2 to 45)	97/67,3	1,4 (1,2 to 1,8)
Crohn's disease	23 (18 to 29,4)	63/48,6	1,3 (1,0 to 1,7)	37,7 (32,4 to 43,9)	168/129,5	1,3 (1,1 to 1,5)
IBD-unclassified	22,2 (10,6 to 46,5)	7/4,8	1,5 (0,7 to 3,1)	29,9 (17,7 to 50,4)	14/11,9	1,2 (0,7 to 2,0)
Extent of ulcerative colitis <sup>b</sup>						
E1 (proctitis)	25,6 (16,1 to 40,7)	18/13,3	1,3 (0,9 to 2,1)	38,5 (23,6 to 62,9)	16/10,8	1,5 (0,9 to 2,4)
E2 (left-sided)	26,8 (11,2 to 64,4)	5/3,7	1,3 (0,6 to 3,2)	35,9 (25,1 to 51,4)	30/26,2	1,1 (0,8 to 1,6)
E3 (extensive)	21,7 (15,4 to 30,6)	33/24,4	1,4 (1,0 to 1,9)	34,8 (28,2 to 43)	86/65,5	1,3 (1,1 to 1,6)
Ex (not defined)	21 (10,0 to 44,1)	7/7,1	1 (0,5 to 2,1)	49 (35,3 to 67,9)	36/27	1,3 (1,0 to 1,8)
Location of Crohn's disease <sup>b</sup>						
L1 (terminal ileitis)	33,9 (16,9 to 67,8)	8/3,1	2,6 (1,3 to 5,1)	44,3 (28,3 to 69,5)	19/13,2	1,4 (0,9 to 2,2)
L2 (colonic)	16,4 (6,8 to 39,3)	5/4,2	1,2 (0,5 to 2,8)	38,9 (24,8 to 61)	19/13,1	1,5 (0,9 to 2,3)
L3 (ileocecal)	9,1 (4,1 to 20,4)	6/6,1	1 (0,4 to 2,2)	29,9 (22,1 to 40,4)	42/31,7	1,3 (1,0 to 1,8)
Lx (not defined)	6,5 (0,9 to 46,5)	1/2,3	0,4 (0,1 to 3,1)	55,1 (34,2 to 88,6)	17/9,3	1,8 (1,1 to 2,9)
Behavior of Crohn's disease <sup>b</sup>						
B1 (non structuring / penetrating)	16,6 (10,2 to 27,1)	16/11,4	1,4 (0,9 to 2,3)	30,8 (23,7 to 40)	56/44,4	1,3 (1,0 to 1,6)
B2 (stricturing)	9,3 (2,3 to 37,3)	2/3	0,7 (0,2 to 2,7)	60 (43,1 to 83,6)	35/18,2	1,9 (1,4 to 2,7)
B3 (penetrating)	-	0/0,8	-	45,7 (19,0 to 109,9)	5/2,0	2,5 (1,0 to 5,9)
B2B3 (stricturing and penetrating)	31,5 (7,9 to 126,1)	2/0,6	3,5 (0,9 to 14,1)	8,4 (1,2 to 59,8)	1/2,6	0,4 (0,1 to 2,7)
Perianal disease of Crohn's disease <sup>b</sup>						
No	15,4 (9,6 to 24,8)	17/13,7	1,2 (0,8 to 2,0)	30,3 (23,6 to 39,1)	60/52,7	1,1 (0,9 to 1,5)
Yes	12,2 (3,9 to 37,8)	3/2	1,5 (0,5 to 4,7)	56,6 (41,0 to 78,1)	37/14,7	2,5 (1,8 to 3,5)
Years since IBD diagnosis						
>1 - 2	25,1 (13,5 to 46,6)	10/4,7	2,1 (1,1 to 3,9)	34,3 (23,5 to 49,9)	27/17,7	1,5 (1,0 to 2,2)
>2 - 5	21,9 (14,5 to 32,9)	23/13,4	1,7 (1,1 to 2,6)	31,3 (24,5 to 39,9)	65/49,9	1,3 (1,0 to 1,7)
>5 - 10	15 (9,7 to 23,2)	20/19,6	1 (0,7 to 1,6)	37 (30,2 to 45,2)	95/70,3	1,4 (1,1 to 1,7)
10+	22,8 (16,5 to 31,5)	37/31,4	1,2 (0,9 to 1,6)	43,4 (35,4 to 53,2)	92/70,9	1,3 (1,1 to 1,6)
Primary sclerosing cholangitis <sup>c</sup>						
No	19,7 (15,9 to 24,3)	85/68,1	1,2 (1,0 to 1,5)	36 (31,9 to 40,6)	264/203,8	1,3 (1,1 to 1,5)
Yes	59,5 (24,8 to 143,1)	5/1,1	4,7 (2,0 to 11,3)	65,4 (39,4 to 108,5)	15/4,8	3,1 (1,9 to 5,2)

Bowel surgery during follow-up<sup>d</sup>

No	21,3 (17 to 26,7)	75/56,3	1,3 (1,1 to 1,7)	34,5 (30,3 to 39,3)	228/184,6	1,2 (1,1 to 1,4)
Yes	17,1 (10,3 to 28,3)	15/12,8	1,2 (0,7 to 1,9)	53,3 (40,5 to 70,2)	51/24,0	2,1 (1,6 to 2,8)

IR, incidence rate, per 100 000 person-years; CI, confidence interval; O, observed number of cases; E, expected number of cases; SIR, standardized incidence ratio.

#All patients were at risk from one year after IBD diagnosis;

<sup>a</sup>Patients diagnosed before 2002 could represent a mix of prevalent and incident patients with IBD, as outpatient data were gradually included in hospital databases and the Swedish national patient register;

<sup>b</sup>Definitions and diagnostic codes were used according to the Montreal classifications using ICD9 and ICD10 in Norwegian data and using ICD-10 in Swedish data, representing maximum disease involvement during follow-up, see Table S2 for details;

<sup>c</sup>Patients with primary sclerosing cholangitis contributed person-time to the non-PSC group until the date of PSC diagnosis;

<sup>d</sup>Bowel surgeries included colectomy, small bowel resection, rectal resection, and colon resection during follow-up. See Table S3 for definitions.

**Table S7: Number of cases, standardized incidence ratio, and crude incidence rates per 100,000 person-years for Hodgkin lymphoma, Norway and Sweden.**

Parameters	Norway 1987-2015			Sweden 1993-2016		
	IR (95% CI)	O/E	SIR (95% CI)	IR (95% CI)	O/E	SIR (95% CI)
Total	3,4 (2,1 to 5,6)	15/10,6	1,4 (0,9 to 2,3)	3,8 (2,7 to 5,5)	29/17,9	1,6 (1,1 to 2,3)
Sex						
Female	3,3 (1,6 to 6,9)	7/4	1,8 (0,8 to 3,7)	2,4 (1,3 to 4,7)	9/7,6	1,2 (0,6 to 2,3)
Male	3,5 (1,8 to 7,1)	8/6,6	1,2 (0,6 to 2,4)	5,2 (3,3 to 8,0)	20/10,2	2 (1,3 to 3,0)
Age at IBD diagnosis						
<20	3,8 (1 to 15,3)	2/1,7	1,2 (0,3 to 4,8)	2,4 (0,6 to 9,7)	2/2,7	0,7 (0,2 to 3)
20-39	3 (1,3 to 6,6)	6/5,1	1,2 (0,5 to 2,6)	3,8 (2,1 to 6,9)	11/6,6	1,7 (0,9 to 3)
40-59	3,7 (1,6 to 9)	5/2,6	1,9 (0,8 to 4,6)	2,9 (1,5 to 5,8)	8/5,4	1,5 (0,7 to 3)
60+	3,8 (0,9 to 15,2)	2/1,2	1,6 (0,4 to 6,6)	7,1 (3,6 to 14,3)	8/3,2	2,5 (1,3 to 5)
Calendar year of IBD diagnosis <sup>a</sup>						
1987/93-2002	2,4 (1,2 to 4,9)	8/7,7	1,0 (0,5 to 2,1)	4,1 (2,7 to 6,3)	21/11,4	1,8 (1,2 to 2,8)
2003-2015/6	6,1 (2,9 to 12,9)	7/2,9	2,4 (1,1 to 5,1)	3,2 (1,6 to 6,4)	8/6,5	1,2 (0,6 to 2,5)
IBD subtype						
Ulcerative colitis	3,7 (1,5 to 8,9)	5/3,4	1,5 (0,6 to 3,6)	4,2 (2,3 to 7,5)	11/6,1	1,8 (1,0 to 3,2)
Crohn's disease	3,6 (2,0 to 6,8)	10/6,5	1,5 (0,8 to 2,9)	3,8 (2,4 to 6,1)	17/10,6	1,6 (1,0 to 2,6)
IBD-unclassified	-	0/0,8	-	2,1 (0,3 to 15,2)	1/1,2	0,9 (0,1 to 6,2)
Extent of ulcerative colitis <sup>b</sup>						
E1 (proctitis)	7,1 (3,0 to 17,1)	5/1,6	3,1 (1,3 to 7,5)	4,8 (1,2 to 19,3)	2/0,9	2,1 (0,5 to 8,4)
E2 (left-sided)	-	0/0,4	-	4,8 (1,8 to 12,8)	4/1,9	2,1 (0,8 to 5,5)
E3 (extensive)	3,3 (1,4 to 7,9)	5/3,7	1,4 (0,6 to 3,2)	3,2 (1,6 to 6,5)	8/5,9	1,3 (0,7 to 2,7)
Ex (not defined)	-	0/0,8	-	4,1 (1,3 to 12,7)	3/1,7	1,7 (0,6 to 5,4)
Location of Crohn's disease <sup>b</sup>						
L1 (terminal ileitis)	-	0/0,6	-	2,3 (0,3 to 16,6)	1/1,0	1 (0,1 to 7,0)
L2 (colonic)	3,3 (0,5 to 23,2)	1/0,7	1,4 (0,2 to 9,7)	10,2 (4,3 to 24,6)	5/1,1	4,4 (1,8 to 10,5)
L3 (ileocecal)	6,1 (2,3 to 16,3)	4/1,7	2,4 (0,9 to 6,3)	3,6 (1,5 to 8,5)	5/3,3	1,5 (0,6 to 3,7)
Lx (not defined)	-	0/0,4	-	-	0/0,7	-
Behavior of Crohn's disease <sup>b</sup>						
B1 (non structuring / penetrating)	4,1 (1,6 to 11,1)	4/2,4	1,7 (0,6 to 4,5)	4,4 (2,2 to 8,8)	8/4,3	1,9 (0,9 to 3,7)
B2 (stricturing)	-	0/0,5	-	-	0/1,3	-
B3 (penetrating)	9,3 (1,3 to 65,9)	1/0,3	3,5 (0,5 to 24,6)	9,1 (1,3 to 64,9)	1/0,3	3,7 (0,5 to 26,4)
B2B3 (stricturing and penetrating)	-	0/0,2	-	16,8 (4,2 to 67,3)	2/0,3	7,8 (1,9 to 31,1)
Perianal disease of Crohn's disease <sup>b</sup>						
No	4,5 (1,9 to 10,9)	5/2,7	1,8 (0,8 to 4,4)	2,5 (1,1 to 6,1)	5/4,6	1,1 (0,5 to 2,6)
Yes	-	0/0,6	-	9,2 (4,1 to 20,4)	6/1,5	4 (1,8 to 8,9)
Years since IBD diagnosis						
>1 - 2	7,5 (2,4 to 23,3)	3/1	3 (1,0 to 9,4)	1,3 (0,2 to 9)	1/1,9	0,5 (0,1 to 3,8)
>2 - 5	1,9 (0,5 to 7,6)	2/2,6	0,8 (0,2 to 3,1)	1,4 (0,5 to 4,5)	3/4,9	0,6 (0,2 to 1,9)
>5 - 10	4,5 (2,0 to 10,0)	6/3,3	1,8 (0,8 to 4,1)	5,1 (2,9 to 8,7)	13/6,1	2,1 (1,2 to 3,7)
10+	2,5 (0,9 to 6,6)	4/3,7	1,1 (0,4 to 2,9)	5,7 (3,2 to 10)	12/5,0	2,4 (1,4 to 4,2)
Primary sclerosing cholangitis <sup>c</sup>						
No	3 (1,7 to 5,2)	13/10,4	1,3 (0,7 to 2,2)	3,8 (2,6 to 5,5)	28/17,3	1,6 (1,1 to 2,3)
Yes	23,8 (6,0 to 95,2)	2/0,2	9,1 (2,3 to 36,3)	4,6 (0,7 to 32,9)	1/0,5	1,8 (0,3 to 13,0)

Bowel surgery during follow-up<sup>d</sup>

No	3,7 (2,1 to 6,3)	13/8,5	1,5 (0,9 to 2,6)	3,3 (2,2 to 5,1)	21/14,9	1,4 (0,9 to 2,2)
Yes	2,3 (0,6 to 9,1)	2/2,2	0,9 (0,2 to 3,7)	8,4 (4,2 to 16,7)	8/2,3	3,5 (1,8 to 7,0)

IR, incidence rate, per 100 000 person-years; CI, confidence interval; O, observed number of cases; E, expected number of cases; SIR, standardized incidence ratio.

#All patients were at risk from one year after IBD diagnosis;

<sup>a</sup>Patients diagnosed before 2002 could represent a mix of prevalent and incident patients with IBD, as outpatient data were gradually included in hospital databases and the Swedish national patient register;

<sup>b</sup>Definitions and diagnostic codes were used according to the Montreal classifications using ICD9 and ICD10 in Norwegian data and using ICD-10 in Swedish data, representing maximum disease involvement during follow-up, see Table S2 for details;

<sup>c</sup>Patients with primary sclerosing cholangitis contributed person-time to the non-PSC group until the date of PSC diagnosis;

<sup>d</sup>Bowel surgeries included colectomy, small bowel resection, rectal resection, and colon resection during follow-up. See Table S3 for definitions.

**Table S8: Number of cases, standardized incidence ratio, and crude incidence rates per 100,000 person-years for non-Hodgkin lymphoma, Norway and Sweden, first year of follow-up included.**

Parameters	Norway 1987-2015			Sweden 1993-2016		
	IR (95% CI)	O/E	SIR (95% CI)	IR (95% CI)	O/E	SIR (95% CI)
Total	20,1 (16,4 to 24,5)	97/74	1,3 (1,1 to 1,6)	41,2 (37,1 to 45,8)	346/227,0	1,5 (1,4 to 1,7)
Sex						
Female	17 (12,5 to 23,2)	40/29	1,4 (1 to 1,9)	31,2 (26,2 to 37,0)	128/89,6	1,4 (1,2 to 1,7)
Male	23 (17,7 to 29,8)	57/45	1,3 (1 to 1,6)	50,9 (44,5 to 58,1)	218/137,3	1,6 (1,4 to 1,8)
Age at IBD diagnosis						
<20	3,5 (0,9 to 14)	2/0,6	3,5 (0,9 to 13,9)	10,9 (5,9 to 20,2)	10/1,6	6,1 (3,3 to 11,4)
20 to 39	6 (3,5 to 10,2)	13/10,5	1,2 (0,7 to 2,1)	12,9 (9,5 to 17,6)	41/19,3	2,1 (1,6 to 2,9)
40-59	31,2 (23,4 to 41,7)	46/34,1	1,3 (1 to 1,8)	46,5 (39,4 to 54,8)	140/95,0	1,5 (1,2 to 1,7)
60+	59,7 (43 to 82,7)	36/28,8	1,2 (0,9 to 1,7)	119,7 (102,3 to 140,1)	155/111,1	1,4 (1,2 to 1,6)
Calendar year of IBD diagnosis <sup>a</sup>						
1987/93-2002	19 (14,9 to 24,2)	66/53,3	1,2 (1 to 1,6)	44,0 (38,7 to 49,9)	240/155,5	1,5 (1,4 to 1,8)
2003-2015/6	22,8 (16 to 32,4)	31/20,8	1,5 (1,1 to 2,1)	36,1 (29,8 to 43,7)	106/71,5	1,5 (1,2 to 1,8)
IBD subtype						
Ulcerative colitis	15,6 (10,3 to 23,4)	23/16,8	1,4 (0,9 to 2,1)	44,3 (37,3 to 52,7)	129/72,9	1,8 (1,5 to 2,1)
Crohn's disease	22,3 (17,6 to 28,4)	67/52	1,3 (1 to 1,6)	40,4 (35,2 to 46,4)	200/140,7	1,4 (1,2 to 1,6)
IBD to unclassified	19,9 (9,5 to 41,6)	7/5,2	1,3 (0,6 to 2,8)	31,8 (19,8 to 51,1)	17/13,4	1,3 (0,8 to 2,0)
Extent of ulcerative colitis <sup>b</sup>						
E1 (proctitis)	25 (15,9 to 39,2)	19/14,1	1,3 (0,9 to 2,1)	33,6 (20,6 to 54,9)	16/12,0	1,3 (0,8 to 2,2)
E2 (left-sided)	28,7 (12,9 to 63,9)	6/4,1	1,5 (0,7 to 3,3)	35,1 (25,0 to 49,4)	33/28,8	1,1 (0,8 to 1,6)
E3 (extensive)	20,5 (14,6 to 28,6)	34/26	1,3 (0,9 to 1,8)	36,9 (30,3 to 44,9)	100/70,0	1,4 (1,2 to 1,7)
Ex (not defined)	21,5 (10,8 to 43)	8/7,8	1 (0,5 to 2,1)	62,0 (47,1 to 81,6)	51/30,0	1,7 (1,3 to 2,2)
Location of Crohn's disease <sup>b</sup>						
L1 (terminal ileitis)	33,9 (17,6 to 65,2)	9/3,4	2,6 (1,4 to 5)	62,0 (43,4 to 88,7)	30/14,6	2,1 (1,4 to 2,9)
L2 (colonic)	18 (8,1 to 40)	6/4,5	1,3 (0,6 to 2,9)	42,3 (28,1 to 63,7)	23/14,2	1,6 (1,1 to 2,4)
L3 (ileocecal)	9,9 (4,7 to 20,7)	7/6,3	1,1 (0,5 to 2,3)	33,9 (25,9 to 44,5)	52/33,6	1,5 (1,2 to 2,0)
Lx (not defined)	5,9 (0,8 to 41,9)	1/2,5	0,4 (0,1 to 2,8)	68,3 (45,8 to 101,9)	24/10,5	2,3 (1,5 to 3,4)
Behavior of Crohn's disease <sup>b</sup>						
B1 (non structuring / penetrating)	17,9 (11,4 to 28)	19/12,3	1,5 (1 to 2,4)	40,9 (33,0 to 50,7)	83/48,4	1,7 (1,4 to 2,1)
B2 (stricturing)	8,7 (2,2 to 34,7)	2/3,1	0,6 (0,2 to 2,6)	63,2 (46,3 to 86,1)	40/19,5	2,1 (1,5 to 2,8)
B3 (penetrating)	0	0/0,8	- to 0)	41,6 (17,3 to 100,1)	5/2,2	2,3 (1,0 to 5,5)
B2B3 (stricturing and penetrating)	29,7 (7,4 to 118,6)	2/0,6	3,4 (0,9 to 13,6)	7,8 (1,1 to 55,7)	1/2,8	0,4 (0,1 to 2,6)
Perianal disease of Crohn's disease <sup>b</sup>						
No	16,5 (10,6 to 25,6)	20/14,7	1,4 (0,9 to 2,1)	40,0 (32,5 to 49,3)	88/57,3	1,5 (1,2 to 1,9)
Yes	11,3 (3,6 to 35)	3/2,1	1,5 (0,5 to 4,5)	57,6 (42,4 to 78,2)	41/15,6	2,6 (1,9 to 3,6)
Years since IBD diagnosis						
0 - 1	16,4 (7,8 to 34,4)	7/4,9	1,4 (0,7 to 3)	79,9 (62,9 to 101,5)	67/18,3	3,7 (2,9 to 4,7)

>1 - 2	25,1 (13,5 to 46,6)	10/4,7	2,1 (1,1 to 3,9)	34,3 (23,5 to 49,9)	27/17,7	1,5 (1,0 to 2,2)
>2 - 5	21,9 (14,5 to 32,9)	23/13,4	1,7 (1,1 to 2,6)	31,3 (24,5 to 39,9)	65/49,9	1,3 (1,0 to 1,7)
>5 - 10	15 (9,7 to 23,2)	20/19,6	1 (0,7 to 1,6)	37,0 (30,2 to 45,2)	95/70,3	1,4 (1,1 to 1,7)
10+	22,8 (16,5 to 31,5)	37/31,4	1,2 (0,9 to 1,6)	43,4 (35,4 to 53,2)	92/70,9	1,3 (1,1 to 1,6)
<b>Primary sclerosing cholangitis<sup>c</sup></b>						
No	19,4 (15,8 to 23,8)	92/72,9	1,3 (1 to 1,5)	40,0 (35,9 to 44,6)	326/221,9	1,5 (1,3 to 1,6)
Yes	56,6 (23,6 to 136)	5/1,1	4,6 (1,9 to 10,9)	81,8 (52,8 to 126,8)	20/5,1	3,9 (2,5 to 6,1)
<b>Bowel surgery during follow up<sup>d</sup></b>						
No	20,4 (16,4 to 25,4)	80/60,8	1,3 (1,1 to 1,6)	38,7 (34,5 to 43,5)	287/202,4	1,4 (1,3 to 1,6)
Yes	18,7 (11,6 to 30,1)	17/13,2	1,3 (0,8 to 2,1)	60,0 (46,5 to 77,5)	59/24,6	2,4 (1,9 to 3,1)

IR, incidence rate, per 100 000 person-years; CI, confidence interval; O, observed number of cases; E, expected number of cases; SIR, standardized incidence ratio,

<sup>#</sup>All patients were at risk from one year after IBD diagnosis;

<sup>a</sup>Patients diagnosed before 2002 could represent a mix of prevalent and incident patients with IBD, as outpatient data were gradually included in hospital databases and the Swedish national patient register;

<sup>b</sup>Definitions and diagnostic codes were used according to the Montreal classifications using ICD9 and ICD10 in Norwegian data and using ICD-10 in Swedish data, representing maximum disease involvement during follow-up, see Table S2 for details;

<sup>c</sup>Patients with primary sclerosing cholangitis contributed person-time to the non-PSC group until the date of PSC diagnosis;

<sup>d</sup>Bowel surgeries included colectomy, small bowel resection, rectal resection, and colon resection during follow-up, See Table S3 for definitions,

**Table S9: Number of cases, standardized incidence ratio, and crude incidence rates per 100,000 person-years for Hodgkin lymphoma, Norway and Sweden, first year of follow-up included.**

Parameters	Norway 1987-2015			Sweden 1993-2016		
	IR (95% CI)	O/E	SIR (95% CI)	IR (95% CI)	O/E	SIR (95% CI)
Total	3,5 (2,2 to 5,7)	17/11,7	1,5 (0,9 to 2,3)	4,0 (2,9 to 5,7)	34/19,8	1,7 (1,2 to 2,4)
Sex						
Female	3 (1,4 to 6,2)	7/4,4	1,6 (0,8 to 3,3)	2,7 (1,5 to 4,8)	11/8,5	1,3 (0,7 to 2,3)
Male	4 (2,2 to 7,5)	10/7,3	1,4 (0,7 to 2,6)	5,4 (3,6 to 8,1)	23/11,3	2,0 (1,3 to 3,1)
Age at IBD diagnosis						
<20	3,5 (0,9 to 14)	2/1,8	1,1 (0,3 to 4,5)	4,4 (1,6-11,6)	4/2,9	1,4 (0,5 to 3,7)
20 to 39	3,2 (1,5 to 6,7)	7/5,7	1,2 (0,6 to 2,6)	3,8 (2,2 to 6,7)	12/7,5	1,6 (0,9 to 2,8)
40-59	4,1 (1,8 to 9,1)	6/2,9	2,1 (0,9 to 4,7)	2,7 (1,3 to 5,3)	8/5,8	1,4 (0,7 to 2,7)
60+	3,3 (0,8 to 13,3)	2/1,4	1,4 (0,4 to 5,7)	7,7 (4,2 to 14,4)	10/3,6	2,8 (1,5 to 5,1)
Calendar year of IBD diagnosis <sup>a</sup>						
1987/93-2002	2,6 (1,3 to 5)	9/8,2	1,1 (0,6 to 2,1)	4,2 (2,8 to 6,3)	23/12,2	1,9 (1,2 to 2,8)
2003-2015/6	5,9 (2,9 to 11,7)	8/3,5	2,3 (1,2 to 4,6)	3,7 (2,1 to 6,8)	11/7,6	1,4 (0,8 to 2,6)
IBD subtype						
Ulcerative colitis	3,4 (1,4 to 8,1)	5/3,7	1,4 (0,6 to 3,3)	4,8 (2,8 to 8,1)	14/6,8	2,1 (1,2 to 3,5)
Crohn's disease	3,7 (2 to 6,6)	11/7,1	1,5 (0,9 to 2,8)	3,8 (2,4 to 6,0)	19/11,7	1,6 (1,0 to 2,5)
IBD-unclassified	2,8 (0,4 to 20,1)	1/0,9	1,2 (0,2 to 8,3)	1,9 (0,3 to 13,3)	1/1,3	0,8 (0,1 to 5,4)
Extent of ulcerative colitis <sup>b</sup>						
E1 (proctitis)	6,6 (2,7 to 15,8)	5/1,7	2,9 (1,2 to 6,9)	4,2 (1,1 to 16,8)	2/1,1	1,8 (0,5 to 7,3)
E2 (left-sided)	-	0/0,5	-	5,3 (2,2 to 12,8)	5/2,2	2,3 (0,9 to 5,5)
E3 (extensive)	3,6 (1,6 to 8)	6/4,1	1,5 (0,7 to 3,3)	3,0 (1,5 to 5,9)	8/6,5	1,2 (0,6 to 2,5)
Ex (not defined)	-	0/0,8	-	4,9 (1,8 to 13,0)	4/1,9	2,1 (0,8 to 5,5)
Location of Crohn's disease <sup>b</sup>						
L1 (terminal ileitis)	-	0/0,7	-	4,1 (1,0 to 16,5)	2/1,1	1,7 (0,4 to 7,0)
L2 (colonic)	3 (0,4 to 21,3)	1/0,8	1,2 (0,2 to 8,8)	11,0 (5,0 to 24,6)	6/1,3	4,7 (2,1 to 10,5)
L3 (ileocecal)	5,6 (2,1 to 15)	4/1,8	2,2 (0,8 to 5,9)	3,9 (1,8 to 8,7)	6/3,6	1,7 (0,8 to 3,8)
Lx (not defined)	-	0/0,4	-	-	0/0,8	-
Behavior of Crohn's disease <sup>b</sup>						
B1 (non structuring / penetrating)	3,8 (1,4 to 10)	4/2,6	1,5 (0,6 to 4)	5,4 (3,0-9,8)	11/4,8	2,3 (1,3-4,1)
B2 (stricturing)	-	0/0,6	-	-	0/1,4	-
B3 (penetrating)	8,6 (1,2 to 60,7)	1/0,3	3,2 (0,4 to 22,6)	8,3 (1,2 to 59,1)	1/0,3	3,4 (0,5 to 24,0)
B2B3 (stricturing and penetrating)	-	0/0,2	-	15,7 (3,9 to 62,8)	2/0,3	7,2 (1,8 to 29,0)
Perianal disease of Crohn's disease <sup>b</sup>						
No	4,1 (1,7 to 9,9)	5/3	1,7 (0,7 to 4)	3,6 (1,8 to 7,3)	8/5,1	1,6 (0,8 to 3,1)
Yes	-	0/0,7	-	8,4 (3,8 to 18,8)	6/1,6	3,6 (1,6 to 8,1)
Years since IBD diagnosis						
0-1	4,7 (1,2 to 18,8)	2/1,1	1,9 (0,5 to 7,5)	6,0 (2,5 to 14,3)	5/2,0	2,5 (1,0 to 6,0)
>1 - 2	7,5 (2,4 to 23,3)	3/1	3 (1 to 9,4)	1,3 (0,2 to 9,0)	1/1,9	0,5 (0,1 to 3,8)
>2 - 5	1,9 (0,5 to 7,6)	2/2,6	0,8 (0,2 to 3,1)	1,4 (0,5 to 4,5)	3/4,9	0,6 (0,2 to 1,9)
>5 - 10	4,5 (2 to 10)	6/3,3	1,8 (0,8 to 4,1)	5,1 (2,9 to 8,7)	13/6,1	2,1 (1,2 to 3,7)
10+	2,5 (0,9 to 6,6)	4/3,7	1,1 (0,4 to 2,9)	5,7 (3,2 to 10,0)	12/5,0	2,4 (1,4 to 4,2)
Primary sclerosing cholangitis <sup>c</sup>						
No	3,2 (1,9 to 5,2)	15/11,4	1,3 (0,8 to 2,2)	4,0 (2,9 to 5,7)	33/19,2	1,7 (1,2 to 2,4)



Bowel surgery during follow to up <sup>d</sup>	Yes	22,6 (5,7 to 90,5)	2/0,2	8,7 (2,2 to 34,6)	4,1 (0,6 to 29,0)	1/0,6	1,6 (0,2 to 11,5)
	No	3,6 (2,1 to 6)	14/9,4	1,5 (0,9 to 2,5)	3,5 (2,4 to 5,2)	26/17,5	1,5 (1,0 to 2,2)
	Yes	3,3 (1,1 to 10,2)	3/2,2	1,3 (0,4 to 4,2)	8,1 (4,1 to 16,3)	8/2,3	3,4 (1,7 to 6,8)

IR, incidence rate, per 100 000 person-years; CI, confidence interval; O, observed number of cases; E, expected number of cases; SIR, standardized incidence ratio,

#All patients were at risk from one year after IBD diagnosis;

<sup>a</sup>Patients diagnosed before 2002 could represent a mix of prevalent and incident patients with IBD, as outpatient data were gradually included in hospital databases and the Swedish national patient register;

<sup>b</sup>Definitions and diagnostic codes were used according to the Montreal classifications using ICD9 and ICD10 in Norwegian data and using ICD-10 in Swedish data, representing maximum disease involvement during follow-up, see Table S2 for details;

<sup>c</sup>Patients with primary sclerosing cholangitis contributed person-time to the non-PSC group until the date of PSC diagnosis;

<sup>d</sup>Bowel surgeries included colectomy, small bowel resection, rectal resection, and colon resection during follow-up. See Table S3 for definitions,

**References**

1. Schneeweiss S, Rassen JA, Brown JS, et al. Graphical Depiction of Longitudinal Study Designs in Health Care Databases. *Ann Intern Med* 2019;170(6):398-406. DOI: 10.7326/M18-3079.
2. Olen O, Askling J, Sachs MC, et al. Mortality in adult-onset and elderly-onset IBD: a nationwide register-based cohort study 1964-2014. *Gut* 2020;69(3):453-461. DOI: 10.1136/gutjnl-2018-317572.
3. Swerdlow SH, Campo E, Pileri SA, et al. The 2016 revision of the World Health Organization classification of lymphoid neoplasms. *Blood* 2016;127(20):2375-90. DOI: 10.1182/blood-2016-01-643569.
4. Fritz AG. International classification of diseases for oncology : ICD-O. Third edition, First revision. ed. Geneva: World Health Organization, 2013.