

The association between inflammatory bowel disease and mental ill health

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3
4 **Title Page**

5
6 **The association between inflammatory bowel disease and mental ill health: a**
7 **retrospective cohort study using data from UK primary care.**

8
9 **Short title:** The incidence of mental illness in IBD patients.

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43 Nigel Trudgill and Phil Harvey contributed equally and are joint senior authors.

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48 **Authorship**

49 Study concept and design was jointly conceived by PH, DK and NT. Data extraction was
50 performed by PH and analysis was performed by PH, NU and NT. Manuscript was drafted by NU
51 and PH. The data and manuscript were critically reviewed, revised, and approved by all authors.

52

53 **Ethics Approval**

54 Use of IQVIA Medical Research Data* is approved by the UK Research Ethics Committee (reference
55 number: 18/LO/0441). In accordance with this approval, the study protocol was reviewed and approved
56 by an independent Scientific Review Committee (SRC) in September 2019 (reference number:
57 19THIN066).

58 *IQVIA Medical Research Data (IMRD-UK) incorporates data from THIN, A Cegedim Database.
59 Reference made to THIN is intended to be descriptive of the data asset licensed by IQVIA. This work
60 used de-identified data provided by patients as a part of their routine primary care.

61

62 **Data Availability statement:**

63 The data underlying this article were provided by IQVIA Medical Research Data under licence and are
64 not available for open access.

65

66 **Abbreviations:**

67 Inflammatory bowel disease (IBD); Crohn's disease (CD); ulcerative colitis (UC); Hazard ratio
68 (HR); The Health Improvement Network (THIN); IQVIA Medical Research Data (IMRD-UK).

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73 SUMMARY

74 Background and aims

75 Patients with active inflammatory bowel disease (IBD) and mental health illnesses experience
76 worse IBD outcomes. This study describes the incidence of mental illnesses, including
77 deliberate self-harm, in IBD patients.

78 Methods

79 A population based retrospective cohort study using IQVIA medical research data, of a primary
80 care database covering the whole UK, between January 1995 and January 2021. IBD patients of
81 all ages were matched 4:1 by demographics and primary care practice to unexposed controls.

82 Following exclusion of patients with mental ill health at study entry, adjusted hazard ratios (adj
83 HR) of developing depression, anxiety, deliberate self-harm, severe mental illness and insomnia
84 were calculated using a Cox proportional hazards model.

85 Results

86 48,799 incident IBD patients: 28,352 ulcerative colitis and 20,447 Crohn's disease. Incidence
87 rate ratios of mental illness were higher in IBD patients than controls (all $p < 0.001$): deliberate
88 self-harm 1.31 (95%CI 1.16-1.47); anxiety 1.17 (1.11-1.24); depression 1.36 (1.31-1.42); and
89 insomnia 1.62 (1.54-1.69). Patients with Crohn's disease were more likely to develop: deliberate
90 self-harm adj HR 1.51 (95%CI 1.28-1.78), anxiety 1.38 (1.16-1.65), depression 1.36 (1.26-1.47)
91 and insomnia 1.74 (1.62-1.86). IBD patients are at increased risk of deliberate self-harm [adj HR
92 1.20 (1.07-1.35)]. The incidence rate ratios of mental illnesses were particularly high during first
93 year following IBD diagnosis: anxiety 1.28 (1.13-1.46); depression 1.62 (1.48-1.77); insomnia
94 1.99 (1.78-2.21).

95

96 **Conclusion**

97 The incidence of deliberate self-harm, depression, anxiety, and insomnia was higher in IBD
98 patients. IBD is independently associated with an increased risk of deliberate self-harm.

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100 **Keywords:**

101 Inflammatory bowel disease, ulcerative colitis, Crohn's disease, depression, anxiety, deliberate
102 self-harm.

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114 **INTRODUCTION**

115 The association between Inflammatory bowel disease (IBD) and anxiety and depression has been
116 described in a number of studies worldwide (1). Active symptomatic IBD is associated with
117 increased rates of anxiety and depression (2,3). Patients with IBD and psychological comorbidity
118 also experience worse IBD outcomes such as increased disease activity requiring escalation of
119 therapy and lower IBD remission rates than those without psychological comorbidity (4,5).
120 Patients with both IBD and a mental health disorder, such as depression and anxiety, have higher
121 rates of workplace absenteeism, increased healthcare utilisation and higher rates of psychotropic
122 medication use when compared to patients with a mental health disorder without coexisting IBD
123 (6). Disordered sleep or insomnia has also been reported to be associated with IBD, and to
124 significantly affect the quality of life of patients with IBD (7,8). Finally, IBD is associated with
125 an increased risk of self-harm, especially among patients diagnosed with IBD in childhood (9–
126 11). A recent study in Denmark and Finland reported that deliberate self harm was a leading
127 cause of mortality among IBD patients (11). However, factors associated with deliberate self
128 harm in patients with IBD have not been previously described. There have been no previous UK
129 population based studies to examine the incidence of mental health diagnoses in IBD patients.

130 Our study aims to investigate the incidence of a wide range of mental health diagnoses in
131 patients with IBD, and factors associated with deliberate self-harm.

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135 **MATERIALS AND METHODS**

136 **Study design, setting and population**

137 A population based retrospective open cohort study was undertaken using IQVIA medical
138 research data (IMRD) UK between January 1995 and January 2021. IMRD was previously
139 named ‘The Health Improvement Network (THIN)’ and is derived from electronic health records
140 from UK primary care providers who use the Vision software system.

141 The THIN database is representative of the UK population in terms of demographic structure
142 and the prevalence of key comorbidities ([12](#)). IMRD primary care practices record patient level
143 phenotypical data through Read codes ([13](#)). Read codes are a hierarchical coding system which
144 can be used to record information on symptoms, examination findings and diagnoses.

145 In this study, records from 831 primary care practices in all regions of the UK were utilised,
146 which in total related to 16,630,426 eligible patients. As entry into the database relies on the use
147 of Vision software, the number of contributing practices can vary over time. For this study, data
148 extraction, transformation and analysis were facilitated using the Data extraction for
149 epidemiological research (DExtER) tool ([14](#)). To improve data quality and reduce under-
150 recording, primary care practices were deemed eligible to contribute data at the later of the
151 following dates: one year after the date the practice electronic record system was installed and
152 the date the practice attained acceptable mortality recording (AMR) ([15](#)). The AMR date is
153 derived from IMRD-UK practices recording of death compared with the predicted mortality rate
154 based on national figures, given a practice’s demographic characteristics. Consequently, when
155 the national and practice IMRD-UK mortality figures align, an AMR date is assigned.

156 **Exposure and outcome definitions**

157 The purpose of this study was to compare exposed patients (those with a code identifying IBD;
158 either Crohn's disease or ulcerative colitis) to matched unexposed patients (those without such
159 codes) and then calculate their risk of developing mental ill health defined through certain Read
160 codes (deliberate self-harm, depression, anxiety, severe mental illness and insomnia). Further
161 references to mental illness in this manuscript include these 5 categories. All ages were included
162 in the study. Read codes relating to IBD exposure and mental ill health were selected with the
163 assistance of gastroenterologists, general practitioners, and public health clinicians. The
164 methodology for Read code selection and their validity has been described previously (16). The
165 clinical codes used in this study can be found in appendix 2. The code lists used to identify
166 patients with IBD, Crohn's disease and ulcerative colitis have been previously validated by other
167 authors (17,18). Lewis et al reported that the probability of having Crohn's disease and ulcerative
168 colitis based on GP reported gastroenterology consultation, surgery, intestinal biopsy ,
169 endoscopy, barium radiography were 94% and 97% respectively in the general practitioner
170 research database (GPRD).In patients who had codes for both Crohn's disease (CD) and
171 Ulcerative colitis (UC), the most recent code was used as the final diagnosis for the patient while
172 the earliest code or diagnosis date was considered as an index date. Patients with undifferentiated
173 IBD diagnoses and those with a pre-existing mental health diagnosis were excluded from the
174 study cohort.

175 **Selection of unexposed group**

176 Each exposed patient was matched to up to four unexposed control patients, who had no
177 previously documented Read code relating to the exposure or a previous mental health diagnosis.

178 Controls were taken from the same primary care practice and were matched by age at index date
179 (+/- one year), Townsend deprivation score (19) and sex. The Townsend score is a measure of
180 material deprivation within a locality, incorporating information on unemployment, household
181 overcrowding and car/home ownership (19).

182

183 **Follow up period**

184 An open cohort study allows patients to enter and exit the study at different time points, with each
185 individual patient only contributing person years of follow-up from the time of cohort entry (index
186 date) to the time they leave the cohort (exit date). In this study, only those with a new diagnosis of
187 IBD during the study period, who met the eligibility criteria, were included in the exposed group
188 and their index date was assigned as the date of their first inputted code relating to an IBD
189 diagnosis. To mitigate immortality time bias (20), eligible unexposed patients were assigned the
190 same index date. The follow-up period for each patient was from the index date until the exit date.
191 The exit date was defined as the earliest of the following dates: study end date; last date of data
192 collection from a given primary care practice; date patient transferred from the practice; date of
193 death; or date the outcome of interest occurred. This time period was considered to be the time at
194 risk for calculating incidence rates.

195 **Covariates**

196 Covariates considered in the model were selected due to their potential independent relationship
197 with the development of mental ill health. These included: age, sex, Townsend deprivation score,
198 ethnicity, smoking status and Charlson comorbidity score (21). Age, sex, and Townsend

199 deprivation score were also used in the modelling despite their inclusion in the matching criteria,
200 to account for any residual confounding. Due to small numbers of patients in minority ethnicity
201 groups these were combined for analysis.

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204 **Statistical analysis**

205 Categorical baseline data were described using proportions, continuous data were described
206 using means or median with standard deviations or inter-quartile range, respectively. Missing
207 data are highlighted in relevant baseline characteristic tables. Where there were missing
208 covariate data, the data are described as a missing category. In order to calculate the incidence
209 rate (IR per 1000 years) for mental ill health, the number of incident outcomes divided by the
210 person years contributed by each group were examined. A Cox proportional hazards regression
211 model then used to estimate adjusted hazard ratios (adj HRs) for each mental health disorder
212 adjusting for demographic factors including Charlson co-morbidity score, Townsend deprivation
213 score, age quintile, ethnicity, sex, and UC/CD exposed group. Hazard ratios were calculated with
214 95% confidence intervals (CI) and a statistical significance threshold of $p < 0.05$. A Cox
215 proportional hazards model was used to identify associations with increased deliberate self-harm.
216 Variables included IBD, demographic characteristics including age quintile, sex and a co-
217 existing diagnosis of mental illness including depression, anxiety, insomnia, and severe mental
218 illness. The proportional hazards assumption was assessed using log-log plots and the
219 Schoenfeld residuals test. P values of < 0.05 were considered to be statistically significant.
220 Statistical analysis was undertaken in Stata version 15 ([22](#)).

221 RESULTS

222 Cohort Demographics

223 48,799 incident patients with IBD, of whom 28,352 (58.1%) had ulcerative colitis and 20,447
224 (41.9%) had Crohn's disease, and 190,075 controls without IBD were included in the study
225 (Figure 1). The demographic details of the IBD patients and controls are shown in Table 1. The
226 median age of the IBD patients was 41.5 (IQR 29.6-57.5) years, with a similar proportion of
227 males and females with IBD (51.7% vs 48.3%).

228 Incident rates of and associations with deliberate self-harm.

229 The results of the incidence analysis of deliberate self-harm are in Table 2. The incidence rate of
230 deliberate self-harm was higher in patients with IBD compared to controls (1.18 vs 0.9 per 1000
231 person-years). The observed difference persisted when adjusted for demographic factors [adj HR
232 1.33 (95% CI 1.18-1.49)]. In Crohn's disease higher rates of deliberate self-harm were observed
233 [1.50 vs controls 1.02 per 1000 years, adj HR 1.51 (1.28-1.78)] but no difference was seen in
234 deliberate self-harm rates in ulcerative colitis [IR 0.93 vs 0.81/1000 person-years, adj HR 1.16
235 (0.98-1.38)]. No increase in the incidence rate of deliberate self-harm was observed for IBD
236 patients diagnosed in childhood (10-18 years) [IR 3.65 vs controls 3.01/1000 person-years IRR
237 1.21 (0.85-1.69), $p=0.25$] but higher rates of deliberate self-harm were observed in IBD patients
238 diagnosed over the age of 50 [IR 0.58 vs 0.34/1000 person-years, IRR 1.66 (1.23-2.23) $p<0.001$].
239 Higher incidence rates of deliberate self harm were observed in IBD patients who were current
240 smokers than in smokers in the unexposed cohort without IBD [(IR 2.4 vs 1.7 per 1000 person-
241 years, IRR 1.4 (1.13-1.72)]. The results are shown in appendix Table 4.
242 The results of Cox proportional hazards modelling for associations with deliberate self-harm are
243 shown in Table 3. Deliberate self-harm was associated with: IBD [adj HR 1.20 (1.07-1.35)],

244 decreasing age [<27.4 adj HR 4.84 (3.95-5.93)], anxiety [1.57 (1.35-1.82)], insomnia [2.32
245 (2.02-2.66)], severe mental illness [5.74 (4.56-7.22)] and depression [5.97 (5.33-6.69)].

246 **Incident rates of anxiety**

247 The results of the incidence analysis of anxiety are shown in Table 4. The incidence rate of
248 anxiety was higher in patients with IBD (5.48 per 1000 person-years) than controls [4.67 per
249 1000 person-years, adj HR 1.31 (95% CI 1.16-1.47)]. The incidence rate of anxiety was
250 increased in both ulcerative colitis and Crohn's disease: ulcerative colitis 5.03 vs 4.41 per 1000
251 person-years, adj HR 1.26(1.07-1.47); Crohn's disease 6.14 vs 5.04 per 1000 person-years, adj
252 HR 1.38 (1.16-1.65). There was no difference in anxiety incidence rates among patients
253 diagnosed with IBD between 10 and 18 years of age [IRR 0.96 (95% CI 0.72-1.25), $p=0.77$]. In
254 contrast, in patients diagnosed in later life over the age of 50, the incidence of anxiety was higher
255 among patients with IBD compared to controls [3.58 vs 3.01 per 1000 person-years, IRR 1.19
256 (95%CI 1.06-1.33), $p<0.003$].

257 Rates of anxiety varied by ethnicity, with higher incidence rates seen in white IBD patients
258 compared to controls [IR 5.81 vs 5.06 per 1000 person-years, IRR 1.15 (1.06-1.24), $p<0.001$],
259 but there was no difference between minority ethnicity patients compared to controls [3.43 vs
260 3.37 per 1000 person-years, IRR 1.01 (0.70-1.44), $p=0.90$]. These results are shown in appendix
261 Table 1.

262 **Incident rates of depression**

263 The results of the incidence analysis of depression are shown in Table 5. The incidence rate of
264 depression was higher in patients with IBD compared to controls [10.75 vs 7.9 per 1000 person-
265 years, adj HR 1.30 (95% CI 1.23-1.36)].

266 Patients with both CD [12.7 vs 8.6 per 1000 person-years, adj HR 1.36 (1.26-1.47)] and
267 ulcerative colitis [9.4 vs 7.4 per 1000 person-years, adj HR 1.24 (1.16-1.33)] had higher rates of
268 depression than controls. The incidence rate ratio of depression in patients with IBD was
269 significantly higher during the first year after IBD diagnosis [1.62 (1.48-1.77)] than overall [1.36
270 (1.31-1.42)] (Appendix Table 3).

271 **Incident rates of severe mental illness**

272 No difference was observed in the incidence rates of severe mental illness in patients with IBD
273 compared to controls [0.35 vs 0.40 per 1000 person-years, IRR 0.87(95%CI 0.70-1.07), p=0.19].

274 **Incident rates of insomnia**

275 The results of incidence analysis of insomnia are shown in appendix Table 2. The incidence rate
276 of insomnia among patients with IBD was higher than in controls [IR 8.53 vs 5.3 per 1000
277 person-years, adj HR 1.56 (95% CI 1.49-1.63)]. Similar effect sizes were noted in both ulcerative
278 colitis [adj HR 1.44 (1.35-1.53)] and Crohn's disease [adj HR 1.74 (1.62-1.86)]. Insomnia was
279 more common among IBD patients diagnosed over the age of 50 [incidence rate 9.42 per 1000,
280 IRR 1.52(1.42-1.64), p<0.001]. However, the group with the largest relative risk compared to
281 controls were IBD patients diagnosed in childhood (10-18) [IRR 2.14 (1.67-2.73), p<0.001]. The
282 incidence rate ratio of insomnia in patients with IBD was significantly higher during the first
283 year after IBD diagnosis [1.99 (1.78-2.21)] than overall [1.62 (1.54-1.69)] (Appendix table 3).

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292 **DISCUSSION**

293 This study has examined in detail the incidence of mental health morbidity in patients with IBD
294 using a large, population-based dataset in the UK. We have shown that patients with IBD,
295 without a diagnosis of mental health disorder at baseline, had a 33% increased risk of deliberate
296 self-harm, 31% increased risk of anxiety, a 30% increased risk of depression, and a 56%
297 increased risk of insomnia. The highest relative risks were in patients with Crohn's disease.
298 Higher rates of anxiety and deliberate self-harm were observed in adults diagnosed with IBD
299 over the age of 50. A sixfold increased risk of deliberate self-harm was associated with
300 depression and severe mental illness in IBD patients than controls. Higher incidence rates of
301 mental illness were observed in current smokers compared to non-smokers for both IBD patients
302 and controls..

303 The present study highlights the association of deliberate self-harm with IBD. IBD patients have
304 been noted to be at increased risk of suicide compared with the general population in previous
305 studies (23–26). A recent Swedish study highlighted the increased risk of self-harm in childhood
306 onset IBD patients suggesting an adjusted HR of 1.4 compared with 1.33 in the present study
307 (9). The potential confounding factors considered in the Swedish analyses were age, year of
308 birth, education and family history in contrast to the present study, which was adjusted for age,
309 sex, ethnicity, Townsend deprivation index and Charlson comorbidity index. A study of Danish
310 and Finnish paediatric IBD patients examined cancer and mortality risks and incidentally found a
311 four-fold increased death rate due to suicide in IBD patients compared to the general population
312 (10,11). Patient surveys conducted in Canada and Korea have reported a more than 30%
313 increased risk of suicide in IBD patients, similar to the findings of the present study (27–29). The
314 higher incidence rates of depression and deliberate self-harm observed in the present study in

315 patients with IBD diagnosed over the age of 50 are in keeping with a recent study from Sweden,
316 which highlighted higher rates of suicide in individuals with late onset IBD and Crohn's disease
317 (30). Doctors caring for patients with IBD should be conscious of the increased burden of
318 psychiatric morbidity, with early mental health diagnosis providing the potential opportunity to
319 improve patient outcomes and reduce the risk of deliberate self-harm (23).

320 A number of studies have highlighted the increased incidence and prevalence of anxiety and
321 depression in patients with IBD (1,3,31-41). The adjusted risks of anxiety and depression in the
322 present study (adjusted hazard ratios 1.31 and 1.30) were lower than a recent population based
323 Korean study, which reported adjusted hazard ratios of 1.6 and 2.0 respectively (40). Female
324 sex, smoking, surgery and extraintestinal manifestations of IBD all increase the risk of anxiety
325 and depression in patients with IBD, resulting in more hospital admissions and imaging
326 (41). There have been several mechanisms proposed for the increased risk of anxiety and
327 depression in patients with IBD. The Gut-brain dysregulation hypothesis highlighted in recent
328 animal model based studies proposes mechanisms such as an increase in peripheral cytokines or
329 damaged nerve terminals in the gut resulting in neuroinflammation, activation of the
330 hypothalamic pituitary axis, which may then cause anxiety and depression in patients with IBD
331 (40,41). Anxiety and depression in patients with IBD are associated with increased healthcare
332 utilisation and taking time off work (6). Previous UK studies have focused on the prevalence of
333 these mental health disorders in IBD patients but an increased incidence of anxiety and
334 depression particularly in the first year following an IBD diagnosis has been reported which was
335 also observed in the present study for depression and insomnia (44). However, there are a
336 number of limitations to the study of Kurina et al, as only secondary care data were analysed and
337 incidence rates were not reported (44). The present study is the first study in UK which reports

338 the incidence rates of anxiety and depression in IBD patients, without a prior mental health
339 diagnosis.

340 The association of insomnia with IBD has been examined through the global measure of sleep
341 quality but only a few single centre studies have highlighted the relationship between insomnia
342 and IBD previously (8,44,45). The present study has highlighted the markedly increased
343 incidence of insomnia in patients with IBD. Although both physical IBD symptoms and mental
344 health disorders may contribute to such symptoms and potential impact of both require clinical
345 assessment in IBD patients presenting with insomnia.

346 **Strengths and limitations**

347 The key strength of this study is the large study population from a UK primary care database.
348 The data are collected at the time of consultation, reducing recall bias. Potential confounding
349 factors are mitigated through the use of multivariable Cox proportional hazards models for
350 analysis. There are some potential limitations given the data source for this study. General
351 practitioners may improve their coding of prevalent diseases over time. However, one would
352 then expect all conditions in such databases to increase in prevalence over time, which is not the
353 case (46). As highlighted in other studies using primary care research databases, there is a
354 recognised margin for error in the diagnosis of IBD based on Read codes (17) and the IBD
355 diagnoses of individual patients could not be externally validated in the present study. It is
356 important to recognise that both ‘anxiety’ and ‘depression’ may be represent symptoms of these
357 disorders, rather than a formal diagnosis given the broad Read code inclusion criteria in the
358 present study. READ codes may have limited sensitivity for mild mental illness but it was
359 beyond the scope of this study to also study prescriptions for mental illness.

360 There is also a possibility of underreporting those with a ‘mixed anxiety-depressive disorder’ in
361 this study. This study has considered all Crohn's disease and all ulcerative colitis as single
362 diseases but due to paucity of data in the THIN database regarding inflammatory bowel disease
363 phenotypic subtypes, the impact of subtypes on the risk of mental illness could not be analysed.
364 The analysis of the impact of ethnicity on mental health disorders was limited due to missing
365 data on ethnicity in 47% of the IBD cohort. The impact of substance and alcohol abuse could
366 also not be examined in the present study. The impact of clinical factors such as the severity of
367 IBD and related symptoms, which might have increased the risk of mental illness after IBD
368 diagnosis, also could not be examined in this study.

369 **Conclusions**

370 The incidence of deliberate self-harm, anxiety, depression, and insomnia are increased in patients
371 diagnosed with IBD. More research is required to determine the causes of these associations and
372 to optimise the treatment of mental health disorders in patients with IBD. Clinicians caring for
373 patients with IBD should be aware of these associations and diagnose and treat them when
374 present for the benefit of both the patient’s mental health and IBD.

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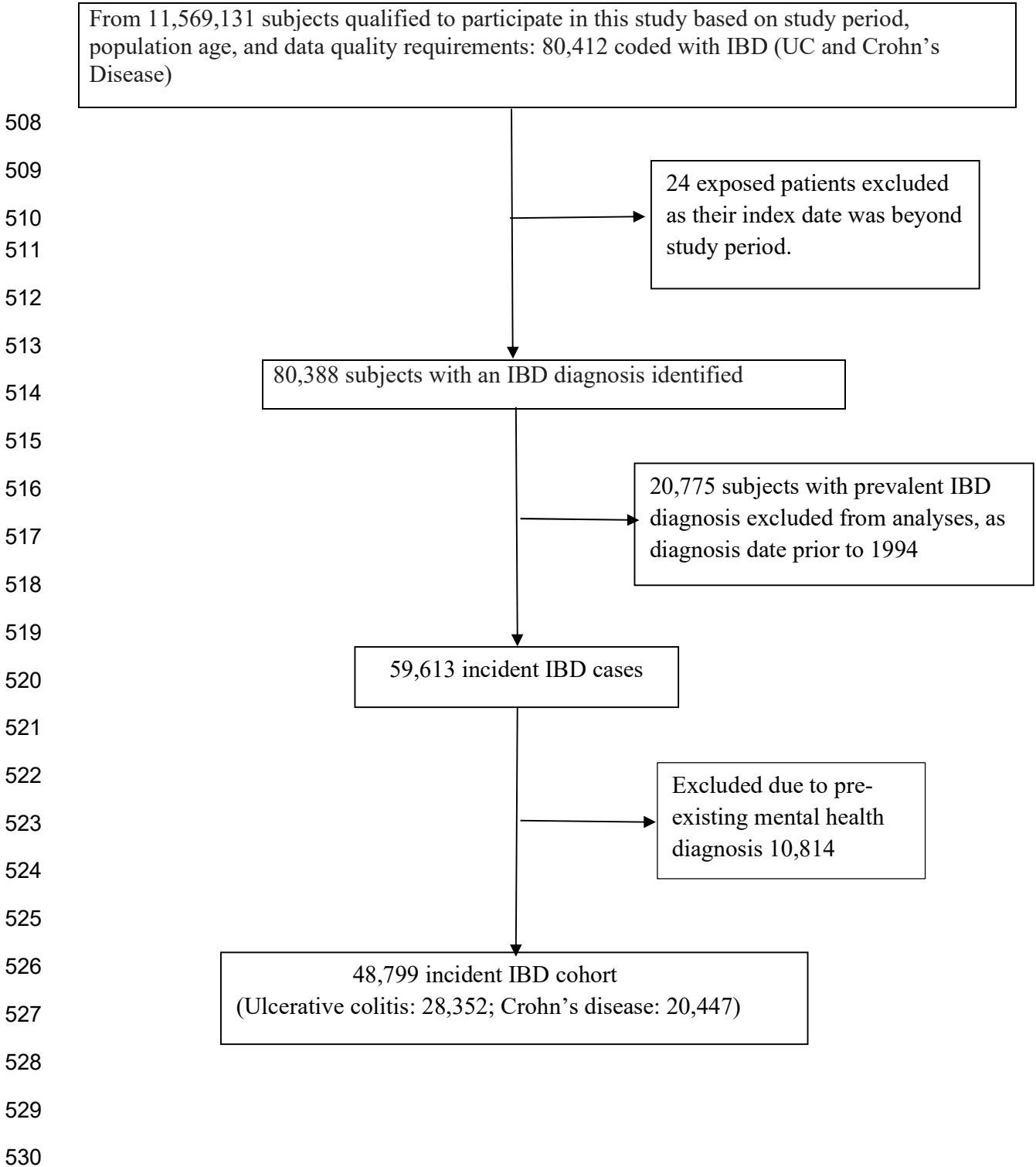
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507 **Figure 1. Study flow chart.**



531 **Table 1: The Demographic details of the IBD patients and controls studied**

Variable	Controls		IBD patients		Full cohort		
	number	%	number	%	number	%	
	190,075	<i>79.6</i>	48,799	<i>20.4</i>	238,874		
Age quintiles (years)	<27.4	42,874	22.5	9,903	20.1	52,777	22.1
	27.4-36.3	39,396	20.7	10,083	20.1	49,479	20.7
	36.4-47.4	37,401	19.7	9,507	19.5	46,908	19.6
	47.4-61.3	35,603	18.7	9,049	18.5	44,652	18.7
	>61.3	34,801	18.3	10,257	20.9	45,058	18.9
Sex	Female	91,808	48.3	23,572	48.3	115,380	48.3
	Male	98,267	51.7	25,227	51.7	123,494	51.7
IBD	UC	109,665	57.7	28,352	58.1	138,017	57.8
	CD	80,410	42.3	20,447	41.9	100,857	42.2
Townsend quintile	1	39,356	20.7	10,092	20.7	49,448	26.0
	2	35,784	18.8	9,193	18.8	44,977	18.6
	3	34,468	18.1	8,996	18.4	43,464	18.8
	4	27,670	14.6	7,292	14.9	34,962	14.6
	5	17,921	9.4	4,730	9.7	22,651	9.5
	Missing	34,876	18.3	8,496	17.4	43,372	18.1
Ethnicity	White	75,409	39.7	23,732	48.6	99,141	41.5
	Black	2,685	1.4	313	0.6	2,998	1.2
	South Asian	4,309	2.3	1,170	2.4	5,479	2.3
	Mixed Race	890	0.5	202	0.4	1,092	0.4
	Other ethnicity	3,013	1.6	434	0.9	3,447	1.4
	Missing	103,769	54.6	22,948	47.0	126,717	53.0
Smoking status	Never	98,375	51.7	24,832	50.1	123,207	51.6
	Current	35,987	18.9	7937	16.3	43,924	18.3
	Ex smoker	29,025	16.3	11,518	23.6	40,543	17.0
	Missing	26,688	15.6	4512	9.2	31,200	13.1
Charlson Comorbidity score category	0	146,592	77.1	34,293	70.3	180,885	75.7
	1	30,912	16.3	9,943	20.4	40,855	17.1
	2	8,194	4.3	2,769	5.6	10,963	4.6
	>2	4,377	2.3	1,794	3.7	6,171	2.6

532 IBD inflammatory bowel disease, UC ulcerative colitis, CD Crohn's disease

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534 **Table 2: The Incidence rates of deliberate self-harm among IBD patients and controls**

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		IBD		
		patients	Controls	p-value
Full Cohort	Number	368	1111	
	Person years at risk	311616	1232025	
	Incidence rate per 1000	1.18	0.9	
	Incidence Rate Ratio	1.31 (95%CI 1.16-1.47)		<0.001
	Adjusted Hazard Ratio	1.33 (95%CI 1.18-1.49)		<0.001
Ulcerative colitis patients				
Ulcerative colitis patients	Number	172	585	
	Person years at risk	184118	718416	
	Incidence Rate per 1000	0.93	0.81	
	Incidence Rate Ratio	1.15 (95%CI 0.96-1.36)		0.11
	Adjusted Hazard Ratio	1.16 (95%CI 0.98-1.38)		0.08
Crohn's disease patients				
Crohn's disease patients	Number	196	526	
	Person years at risk	127498	513609	
	Incidence Rate per 1000	1.5	1.02	
	Incidence Rate Ratio	1.50 (95%CI 1.27-1.77)		<0.001
	Adjusted Hazard Ratio	1.51 (95%CI 1.28-1.78)		<0.001
Childhood IBD diagnosis (aged 10-18)				
Childhood IBD diagnosis (aged 10-18)	Number	45	166	
	Person years at risk	12332	55058	
	Incidence Rate per 1000	3.65	3.01	
	Incidence Rate Ratio	1.21 (95%CI 0.85-1.69)		0.25
Diagnosed with IBD over the age of 50.				
Diagnosed with IBD over the age of 50.	Number	68	153	
	Person years at risk	117878	442662	
	Incidence Rate per 1000	0.58	0.34	
	Incidence Rate Ratio	1.66 (95%CI 1.23-2.23)		<0.001

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538 **IBD** Inflammatory bowel disease, **CI** confidence interval.

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544 **Table 3: Cox proportional hazards modelling of associations with deliberate self-harm**
 545 **in the IBD patients and controls**
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		Adj HR	95%CI	p-value
	IBD	1.20	1.07 - 1.35	<0.002
Sex	Female	1.06	0.95 - 1.17	0.300
Age	<27.4	4.84	3.95 - 5.93	<0.001
	27.4-36.3	2.47	1.99 - 3.07	<0.001
	36.4-47.4	1.87	1.50 - 2.33	<0.001
	47.4-61.3	1.23	0.96 - 1.56	0.099
	>61.3	Reference category		
Co-existent mental health diagnoses	depression	5.97	5.33 - 6.69	<0.001
	anxiety	1.57	1.35 - 1.82	<0.001
	insomnia	2.32	2.02 - 2.66	<0.001
	severe Mental Illness	5.74	4.56 - 7.22	<0.001

547 **adj HR** Adjusted Hazard Ratio, **IBD** Inflammatory bowel disease, **CI** confidence interval.
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Table 4: The Incidence rates of anxiety among IBD patients and controls

		IBD patients	Controls	p-value
Full cohort	Number	1669	5643	
	Person years at risk	304296.4	1206866	
	Incidence Rate per 1000	5.48	4.67	
	Incidence Rate Ratio	1.17 (95% CI 1.11-1.24)		<0.001
	Adjusted Hazard Ratio	1.31 (95% CI 1.16-1.47)		<0.001
Ulcerative Colitis patients	Number	905	3111	
	Person years at risk	179787	704444	
	Incidence Rate per 1000	5.03	4.41	
	Incidence Rate Ratio	1.14 (95%CI 1.06-1.23)		<0.001
	Adjusted Hazard Ratio	1.26 (95%CI 1.07-1.47)		<0.005
Crohn's Disease patients	Number	764	2532	
	Person years at risk	124509	502422	
	Incidence Rate per 1000	6.14	5.04	
	Incidence Rate Ratio	1.22 (95%CI 1.12-1.32)		<0.001
	Adjusted Hazard Ratio	1.38 (95%CI 1.16-1.65)		<0.001
Childhood IBD Diagnosis (aged 10-18)	Number	67	310	
	Person years at risk	12259	54422	
	Incidence Rate per 1000	5.46	5.69	
	Incidence Rate Ratio	0.96 (95%CI 0.72-1.25)		0.77
Diagnosed with IBD over the age of 50.	Number	415	1315	
	Person years at risk	115762	435588	
	Incidence Rate per 1000	3.58	3.01	
	Incidence Rate Ratio	1.19 (95%CI 1.06-1.33)		<0.003

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IBD Inflammatory bowel disease. **CI** confidence interval

587 **Table 5: The Incidence rates of depression among IBD patients and controls**

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		IBD patients	Controls	p-value
Full cohort	Number	3167	9317	
	Person years at risk	294659	1182021	
	Incidence Rate per 1000	10.75	7.9	
	Incidence Rate Ratio	1.36 (95% CI 1.31-1.42)		<0.001
	Adjusted Hazard Ratio	1.30 (95%CI 1.23-1.36)		<0.001
Ulcerative Colitis patients	Number	1652	5088	
	Person years at risk	175204	690654	
	Incidence Rate per 1000	9.43	7.4	
	Incidence Rate Ratio	1.28 (95%CI 1.21-1.35)		<0.001
	Adjusted Hazard Ratio	1.24 (95%CI 1.16-1.33)		<0.001
Crohn's Disease patients	Number	1515	4229	
	Person years at risk	119456	491367.5	
	Incidence Rate per 1000	12.7	8.6	
	Incidence Rate Ratio	1.47 (95%CI 1.39-1.56)		<0.001
	Adjusted Hazard Ratio	1.36 (95%CI 1.26-1.47)		<0.001
Childhood IBD diagnosis (aged 10-18)	Number	130	381	
	Person years at risk	12010	53976	
	Incidence Rate per 1000	10.82	7.05	
	Incidence Rate Ratio	1.53 (95%CI 1.25-1.87)		<0.001
Diagnosed with IBD over the age of 50	Number	891	2365	
	Person years at risk	112892	429655	
	Incidence Rate per 1000	7.9	5.5	
	Incidence Rate Ratio	1.43 (95%CI 1.33-1.55)		<0.001

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590 **IBD** Inflammatory bowel disease, **CI** confidence interval.

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599 **Statement of Interests:** Nothing to declare