ORIGINAL ARTICLE

Work disability in inflammatory bowel disease patients 10 years after disease onset: results from the IBSEN Study

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► An additional table is published online only. To view this file please visit the journal online (http://dx.doi.org/10.1136/gutjnl-2012-302311)

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Revised 16 May 2012
Accepted 17 May 2012
Published Online First 20 June 2012

ABSTRACT

Objective To compare the work disability (WD) rate in inflammatory bowel disease (IBD) patients 10 years after disease onset, with the WD rate in the background population,and to assess whether clinical or demographic factors in the early disease course could predict WD after 10 years disease.

Design A large, population-based inception cohort (the Inflammatory Bowel in South Eastern Norway cohort) was prospectively followed up at 1, 5 and 10 years after diagnosis. At the 10-year follow-up data on WD were collected. Data on disability pension (DP) in the background population were retrieved from public databases. We calculated overall and age-standardised relative risks (RR) for DP. Logistic regression analysis was used to examine predictive factors.

Results A total of 518 patients completed the 10-year follow-up (response rate 83.5%). The overall disability rate in the IBD population was 18.8%, and the RR was 1.8 (95% CI 1.4 to 2.3) for ulcerative colitis (UC) and 2.0 (95% CI 1.4 to 2.7) for Crohn's disease (CD). The RR for DP was highest in patients aged below 40 years while patients aged over 60 years had no increased RR. Steroid treatment at the 1-year follow-up predicted WD after 10 years disease in both CD and UC. In UC, increased C-reactive protein (CRP) or erythrocyte sedimentation rate (ESR) at diagnosis, early colectomy, and more than two relapses during the first year of the disease also predicted WD.

Conclusion Ten years after disease onset IBD patients had an increased RR for DP as compared with the background population. The youngest patients had the highest RR. Markers of severe disease course predicted WD.

Significance of this study

What is already known on this subject?
- Work disability (WD) can lead to important negative impact on financial, psychosocial and health issues for the individual patient.
- For society, a large part of the indirect costs from inflammatory bowel disease is due to WD.
- Long term data from prospective, population-based studies are scarce.

What are the new findings?
- Ten years after disease onset 18.8% of the inflammatory bowel disease patients received a disability pension.
- Patients below 40 years of age had the highest RR, while patients above the age of 60 did not have an increased RR.
- The use of corticosteroids 1 year after disease onset predicted WD after 10 years disease course.
- The use of steroids was strongly associated with relapse and surgery, thus likely a marker of severe disease and continuous disease activity.

How might it impact on clinical practice in the foreseeable future?
- Both within the social and the healthcare systems one should be aware of the large risk for WD especially in young patients and patients with severe and continuous disease activity in the early disease course. Efforts should be made to prevent WD and to help work disabled patients back into the labour market.

INTRODUCTION

A chronic and unpredictable disease course, potentially debilitating and taboo symptoms, and disease onset in adolescence or early adulthood can make inflammatory bowel disease (IBD) a heavy burden for patients. One possible consequence of IBD is a reduced ability to work or study, which can be decisive for future life expectations for the patients and their families. Additionally, a large portion of the societal costs associated with IBD are indirect and are associated with sick leave, disability pensions (DP), and early retirement.[1–3] Therefore, the prevention or postponement of work disability (WD) is an important goal in the treatment of IBD patients; however, this requires a thorough knowledge of disability rates and the predictors of disability.

The disability rates of IBD patients reported in the literature vary considerably and range between 1.3% and 34%.[4–11] However, the studies reporting these rates had different designs, and many socioeconomic factors, such as differences in social security systems, employment rates and definitions of disability, differed in the countries and time periods in which the studies were conducted.

Several factors have been associated with WD, including female sex,[5 8 11] age,[5 11] diagnosis (ie,

patients with Crohn's disease (CD) are more often disabled compared with ulcerative colitis (UC) patients),[7] surgery (eg, bowel resection or CD-related gastrointestinal surgery),[8 10] hospitalisations,[10] a lower quality of life[10] and a higher education level.[7] However, few of the studies reporting these associations were prospective and none were designed to assess whether factors present early in the disease course predicted WD at a later stage.

The Inflammatory Bowel in South Eastern Norway (IBSEN) cohort is a well-defined, population-based study designed to include IBD patients at the time of diagnosis and follow them prospectively. Follow-up visits occurred 1, 5, and 10 years after diagnosis. At the 10-year follow-up, data regarding WD were collected.

The main aim of this study was to determine the disability rate in a cohort of IBD patients 10 years after disease onset and to compare this rate to the disability rate of the general population. Furthermore, we also assessed whether clinical and demographic factors present early in the disease course (from diagnosis to 1-year follow-up) predicted WD after 10 years of disease.

METHODS

Study design and study population

From 1 January 1990 to 31 December 1993, all newly diagnosed cases of IBD or possible IBD in four well-defined areas in South-eastern Norway, namely the counties of Oslo, Østfold, Telemark and Aust-Agder, were registered prospectively. In total, 843 patients were initially included in this inception cohort. The cohort has been followed comprehensively for 10 years with scheduled follow-up visits at 1, 5 and 10 years (±1 year) after diagnosis. The cohort organisation, patient diagnostic criteria and clinical follow-up protocol have been described in detail elsewhere.[12–14]

Data collection

In this study, we present data from the enrolment, 1-year follow-up and 10 year follow-up time points. The enrolment and 1-year follow-up assessments consisted of a structured interview, clinical examination, ileocolonoscopy, laboratory tests and a review of hospital records. In addition to the above, the 10-year follow-up visit also included a patient-reported questionnaire covering questions on work status and disability. The patients were asked for their employment status, which was defined using the following categories: working, student, DP, housewife, pensioner or unemployed. Additionally, patients were asked if they had applied for or received a rehabilitation benefit or DP because of their IBD. This information was verified using hospital records.

Definitions of outcome and predictor variables

Sick leave, rehabilitation benefits and DPs are covered through a national program as a part of the Norwegian social security system.[15] Employees are allowed a maximum of 52 weeks of continuous sick leave. If they are not able to return to work or school after this time, they are transferred to medical or vocational rehabilitation programs. If this is not successful, it is possible to apply for a DP. Students and unemployed persons can also apply for rehabilitation programs and/or DPs. The time elapsed between a need for long-term sick leave and when a DP is granted varies considerably due to age, occupation and disease severity.

In this study, two definitions of disability were used: (1) WD, defined as all patients who had applied for or had been granted rehabilitation benefits or DPs because of their IBD at the 10 year follow-up time point (all of these patients would have had at least 52 weeks of sick leave) and (2) DP, defined as individuals who received a DP due to either their IBD or any other diagnosis at the 10-year follow-up. Receiving a DP was used as the outcome measure when we compared the proportion of IBD patients receiving a DP with the corresponding proportion in the background population. WD was used as the outcome measure in the analysis of predictive factors because we considered this outcome to be an important marker for the long-term socioeconomic consequences of IBD.

Possible predictive variables were chosen based on earlier studies that focused on predictors for WD and on studies that focused on predictors for clinical outcomes; the possible predictive variables used in this study are listed in table 1.

Age was included as a dichotomised variable because it is not likely that age has a linear effect on disability; the cut-off was set to 40 years of age at the time of diagnosis. Education level was classified as 'lower education' (≤12 years) or 'higher education' (>12 years). Smoking status was defined as 'yes' (more than one cigarette daily) or 'no' (including ex-smokers). Relapse was defined as an aggravation of symptoms occurring after the initial disease flare-up that resulted in more intensive medical treatment or surgery. Surgery was defined as any intra-abdominal procedure for the treatment of active CD or UC. The use of oral corticosteroids was defined as 'yes' or 'no' at diagnosis and the 1-year follow-up. While there was no international classification system for CD phenotypes at the time of enrolment or the 1-year follow-up, disease localisation, stenosis, fistulas and abscesses were recorded both at diagnosis and follow-up. This information made it possible to retrospectively classify the patients according to the Vienna classification system.[16] UC location was classified as 'proctitis' (ie, inflammatory changes up to 15 cm from the anus), 'left-sided colitis' (ie, inflammatory changes up to the splenic flexure) or 'extensive colitis' (ie, inflammatory changes above the splenic flexure). Mucosal healing was assessed using endoscopic evaluation at the 1-year follow-up time point and was evaluated using an endoscopic score of 0–2 (0, normal; 1, light erythema or granularity; 2, granularity, friability, and bleeding with or without the addition of ulcerations). A score of 0 or 1 was considered indicative of mucosal healing.[17] An anti-Saccromyces cerevisiae antibody (ASCA) was measured by ELISA from Diagnostica Germany. ASCA IgG and IgA were considered positive at a binding index >1.

Table 1 Possible predictive factors for a serious disease outcome and/or work disability

	Study references	
Variable	**Association with serious disease outcome**	**Association with work disability**
Gender		5, 7, 8
Age	14, 24–26, 28	5, 11
Education level		7
Smoking status	35	
CRP or ESR	28	
Disease phenotype	24–26, 28, 31, 33	
Steroid treatment	14, 24, 28, 31	
Relapse	35	
Surgery		8, 10
Mucosal healing	17	
ASCA status	34, 35	

ASCA, anti-Saccromyces cerevisiae antibodies; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate.

Data from the background population

In order to compare our disability data to comparable data from the Norwegian background population at the same time point, we retrieved data on population (number of persons per age (year) for males and females) and data on DP (number of persons on DP per 10 year strata for males and females) in the year 2001 from Statistics Norway (SSB)[18] and the Norwegian Labour and Welfare Administration (NAV).[19] SSB and NAV have publicly available databases.

Statistics

Continuous variables were described with medians and range, and categorical variables as proportions with percentages. The continuous variables of age and disease duration had a skewed distribution; therefore, crude associations between groups were analysed using the non-parametric Mann–Whitney Wilcoxen test for continuous variables. The χ^2 test was used to compare categorical variables.

To compare the proportion of individuals with DPs in the study population and the background population, we calculated the overall and age-standardised RR with 95% CIs.[20]

Logistic regression models were fitted to assess possible predictive factors for WD. Univariate analyses were performed for all of the relevant variables mentioned above (table 1). Variables that reached the least borderline significance ($p<0.1$) in the univariate analyses were considered for inclusion into the multivariate models. However, as the multivariate analyses were restricted to include a maximum of four variables due to the low number of cases with WD, consideration of clinical importance was critical for the final selection of variables. Clinically related variables were examined for statistical association using the χ^2 test. When variables were statistically associated, we chose to include only one in the multivariate models in order to reduce problems due to multi-colinearity. We fitted separate models for UC and CD. P values <0.05 were considered statistically significant. All statistical analyses were performed using the Predictive Analytics Software *PASW* V.18.0 (IBM Corporation).

Ethics

The regional ethics committees and the Norwegian Data Inspectorate approved the study. Patient identity and record confidentiality was maintained using guidelines from the Norwegian Ministry of Health. This study was conducted in accordance with the Declaration of Helsinki.

RESULTS

At the 10-year follow-up time point, 756 patients had a definitive diagnosis of UC or CD. Of the original cohort, 71 patients were dead, 65 were lost to follow-up and two were under the age of 18; thus, 618 patients completed the 10-year follow-up. In total, 587 patients were assessed during a prescheduled follow-up visit, 18 were interviewed on the telephone and 13 were assessed using hospital records. Overall, 518 patients completed the patient-reported questionnaires (responders), giving a response rate of 83.5% (518/618). Seventeen patients were older than 67 at the time of diagnosis and thus not at risk for WD. These patients were excluded from our analyses, leaving 501 patients. Demographic data for the responders and the non-responders, including the patients who were interviewed by telephone and those who did not complete the questionnaires, are listed in table 2. No differences were observed between the responders and the non-responders with regard to diagnosis, gender or age.

Table 2 Diagnosis and demographic data for responders and non-responders

	Responders, *n*=518	Non-responders, *n*=100	p Value
Diagnosis			
Ulcerative colitis *n* (%)	354 (68.2)	68 (68.0)	
Crohn's disease *n* (%)	165 (32.8)	32 (32.0)	0.92*
Gender			
Female *n* (%)	262 (50.5)	41 (41.0)	0.10*
Age at 10-year follow-up			
Median (range)	43.4 (19.1 to 86.1)	43.8 (18.3 to 93.3)	0.38†

*χ^2 test.
†Mann–Whitney Wilcoxen test.

The clinical and demographic characteristics of the responders are described in table 3. The UC patients were significantly older than the CD patients, mirroring the age difference at the time of diagnosis. Although more CD patients were smokers, no statistically significant differences were observed in education level between UC and CD patients.

The overall disability rate in the IBD population was 18.8% (63/501). There was no difference in the disability rates of the UC and CD patients, which were 18.5% (63/341) and 19.4% (31/160), respectively (p=0.8) (table 3). IBD was given as the main cause for receiving a DP significantly more often by CD

Table 3 Clinical and demographic characteristics of the study population

	Ulcerative colitis (*n*=341)	Crohn's disease (*n*=160)	p Value
Age at 10-year follow-up			
Median (range)	45.6 (22.2 to 76.8)	38.1 (19.1 to 74.6)	<0.001
Gender			
Female *n* (%)	172 (50.4%)	79 (49.4%)	NS
Disease duration, months			
Median (range)	124 (107 to 165)	122 (108 to 148)	0.024
Education at diagnosis			
≤12 years	155 (50.5%)	87 (59.6%)	NS
>12 years	152 (49.5%)	59 (40.4%)	
	Missing=34	*Missing=14*	
Smoking at diagnosis			
Yes	44 (12.9%)	70 (44.3%)	<0.001
	Missing=2	*Missing=2*	
Disease localisation at diagnosis			
Proctitis	121 (35.5%)		
Left sided	118 (34.6%)		
Extensive	102 (29.9%)		
L1, ileal		45 (28.1%)	
L2, colonic		70 (43.8%)	
L3, ileocolonic		41 (25.6%)	
L4, upper		4 (2.5%)	
Disease behaviour at diagnosis			
B1, non-stricturing/penetrating		97 (60.6%)	
B2, stricturing		45 (28.1%)	
B3, penetrating		18 (11.3%)	
Disability			
No	269 (78.9%)	115 (71.9%)	NS
Because of IBD	32 (9.4%)	25 (15.6%)	0.040
Other causes	31 (9.1%)	6 (3.8%)	0.032
Rehabilitation	9 (2.6%)	14 (8.8%)	0.002

Age and disease duration data were compared using the Mann-Whitney Wilcoxen test. All categorical data were analysed with the χ^2 test.
IBD, inflammatory bowel disease; NS, not significant that is, p>0.05.
L1 to L4 and B1 to B3, disease classification according to the Vienna classification system.

Table 4 Relative risk for disability pension in inflammatory bowel disease patients compared with the background population

	Ulcerative colitis				Crohn's disease			
	Pts (*n*)	Observed number*	Expected number†	RR (95% CI)	Pts (*n*)	Observed number*	Expected number†	RR (95% CI)
Overall	306	55	30.52	1.80 (1.41 to 2.27)	152	30	15.16	1.98 (1.42 to 2.68)
18–29 years	19	1	0.24	4.25 (0.63 to 28.64)	34	3	0.42	7.13 (2.42 to 21.00)
30–39 years	82	8	2.87	2.78 (1.44 to 5.38)	57	7	2.00	3.50 (1.75 to 7.01)
40–49 years	109	13	9.00	1.44 (0.87 to 2.41)	34	9	2.81	3.21 (1.83 to 5.62)
50–59 years	60	18	11.15	1.61 (1.1 to 2.38)	17	5	3.16	1.58 (0.78 to 3.31)
60–67 years	36	15	12.40	1.21 (0.71 to 1.51)	12	6	4.65	1.29 (0.73 to 2.27)
Female	155	33	18.03	1.83 (1.34 to 2.44)	73	21	8.49	2.47 (1.69 to 3.44)
Male	151	22	12.62	1.74 (1.17 to 2.52)	79	9	6.60	1.36 (0.73 to 2.42)

*The observed number of patients with disability pension in the study population.
†The expected number of patients is estimated by using data from the background population.[18 19]
Pts, patients; RR (relative risk=observed number/expected number).

patients (15.6%, 25/160) than UC patients (9.4% 32/341) (p=0.040). Furthermore, significantly more CD patients were on rehabilitation programs when compared with UC patients (8.8% vs 2.6%, p=0.002).

Comparison to the background population

The overall RR for receiving a DP in the IBD patients compared with the background population was significantly increased in both UC (RR 1.80; 95% CI 1.41 to 2.27) and CD (RR 1.98; 95% CI 1.42 to 2.68) patients (table 4). Although both men and women with UC had an increased RR for receiving a DP, in CD patients, an increased overall risk was identified only in women. In the age-stratified analysis, the RR of receiving a DP was highest in the youngest age groups.

The proportion of individuals in the study population receiving a DP as a result of IBD or because of other diagnoses and the proportion of individuals in the background population receiving a DP is shown in figure 1. (RR for DP because of IBD is shown only in table 4b, online). In UC patients, the proportion of individuals receiving a DP because of conditions other than IBD was predominant in all age groups except for 30–39 year olds. In contrast, IBD was the predominant cause of CD patients receiving a DP except in the youngest patient group.

Regression analysis

In the univariate analysis of UC patients, the variables of C-reactive protein (CRP) or erythrocyte sedimentation rate (ESR) less than 30 at diagnosis, steroid treatment at the 1-year follow-up, >2 relapses during the first year, and colectomy during the first year were associated with an increased OR for WD after 10 years of disease (table 5). However, there was a significant association between the variables of steroid treatment at the 1-year follow-up, CRP or ESR >30, relapse during the first year and surgery during the first year. These variables could therefore not be included in the same multivariate model due to the risk of multi-colinearity issues. We made one multivariate model, including gender and age, for each of these variables, (table 6) and a significantly increased OR for WD was found for each variable.

Variables associated with an increased OR for long-term disability in CD patients were female sex, an age >40 years at diagnosis and steroid treatment at the 1-year follow-up time point (table 7). For CD patients, only female gender and steroid treatment remained significant predictors in the multivariate analysis.

DISCUSSION

This study is a long-term, population-based study that presents prospective results regarding WD in individuals with IBD. The RR for receiving a DP was significantly increased in both UC and CD patients. The age-stratified analysis showed that the RR was highest in the youngest age groups. The majority of CD patients received a DP because of their IBD, whereas other diagnoses were the most common reason for receiving a DP in the UC patients. Steroid treatment at the 1-year follow-up time point predicted an increased risk of WD after 10 years of disease in both UC and CD patients, while increased CRP or SR at diagnosis, colectomy before the 1-year follow-up and more than two relapses before the 1-year follow-up predicted WD in UC only. In addition, whereas female gender predicted WD in CD patients, an older age at diagnosis predicted WD in UC patients.

The overall proportion of individuals with CD or UC receiving a DP was 19.4% and 18.5%, respectively, both of which are high compared to previous studies. For example, a 3% incidence of

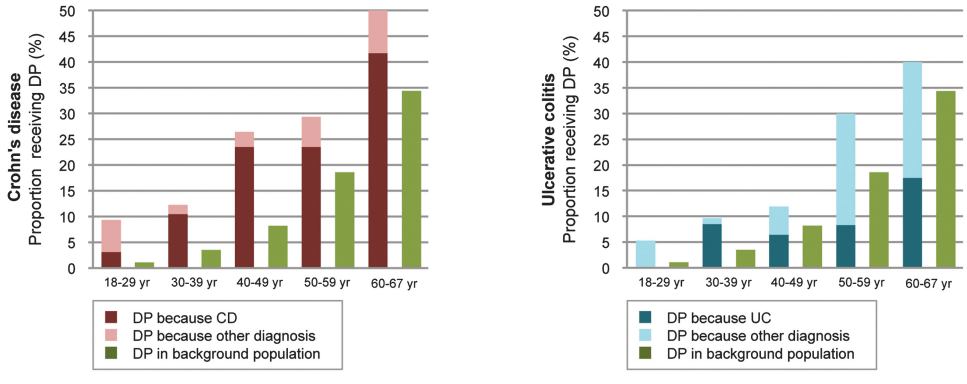

Figure 1 Proportion of the study population and the background population receiving disability pension. DP, disability pension; yr, age in years at the 10 year follow-up.

Table 5 Univariate analyses of ulcerative colitis patients with work disability as the dependent variable

		Univariate		
Variable	***n***	**OR**	**95% CI**	**p Value**
Gender				
Male (ref)	169	1		
Female	172	1.63	0.83 to 3.17	0.15
Age at diagnosis				
≤40 years (ref)	218	1		
>40 years	123	1.63	0.84 to 3.14	0.15
Education level at diagnosis				
Missing=34				
≤12 years (ref)	155	1		
>12 years	152	0.57	0.27 to 1.17	0.12
Smoking at diagnosis				
Missing=1				
Non-smoker (ref)	296	1		
Smoker	44	1.77	0.76 to 4.13	0.19
ESR or CRP at diagnosis				
Missing=30				
≤30 (ref)	246	1		
>30	65	2.43	1.18 to 4.99	0.02
Disease localisation at diagnosis				
Proctitis (ref)	121	1		
Left sided	118	0.71	0.30 to 1.66	0.43
Extensive	102	1.53	0.71 to 3.27	0.28
Steroid treatment at diagnosis				
No (ref)	261	1		
Yes	80	1.23	0.59 to 2.58	0.59
Steroid treatment at 1-year follow-up				
Missing=16				
No (ref)	288	1		
Yes	37	4.29	1.95 to 9.43	<0.001
Number of relapses during 1st year				
Missing=17				
None (ref)	146	1		
1–2	137	1.45	0.67 to 3.11	0.34
>2	41	3.30	1.32 to 8.22	0.01
Colectomy before 1-year follow-up				
No (ref)	323	1		
Yes	18	4.11	1.45 to 11.65	0.01
Mucosal healing at 1-year follow-up				
Missing=52				
Yes (ref)	134	1		
No	155	1.62	0.79 to 3.34	0.19
ASCA				
Missing=27				
Negative	300	1		
Positive	14	0	0	0.99

No work disability, $n=300$; work disability, $n=41$.
ASCA, anti-Saccromyces cerevisiae antibodies; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; Ref, reference category; WD, work disability because of inflammatory bowel disease (applied for or granted a rehabilitation benefit or disability pension).

WD was reported in a hospital-based Danish cohort of CD patients from the 1980s.[4] Additionally, a study that used data from German societal security statistics from the same period reported that 3% of German employees with IBD were granted DPs annually.[5] In a Canadian population-based IBD cohort from 1995, only 1.3% of patients were reported to be disabled; however, 11.4% were unemployed in this study.[6] Anan-thakrishnan *et al* reported a 5.3% incidence of WD in CD patients from a US tertiary referral centre.[10] In contrast, data from a clinical multicentre study including CD patients with moderately to severely active disease (CDAI >220 and <400) reported that 25% of the patients were receiving disability compensation, with a higher proportion in Europe (34%) as compared to USA (20%).[8] A recent Swedish population-based study reported a 15.2% incidence of disability in CD patients.[11] Additionally, in a postal survey of patients from Germany's Crohn's and Colitis Association, Stark *et al* reported 7% long-term disability in UC patients and 19% in CD patients.[3] In addition to being the result of different study designs, these differences emphasise that socioeconomic and political factors likely are important determinants with regard to WD.

The finding of an increased RR for receiving a DP in both UC and CD patients compared to the background population was consistent with studies from the Netherlands[7] and Sweden.[11] While these studies were population-based and conducted over the same time period as our study and both countries have social security systems similar to Norway's, these studies were not prospective in design and the duration of the disease in the patients differed considerably.

The RR for receiving a DP was highest among the youngest patients; additionally, no increase in RR was observed in the oldest age groups. Thus, one can assume that if the oldest patients were not granted a DP because of IBD, they would probably have been disabled from other causes. Consequently, the excess cost caused by IBD-related DPs is limited in the oldest patients. However, this might change with increased disease duration.

A higher proportion of UC patients disabled because of other diagnoses relative to CD patients. The older age in the UC patients could explain some of this difference; UC patients might have developed other age-associated diseases prior to IBD onset. This finding could also be the result of a more serious long-term intestinal disease course in CD patients, indicating that long-term clinical consequences could exceed potential comorbidities due to age.

Women with CD had the highest RR for receiving a DP among all IBD patients studied; furthermore, female gender was a risk factor for WD in CD patients. As no studies have demonstrated that the clinical course of disease in CD is more serious disease in women than in men, it is difficult to explain this gender difference. However, we did not find the same gender difference in UC patients. While specific gender-related factors in CD, such as consequences of perianal or fistulising disease, could be playing a role, our study did not have enough statistical power to analyse these subgroups of patients. Some studies have reported that males are more negatively affected by being outside the workforce than females.[21 22] Consequently, males might postpone an exit from the workforce, which could, in part, explain our findings. High RR for WD in CD women was also described in a Swedish CD population,[11] but studies from the Netherlands[7] and USA[10] did not identify this type of gender difference. The results could also be affected by the fact that both Norway and Sweden have very high overall employment rates for women compared to the Netherlands and USA[23]; thus, more women might be eligible for DPs. A gender difference could therefore have been underestimated in the Dutch and American studies.

One might predict that it is the patients with the most severe symptoms and refractory disease that have problems performing their work. In this case, one would hypothesise that the positive and negative predictors for WD are the same as the predictors for disease outcome.

In CD, a younger age at diagnosis is a predictor for a more severe disease outcome.[14 24–26] However, we did not find an association between age and WD in CD, either with age as

Table 6 Ulcerative colitis patients. Multivariable logistic regression models with work disability as the dependent variable

		Multivariate-model 1			Multivariate-model 2			Multivariate-model 3			Multivariate-model 4		
Variable	***n***	**OR**	**95% CI**	**p Value**	**OR**	**95% CI**	**p Value**	**OR**	**95% CI**	**p Value**	**OR**	**95% CI**	**p Value**
Gender													
Male (ref)	169	1			1			1			1		
Female	172	1.80	0.90 to 3.62	0.10	1.76	0.87 to 3.53	0.11	1.87	0.92 to 3.77	0.08	1.73	0.87 to 3.41	0.12
Age at diagnosis													
≤40 years (ref)	218	1			1			1			1		
>40 years	123	2.07	1.02 to 4.21	0.04	1.71	0.86 to 3.41	0.13	1.78	0.90 to 3.54	0.1	1.81	0.92 to 3.56	0.086
Steroid treatment at 1-year follow-up													
Missing=16													
No (ref)	288	1											
Yes	37	5.46	2.37 to 12.59	<0.001									
ESR or CRP at diagnosis													
Missing=30													
≤30 (ref)	246				1								
>30	65				2.49	1.20 to 5.16	0.015						
Number of relapses during 1st year													
Missing=17													
None (ref)	146							1					
1–2	137							1.51	0.70 to 3.29	0.3			
>2	41							3.68	1.45 to 9.35	0.006			
Colectomy before 1-year follow-up													
No (ref)	323										1		
Yes	18										4.82	1.65 to 14.1	0.004

The models include gender, age and either steroid treatment, ESR or CRP, relapses or surgery. No work disability, n=300; work disability, n=41.
ASCA, anti-Saccromyces cerevisiae antibodies; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; Ref, reference category; WD, work disability because of inflammatory bowel disease (applied for or granted a rehabilitation benefit or disability pension).

a continuous variable (data not shown) or with age as a dichotomised variable. Although a previous study reported an association between disability and increasing age (as a continuous variable) in CD,[11] the patients in this study were older (median age, 46 years) and the median disease duration was longer (15 years) as compared with the patients in our cohort (median age 38 years at the 10-year follow-up). The effect of age on the clinical prognosis is unclear in UC, and we did not find a consistent association between age and WD in our study. Some studies have shown that a younger age at diagnosis predicts a more severe disease course,[27] in other studies, an older age at disease onset predicts a more severe disease course in UC patients.[26 28]

Early relapse and colectomy were associated with WD in UC patients. Early relapse was also associated with an increased risk for multiple relapses in a large European population-based study examining UC patients[29]; thus, an association with long-term disability was expected. On the other hand, one might expect that colectomy would reduce the risk for WD. The fact that we did not observe this association might result from the long-term postoperative complications, such as pouchitis,[30] which occur in these patients. Neither early relapse nor early resection was associated with long-term disability in CD patients, but this lack of association could be explained by type II errors. Feagan *et al* reported that prior bowel resection predicted a higher likelihood of receiving a DP; however, this study was conducted using a highly selected patient group and the time of surgery was not reported.[8]

Several studies have shown that the use of steroids predicts a severe disease course.[14 24 28 31] Treatment with steroids at the 1-year follow-up time point predicted WD in both UC and CD patients in our study, findings that have not been reported previously. The use of steroids at the 1-year follow-up time point was also strongly associated with relapse and in UC patients with colectomy. Therefore, steroid treatment is likely a marker of severe disease and continuous disease activity. The enrolment period of this study was before immunomodulators were widely used as maintenance therapy and also prior to the era of anti-tumour necrosis factor (anti-TNF) treatment. A portion of the patients who received steroids at the 1-year follow-up time point in our study would likely be treated with immunomodulators and/or anti-TNF agents today. Whether this improves the long-term disease course and consequently reduces the need for WD is uncertain but a recent population-based study found both the use of long-term corticosteroids and the surgery rates were reduced in CD patients between 1986 and 2003.[32] Although an American case-control study did find that current or past use of anti-TNF agents was associated with increased rates of WD in a univariate analysis, these data came from a tertiary referral centre, suggesting that the patients had a more severe disease than the patients in our population-based cohort.[10]

In clinical settings, phenotype predicts prognosis. In UC, extensive disease predicts an increased risk for colectomy[28] and the use of immunosuppressants.[31] In contrast, small bowel localisation[26 33] and stricturing or penetrating disease predicts surgery in CD.[14 26] However, the disease phenotype at diagnosis did not predict WD in either UC or CD patients. Also ASCA and mucosal healing have been shown to predict disease outcome,[17 34 35] but neither of these variables were associated with subsequent WD in our study. In addition, smoking at the time of diagnosis was not associated with long-term disability in our study while it is known that current smoking appears to worsen the disease course in CD patients,[36] while it seems to improve disease course in UC patients.[37] Limited power may have influenced our analyses, especially in the CD group. The possible effects of smoking could have been confounded by socioeconomic factors which we could not control.

Socioeconomic factors, such as social class, may have confounded our results. However, we did have information on the education level of the subjects, which could be used as a proxy for social class. Neither education level at diagnosis (tables 3 and 4) nor education level at the 10-year follow-up time point (data not shown) was associated with WD in our study.

Table 7 Logistic regression analyses of Crohn's disease patients with work disability as the dependent variable

		Univariate			Multivariate		
Variable	***n***	**OR**	**95% CI**	**p Value**	**OR**	**95% CI**	**p Value**
Gender							
Male (ref)	81	1			1		
Female	79	2.22	1.05 to 4.67	0.04	2.41	1.07 to 5.40	0.03
Age at diagnosis							
≤40 years (ref)	124	1			1		
>40 years	36	2.13	0.95 to 4.78	0.07	1.99	0.82 to 4.80	0.13
Education level at diagnosis							
Missing=14							
<12 years (ref)	87	1					
>12 years	59	1.27	0.60 to 2.69	0.53			
Smoking at diagnosis							
Missing=2							
Non-smoker (ref)	88	1					
Smoker	70	1.67	0.81 to 3.45	0.17			
SR or CRP at diagnosis							
Missing=5							
≤30 (ref)	49	1					
>30	106	1.75	0.76 to 4.05	0.19			
Disease localisation at diagnosis							
L1 or L4 (ref)	49	1					
L2	70	0.63	0.27 to 1.47	0.28			
L3	41	0.92	0.36 to 2.32	0.85			
Disease behaviour at diagnosis							
B1 (ref)	97	1					
B2	45	0.82	0.36 to 1.9	0.65			
B3	18	0.82	0.25 to 2.73	0.75			
Abscess and/or fistula at diagnosis							
Missing=10							
Yes (ref)	20	1					
No	130	1.02	0.34 to 3.03	0.97			
Steroid treatment at diagnosis							
Missing=2							
No (ref)	68	1					
Yes	90	1.40	0.66 to 2.97	0.38			
Steroid treatment at 1-year follow-up							
Missing=4							
No (ref)	102	1			1		
Yes	54	4.30	2.00 to 9.28	<0.001	4.33	1.96 to 9.59	<0.001
Number of relapses during 1st year							
Missing=4							
None (ref)	75	1					
1–2	69	1.63	0.76 to 3.52	0.21			
>2	12	1.33	0.32 to 5.54	0.69			
Resection before 1-year follow-up							
No (ref)	130	1					
Yes	30	0.93	0.37 to 2.38	0.88			
Mucosal healing at 1-year follow-up							
Missing=43							
Yes (ref)	56	1					
No	61	1.20	0.50 to 2.84	0.69			
ASCA							
Missing=13							
Negative (ref)	103	1					
Positive	43	1.13	0.50 to 2.58	0.77			

No work disability, *n*=121; work disability, *n*=39.
ASCA, anti-Saccromyces cerevisiae antibodies; Ref, reference category; WD, work disability because IBD (applied for or granted rehabilitation benefits or disability pension).

These findings are consistent with results from Sweden,[11] but contrast results from the Netherlands.[7]

The proportion of individuals receiving disability and/or rehabilitation benefits is relatively high in Norway compared to other Organisation for Economic Co-operation and Developement (OECD) countries.[38] This might reduce the generalisability of our results. However, the RR of receiving a DP in IBD patients as compared with the background population should be transferable

to other countries. Additionally, our definition of WD should be applicable to other social security systems. Therefore, we believe that our results are realistic estimates of the effects of the disease burden of IBD on the health and social security system.

In conclusion, after 10 years of disease, IBD patients had an increased RR for receiving a DP compared with the Norwegian background population. The RR was highest in the youngest patients, while in the oldest patients (60–67 years) the risk was similar to the background population. In CD patients, women had a higher risk of receiving DP than men; in contrast, no such gender difference was observed in UC patients. Markers of early serious disease course, such as steroid treatment at the 1-year follow-up time point predicted WD after 10 years of disease in both diagnostic groups.

Acknowledgements The authors thank the following members of the IBSEN Study Group: Morten Vatn, Akershus University Hospital, Øyvind Palm, Jørgen Jahnsen and Idar Lygren; Oslo University Hospital, Njaal Stray; Diakonhjemmet Hospital, Jostein Sauar; Telemark Hospital, Stein Dahler; Blefjell Hospital , Øystein Kjellevold; Telemark Hospital, Finn Strøm; Lovisenberg Diakonale Hospital, Ole Høie; Sørlandet Sykehus.

Contributors Study concept and design: all authors, Acquisition of data: BM, ICS, TB and MH, Statistical analysis: MLH and MC, Interpretation of data: all authors. Drafting of manuscript: MLH. Critical revision of the manuscript for important intellectual content: all authors. Final approvement of the submitted manuscript: all authors.

Funding Marte Lie Høivik was supported by South-Eastern Norway Regional Health Authority with a full-time research grant.

Competing interests None.

Ethics approval Ethics approval was provided by the Regional Ethichs Comitee of the South-Eastern Norway Regional Health Authorities.

Provenance and peer review Not commissioned; externally peer reviewed.

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