Do gastrointestinal complaints increase the risk for subsequent medically certified long-term sickness absence? The HUSK study

Simon Øverland1*, Marit Knapstad1, Ingvard Wilhelmsen2, Arnstein Mykletun1,3 and Nick Glozier4

Abstract

Background: Gastrointestinal complaints are very common in the general population and very often co-occur with common mental disorders. We aimed to study the prospective impact of gastrointestinal complaints on long term sickness absence, and address the contribution from co-occurring common mental disorders and other somatic symptoms.

Method: Health data on 13 880 40-45 year olds from the Hordaland Health Study (1997-99) were linked to national registries on sickness absence. As part of a wider health screening, gastrointestinal complaints were ascertained. Participant’s anxiety and depression, and the presence of other somatic symptoms were evaluated. In Cox regression models, we predicted sickness absences over an average 5.4 years follow-up, with adjustment for confounders, anxiety and depression and other somatic symptoms.

Results: After adjusting for gender, level of education and smoking, those reporting GI complaints had higher risk for later sickness absence (HR = 1.42, 95% CI 1.34-1.51). GI complaints were associated with both anxiety (OR = 3.66, 95% CI 3.31-4.04) and depression (OR = 3.28, 95% CI 2.89-3.72), and a high level of other somatic symptoms (OR = 8.50, 95% CI 7.69-9.40). The association of GI complaints was still independently associated with future sickness absence (HR = 1.17, 95% CI 1.10-1.16) adjusting for mental illness and other somatic symptoms.

Discussion: Sickness absence is a complex behavioural outcome, but our results suggest GI complaints contribute by increasing the risk of long term sickness absence independently of comorbid mental illness and presence of other somatic symptoms. Occupational consequences of illness are important, and should also be addressed clinically with patients presenting with GI complaints.

Keywords: Sickness absence, gastrointestinal complaints, anxiety, depression
societal and individual consequences of sickness absence [17] the lack of quality studies on the causes of sickness absence is striking [18], with few studies addressing this topic amongst people with GI complaints. Drossman and colleagues found that persons with GI complaints such as functional gastrointestinal disorder reported a higher number of days off work per year than the population free of such disorders [1]. A few other studies also provide indications for an association between GI complaints and self-reported sickness absence [19,20], but a recent Swedish study, found no such association between functional gastrointestinal disorders and sickness absences recorded in patient journals [21]. Only one study has evaluated this prospectively; a recent US study found that patients with functional dyspepsia had more short and long sickness absences than controls [22].

A number of cross sectional general population studies have reported strong associations between gastrointestinal complaints and both common mental disorders such as anxiety and depression [2,23–27] and general symptom reporting [28–30]. Mussel et al recently found that about one in five GI-patients in primary care also satisfy criteria for anxiety and depression [31], and a meta-analysis suggested that anxiety and depression are more common in people with both functional and verified gastrointestinal disorders than healthy controls [32]. As common mental disorders and somatic symptom reporting across organ systems are strong predictors for later awards of disability pension [33], any observed associations between GI complaints and sickness absence reported above may therefore be explained by these confounders. Further “lifestyle-factors” such as physical activity [34], smoking [35], alcohol use [36] and obesity [27,37] have all been linked to GI complaints and chronic physical illnesses. As these same factors also might relate to functional outcomes like sickness absence, they could explain parts of any association between GI complaints and sickness absence.

Given that the risk for permanent work force exit increases when sickness absence is long lasting [38] much policy is focussed upon those with long term sickness group. Efforts are being made to identify both high risk groups for this outcome and selected or indicated interventions to prevent it. Although there is a suggestion that people with GI complaints may be an important group to identify clinically the current literature on consequences of GI complaints seems to leave some important questions unanswered: Does reporting a high level of GI complaints at baseline predict long term sickness absences? If so, is it accounted for by one or more particular GI complaint? And, if such a predictive relationship is found, is it explained (in part or fully) by associated comorbidities or confounders measured at baseline?

**Methods**

We conducted an historical cohort study employing data from a large population based health survey, linked to national registries of medically sickness absence benefits awarded up to 6.1 years after the baseline health survey.

**Population and data material**

The Hordaland Health Study 1997–1999 (HUSK) was a joint epidemiological research project carried out by the National (Norwegian) Health Screening Service in collaboration with the University of Bergen. The base population included 29 400 individuals in Hordaland County in western Norway born 1953–57, aged 40–47 at the time of the data collection. Data were collected using two sets of questionnaires and clinical examinations. A total of 18 581 (8 598 men and 9 983 women) both answered the first questionnaire and came to the clinical examinations, yielding an initial participation rate of 63% (57% for men and 70% for women).

We excluded another 2 646 cases who did not return or complete needed items on the second questionnaire (administered at the clinical examination to be filled out and returned later), and another 1 875 who did not report being in paid work at baseline. A further 164 were excluded as their first short sickness absence period after health survey participation led directly to award of a permanent disability pension e.g. in the case of certain terminal or catastrophic illness. This left a final sample of 13 880 (approximately 47% of the base population).

**Exposure: Gastrointestinal complaints**

In the first questionnaire participants were asked if they experienced each of six common gastrointestinal (GI) complaints (“stomach pain”, “nausea”, “feeling bloated”, “coated tongue”, “vomiting or regurgitation” and “frequent loose bowel movements”, extracted from the ICD-10 research criteria for F45-Somatof orm disorders [39]), “almost never”, “rarely”, “sometimes”, “often”, or “almost always”, scored 0–4. For the main analysis, we were interested in identifying people who reported a high level of gastrointestinal complaints; We therefore summed each participant’s total score across the 6 GI items, and as the distribution was highly skewed, we constructed a dichotomy with the 80th percentile as cut off (high level of GI complaints). To examine if the risk of sickness absence was confined to specific complaints, we constructed another set of variables where a response to each of the six
items of “often” or “almost always” was dichotomously coded as 1, and less often as 0.

**Anxiety and depression**

Anxiety and depression were assessed with the Hospital Anxiety and Depression Scale (HADS), which contain seven items each on cognitive symptoms of anxiety disorder and depression (HADS) [40]. In a recent literature review, HADS showed good case-finding properties for anxiety and depression in primary care patient populations [41]. A cut-off score of ≥8 on each subscale was found to give the optimal balance between sensitivity and specificity (both about 0.8) for depression and anxiety according to DSM-III and IV, or ICD-8 and -9 [41], and was therefore was therefore used as cut-off.

**Other somatic symptoms**

The participants were also asked if they experienced each of the following 11 symptoms “almost never”, “rarely”, “sometimes”, “often” or “almost always” (0-4): chest pain, breathlessness, dysuria, unpleasant sensations in or around the genitals, complaints of blotchiness or discoloration of the skin, unpleasant numbness or tingling sensations, joint or muscle pain (all derived from the ICD-10 research criteria for F45 - Somatoform disorders [39]), sore or running eyes or nose, headache, dizziness, fatigue. In line with identifying those with high GI complaints levels we constructed another variable identifying a general high level of somatic symptoms by summing these scores and dichotomised at the 80th percentile.

**Physical conditions**

Physical conditions were assessed through self-report in the form: “do you have or have you had any of the following”, followed by a list of ten conditions: coronary infarction, angina, stroke, asthma, diabetes, multiple sclerosis, hay-fever, chronic bronchitis, osteoporosis or fibromyalgia. From previous studies it was clear that the prevalence of these conditions in this middle aged working population was low. We therefore dichotomised this into those with no conditions “0”, and those with one or more conditions “1”. Weight and height was measured by research nurses, and BMI categorised as normal (BMI < 24.9), overweight (BMI 25-29.9) and obese (BMI 30+).

**Demographics and health behaviours**

The highest education level reported was recoded into four categories: “elementary schooling”, “upper secondary school”, “1-3 years of higher education” and “higher education exceeding four years”. Information on age and gender was provided by the national population registry prior to invitation and inclusion in the health survey. Alcohol usage, assessed through self reported consumption of beer, wine and spirits over the past two-week period was categorised as abstinence, or low, medium and high consumption defined according to gender specific tertiles. Physical activity was measured through two variables on intense and light physical activity. These were combined into one variable reflecting “no”, “moderate” and “high levels of physical activity”. Smoking status was defined as daily smoker vs. other.

**Outcome: Sickness absence**

Information on sickness absence awarded until end of 2003 was collected from the Norwegian National Insurance Administration, and merged with the HUSK data by Statistics Norway using national personal identification numbers. In Norway, the employers cover the first 16 days of a sickness absence (first 14 days until April 1998). After this, the National Insurance Scheme covers absences up to a total of 52 weeks. As a consequence, the official registries (which are used in the present study) do not include information on absences shorter than 16 (or previously 14) days. Further in the Norwegian system, a 56-day consecutive sickness absence prompts a thorough medical report including an activity plan for the patient’s return to work. After 12 weeks, the national insurance scheme requires an extended plan and meetings towards the same purpose, which falls close to the previously used definition of long-term sickness absence of 90 consecutive days [42]. We therefore registered the first incident sickness absence from 17 days after the health survey participation, and used the start-stop dates to constructed the following mutually exclusive variables: i) The first LTSA (Long Term Sickness Absence) lasting from 17-55 consecutive days during follow-up, ii) The first LTSA lasting from 56-89 consecutive days during follow-up, and iii) The first LTSA lasting for more than 90 consecutive days during follow-up. As contrast for all these variables were those with no LTSA during follow-up.

**Statistical analysis**

Descriptive statistics were reported as means and frequencies. We then examined if there were significant differences in the distribution of the potential confounding variables between participants with and without GI complaints, and those with or without sickness absence during the follow up period using independent sample t-tests for continuous variables and chi-square statistics for categorical variables. Due to the large sample size, differences may be significant but yet without practical importance. For all significant associations we calculated the effect size (Cohen’s w [43]) and included variables in the multivariate models only if they were significantly associated to both exposure and outcome, and had at
least a small effect size (w=0.10) with either exposure or outcome. Logistic regression models (presented as odds ratios with 95% confidence intervals) were used to investigate the strength of associations between anxiety/depression/somatic symptoms and both the individual gastrointestinal symptoms, as well as high GI complaints. As we had exact information on the time between the baseline measurements and outcome data, we used Cox regression to estimate hazard ratios (with 95% confidence intervals) for later sickness absence from GI complaints, adjusted for confounding. We predicted risk for the first occurrence of long term sickness absence after the baseline health survey, while also taking into account length of this first period. In a hierarchical fashion these models were then adjusted for anxiety or depression, or experiencing a high load of other somatic symptoms. Finally, we examined if there were any additive interaction between GI complaints and anxiety, depression or gender towards risk of LTSA. All analyses, including identifying regression coefficients for the interaction analyses, was done in STATA 11, while the presence of additive interaction was examined using the algorithm suggested by Andersson et.al [44], where a synergy index (SI) deviating from “1” indicates presence of an additive interaction [45].

Ethics
The study protocol was approved by the Regional Committee for Medical Research Ethics, Western Norway and by the Norwegian Data Inspectorate.

Results
Higher levels of gastrointestinal complaints were observed amongst females, those with lower levels of education, the health risk behaviours of smoking, high BMI, and low levels of physical activity, and amongst those reporting physical illness, high physical symptom load and case levels of anxiety and depression. Only the associations with the last three variables were of sufficient effect for inclusion in the further analyses (table 1). The same variables had similar associations with the taking of at least one episode of sickness absence greater than 16 days during follow up (LTSA), with female gender, lower education and smoking being associated at the level set for inclusion in further analyses, in addition to high physical symptom load, anxiety and depression (table 2). Age and the level of alcohol use were not associated with either GI symptoms or LTSA.

Each of the individual GI symptoms was statistically significantly associated with anxiety and depression, with odds ratios ranging from 2.29 to 4.63 (table 3). The strongest association was found between anxiety and nausea (OR 4.63, 95% CI 3.38-6.34). While some of the specific GI complaints were more strongly associated with anxiety and depression than others, their respective associations with anxiety and depression were similar with overlapping confidence intervals. For each of the specific GI-symptoms, the association with a general high level of somatic symptom reporting was stronger compared to that for anxiety and depression.

The presence of high levels of GI complaints was associated with future LTSA (table 4). The overall risk for any LTSA over follow up, adjusted for gender, education and smoking was 1.42 (95% CI 1.34-1.51), and 1.17 (95% CI 1.10-1.16) in the fully adjusted model. When comparing subgroups of LTSA defined by duration, the hazard ratios were higher with longer durations of the first period of LTSA after the health screening, although with overlapping confidence intervals: For LTSA lasting 17-55 consecutive days, the gender, education and smoking adjusted risk from GI complaints was 1.47 (95% CI 1.34-1.60), while the corresponding risk if the first period lasted 90 days or more was 1.70 (95% CI 1.51-1.93). Individual further adjustment for depression explained between 7 and 8% of the risk, while adjustment for anxiety explained between 10 and 17% of the risk. Adjustment for potential confounding of general somatic symptom reporting on top of gender, education and smoking explained a larger proportion of the risk: between 32 and 48%. In the final model including all covariates simultaneously, the risk was substantially attenuated but still statistically significant at 1.19 (95% CI 1.08-1.32) for LTSA’s between 17-55 days and 1.33 (95% CI 1.16-1.53) for 90 or more days (table 4).

With regard to specific GI complaints, stomach pain had the strongest gender, education and smoking adjusted association with LTSA (HR = 1.69, 95% CI 1.53-1.87). The variable “coated tongue” had the weakest initial risk with HR = 1.35 (95% CI 1.23-1.48). After adjustment for other symptoms, nausea and coated tongue no longer incurred any independent risk of LTSA (table 5).

Finally, we did not identify any significant additive interactions between GI complaints and anxiety (SI = 1.10, 95% CI 0.84-1.42), depression (SI = 1.09, 95% CI 0.78-1.53), or gender (SI = 1.06, 95% CI 0.89-1.27), in predicting LTSA.

Discussion
Main findings
In this large population based cohort study, people who reported high levels of GI complaints were at increased risk of long-term sickness absence (>16 days in the Norwegian system) over up to 6 years later. As in previous studies, there was a strong association between anxiety and depression and a high level of GI complaints, particularly nausea. Despite this, anxiety and depression explained relatively little of the increased risk for
sickness absence arising from GI complaints. An overall high level of other somatic symptoms explained comparatively more of the risk. These results were similar for any one of the specific GI complaints.

**Strength and weaknesses**

The main strengths of this study lie in its prospective nature, size, ability to adjust for multiple confounders, and that measurement at baseline could not be biased with regards to the aim of this study. Furthermore our combined use of health study data and objective information on sickness absences from public registries reduces common method problems. The payment of benefits requires correct registration and a personal identification number, and for this reason the outcome data are considered highly accurate. Only people leaving Norway or dying would be excluded from follow up.

However the final participation rate with full data was only 47%. Results from a recent study suggest that non-participation in Norwegian population based health studies probably lead to underestimated prevalence estimates, but that studies focusing on associations between variables suffers less from health selection in non-participation [46]. In addition non-participation is higher amongst sicker people, those with mental disorder and those with higher rates of LTSA. Thus our observations would likely be an underestimate of any true association.

**Table 1 Total sample characteristics and associations with levels of GI complaints at baseline**

|                                | Full sample | GI complaints <80th percentile | GI complaints >80th percentile | difference | Cohen’s w** |
|--------------------------------|-------------|-------------------------------|-------------------------------|------------|------------|
| Total sample                   | 13880       | 11245                         | 2635                          | 19.0       |            |
| Age (mean/SD)***              | 43.2        | 43.2                          | 43.2                          | 1.56       | t(-1.4), df = 13878, p = 0.17 -  |
| Gender                         |             |                               |                               |            |            |
| Males                          | 6694        | 5623                          | 1071                          | 40.7       |            |
| Females                        | 7186        | 5622                          | 1564                          | 59.4       |            |
| Highest education level        |             |                               |                               |            |            |
| Elementary school              | 2226        | 1688                          | 538                           | 20.6       |            |
| Upper secondary school         | 6367        | 5111                          | 1256                          | 48.0       |            |
| Higher education               | 5189        | 4368                          | 821                           | 31.4       |            |
| Physical illness               | 1010        | 741                           | 269                           | 10.2       |            |
| BMI                            |             |                               |                               |            |            |
| Normal (BMI < 25)              | 7083        | 5776                          | 1307                          | 49.7       |            |
| Overweight (BMI 25-30)         | 5296        | 4322                          | 974                           | 37.0       |            |
| Obese (BMI >30)                | 1491        | 1140                          | 351                           | 13.3       |            |
| Smoking                        | 4705        | 3658                          | 1047                          | 39.7       |            |
| Alcohol use                    |             |                               |                               |            |            |
| Abstainer                      | 1027        | 828                           | 199                           | 7.7        |            |
| Low consumption                | 4431        | 3577                          | 854                           | 33.1       |            |
| Average consumption            | 4287        | 3504                          | 783                           | 30.4       |            |
| High consumption               | 3823        | 3082                          | 741                           | 28.8       |            |
| Physical activity              |             |                               |                               |            |            |
| No activity                    | 2103        | 1629                          | 474                           | 18.2       |            |
| Moderate                       | 5622        | 4526                          | 1096                          | 42.0       |            |
| High                           | 6041        | 5002                          | 1039                          | 39.8       |            |
| Anxiety                        | 2281        | 1376                          | 905                           | 34.4       |            |
| Depression                     | 1186        | 718                           | 468                           | 17.8       |            |
| Somatic symptoms               | 2375        | 1090                          | 1285                          | 48.8       |            |

* For dichotomous variables we present numbers and rates for positive cases only
** Effect sizes calculated for significant univariate associations only
*** Continuous variable: presented with mean and standard deviations (SD) and test for differences with independent sample t-test.
In previous papers using the same variable on somatic symptoms, including the GI symptoms, we have employed missing substitutions using individual mean substitution assuming “missing at random”. We did not go to any such steps for the GI items for this paper, as this would inflate the correlations between the GI complaints and other symptoms.

The health study did not include any of the clinical information required for excluding organic aetiology for the GI complaints presented by the participants in the present study. Other physical conditions, which are adjusted for, and medications taken should in theory be only partly related to GI complaints, as supported in our initial univariate analysis on this association. This is

Table 2 Association of baseline characteristics with Long Term Sickness Absence (LTSA) over up to 6 years of follow up*

|                                    | No LTSA during follow up | One or more period of LTSA during follow up | difference | Cohen’s w** |
|------------------------------------|--------------------------|---------------------------------------------|------------|-------------|
| Total sample                       | 7422 53.5                | 6458 46.5                                   |            |             |
| Age (mean/SD)***                   | 43.1 1.54                | 43.2 1.35                                   | t(-1.8), df = 13878, p = 0.08 | -           |
| Gender                             |                          |                                             | $\chi^2 = 304.7$, df = 1, p < 0.001 | 0.15        |
| Males                              | 4444 54.4                | 2250 39.4                                   |            |             |
| Females                            | 3722 45.6                | 3464 60.6                                   |            |             |
| Highest education level            |                          |                                             | $\chi^2 = 265.2$, df = 2, p < 0.001 | 0.14        |
| Elementary school                  | 1058 13.0                | 1168 20.6                                   |            |             |
| Upper secondary school             | 3592 44.3                | 2775 49.0                                   |            |             |
| Higher education                   | 3465 42.7                | 1724 30.4                                   |            |             |
| Physical illness                   | 500 6.1                  | 510 9.0                                     | $\chi^2 = 39.3$, df = 1, p < 0.001 | 0.05        |
| BMI                                |                          |                                             | $\chi^2 = 26.4$, df = 2, p < 0.001 | 0.04        |
| Normal (BMI < 25)                  | 4194 51.4                | 2889 50.6                                   |            |             |
| Overweight (BMI 25-30)             | 3182 39.0                | 2114 37.0                                   |            |             |
| Obese (BMI >30)                    | 787 9.6                  | 704 12.3                                    |            |             |
| Smoking                            | 2460 30.1                | 2245 39.3                                   | $\chi^2 = 126.0$, df = 1, p < 0.001 | 0.10        |
| Alcohol use                        |                          |                                             | $\chi^2 = 17.3$, df = 3, p = 0.54 | -           |
| Abstainer                          | 578 7.2                  | 449 8.1                                     |            |             |
| Low consumption                    | 2535 31.6                | 1896 34.1                                   |            |             |
| Average consumption                | 2618 32.7                | 1669 30.0                                   |            |             |
| High consumption                   | 2281 27.5                | 1542 27.8                                   |            |             |
| Physical activity                  |                          |                                             | $\chi^2 = 32.2$, df = 2, p < 0.001 | 0.05        |
| No activity                        | 1155 14.2                | 948 16.8                                    |            |             |
| Moderate                           | 3255 40.1                | 2367 41.9                                   |            |             |
| High                               | 3712 45.7                | 2329 41.3                                   |            |             |
| Anxiety                            | 1129 13.8                | 1152 20.2                                   | $\chi^2 = 98.3$, df = 1, p < 0.001 | 0.08        |
| Depression                         | 591 7.2                  | 595 10.4                                    | $\chi^2 = 43.4$, df = 1, p < 0.001 | 0.06        |
| Somatic symptoms                   | 1019 12.5                | 1356 23.7                                   | $\chi^2 = 300.1$, df = 1, p < 0.001 | 0.15        |

* For dichotomous variables we present numbers and rates for the positive cases only

** Effect sizes calculated for significant univariate associations only

*** Continuous variable: presented with mean and standard deviations (SD) and test for differences with independent sample t-test.

Table 3 Gender, education and smoking adjusted associations between the GI complaints individually and combined, and anxiety, depression and other somatic symptoms

|                      | Nausea | Stomach pain | Feeling bloated | Coated tongue | Vomiting or regurgitation | Frequent loose bowel movements | GI complaints (>80th percentile) |
|----------------------|--------|--------------|----------------|---------------|--------------------------|-------------------------------|---------------------------------|
|                      | OR     | 95% CI       | OR             | 95% CI        | OR                       | OR                             | OR                             |
| Anxiety              | 4.63   | 3.38-6.34    | 3.23           | 2.75-3.80     | 2.56                     | 2.27-2.88                     | 2.42                           | 2.09-2.81                       | 2.63                           | 2.26-3.07                      | 3.66                           | 3.31-4.04                      |
| Depression           | 4.43   | 3.10-6.32    | 3.19           | 2.63-3.87     | 2.56                     | 2.20-2.97                     | 2.29                           | 1.89-2.76                      | 2.79                           | 2.02-3.84                      | 2.55                           | 2.12-3.06                      | 3.28                           | 2.89-3.72                      |
| Somatic symptoms     | 7.20   | 5.19-9.99    | 4.75           | 4.04-5.64     | 4.16                     | 3.70-4.64                     | 4.60                           | 4.00-5.30                      | 4.93                           | 3.78-6.44                      | 3.80                           | 3.28-4.42                      | 8.50                           | 7.69-9.40                      |
a clear limitation as the GI complaints could be symptoms of underlying pathology. Below, we discuss the relevance of this for clinical management.

**Interpretation**

The key finding in the present study was the increased risk of LTSA during follow-up among those with a higher level of GI complaints. The most parsimonious interpretation of this is that these GI complaints are symptoms or a marker for a range of underlying gastrointestinal pathologies. In this study, we had no capacity to examine possible organic causes for these GI complaints. At the same time, we know that much of the time such complaints are not explained by positive findings [5,6,15,47,48] and in a non-clinical sample of people in their forties, functional complaints should be more common than organic failure or pathology. Supporting this are the observations that although nearly 14,000 individuals provided answers to the items of interest for the present study, this is still only about 47% of the approximately 29,000 eligible 40-47 year olds in the county at the time of the health study. Those who did not participate had poorer average health [49,50] and more often received benefits [51].

Another explanation could be that these symptoms are expressions of the most common causes of long term sickness absence: depression and anxiety. Certainly we confirmed a strong association between GI complaints and anxiety/depression. However adjusting for these potential confounders did little to explain the observed association. The overall measure of physical symptom reporting was both highly associated with GI complaints and LTSA and appeared to be a strong confounder. In this study relatively few participants (7.3%) had a chronic physical illness, and only a few of these illnesses in the list above would have resulted in GI complaints. In some cases, these other somatic symptoms may well be followed by gastro-related organic failure. Adjusting for the other symptoms could reflect overadjustment, leading us to underestimate the impact of the GI complaints on sickness absence. This latter is in line with Agreus’ study where those with GI complaints had more sickness absence than the general population, but their sickness absences were most often warranted from non GI-related medical causes [20]. While this certainly is possible within such a large sample, several factors suggest this should not be a major factor. The GI complaints were also abstracted from a list of symptoms that in sum makes up the requirements for somatisation disorder. Splitting these symptoms into organ specificity, and then reintroducing the remaining symptoms as adjustments, may by default introduce

| Adjustments | LTSA >16-55 consecutive days (predicting 2763 LTSA’s) | LTSA >55-89 consecutive days (predicting 1258 LTSA’s) | LTSA >89 consecutive days (predicting 1340 LTSA’s) |
|-------------|----------------------------------------------------|----------------------------------------------------|---------------------------------------------------|
|             | HR       | 95%CI      | HR       | 95%CI      | HR       | 95%CI      |
| Crude       | 1.59     | 1.46-1.74  | 1.72     | 1.51-1.96  | 1.91     | 1.69-2.16  |
| Model 1: Gender, education and smoking | 1.47     | 1.34-1.60  | 1.55     | 1.36-1.77  | 1.70     | 1.51-1.93  |
| Model 1 + depression | 1.43     | 1.31-1.57  | 1.50     | 1.31-1.71  | 1.63     | 1.44-1.85  |
| Model 1 + anxiety | 1.40     | 1.27-1.53  | 1.48     | 1.29-1.70  | 1.61     | 1.42-1.83  |
| Model 1 + somatic symptoms | 1.22     | 1.10-1.34  | 1.35     | 1.17-1.56  | 1.38     | 1.20-1.58  |
| Full adjustment* | 1.19     | 1.08-1.32  | 1.31     | 1.13-1.52  | 1.33     | 1.16-1.53  |

* Adjusted for gender, education, smoking, depression, anxiety and somatic symptoms.

| Nausea | Stomach pain | Feeling bloated | Coated tongue | Vomiting or regurgitation | Frequent loose bowel movements |
|--------|--------------|----------------|---------------|---------------------------|-------------------------------|
| HR     | 95%CI        | HR             | 95%CI         | HR                        | 95%CI                        |
| Crude  | 1.65         | 1.34-2.02      | 1.69          | 1.53-1.87                | 1.51                         | 1.41-1.63                   | 1.35                         | 1.23-1.48                   | 1.60                         | 1.35-1.90                   | 1.38                         | 1.25-1.52                   |
| Adjusted for gender, education and smoking | 1.42         | 1.16-1.75      | 1.57          | 1.42-1.74                | 1.38                         | 1.28-1.49                   | 1.27                         | 1.16-1.40                   | 1.59                         | 1.34-1.89                   | 1.42                         | 1.29-1.57                   |
| Anxiety* | 1.28         | 1.05-1.58      | 1.46          | 1.32-1.62                | 1.32                         | 1.22-1.42                   | 1.21                         | 1.10-1.33                   | 1.47                         | 1.23-1.75                   | 1.34                         | 1.22-1.48                   |
| Depression* | 1.33         | 1.08-1.63      | 1.51          | 1.36-1.67                | 1.34                         | 1.25-1.44                   | 1.24                         | 1.13-1.37                   | 1.51                         | 1.27-1.80                   | 1.37                         | 1.24-1.51                   |
| Somatic symptoms* | 1.14         | 0.93-1.40      | 1.35          | 1.21-1.49                | 1.21                         | 1.12-1.31                   | 1.09                         | 0.98-1.20                   | 1.34                         | 1.13-1.60                   | 1.25                         | 1.13-1.38                   |

* Adjusted for the health variable on top of gender, education and smoking.
over-adjustment of associations. Taken together, these findings could indicate that although GI complaints are related to anxiety and depression, the functional outcomes from GI complaints in terms of sickness absence are possibly due in large part to GI complaints being part of a person’s tendency to experience and/or report symptoms across the various organ systems. This hypothesis is supported by a previous paper from this cohort showing that high levels of health anxiety was a strong predictor of leaving the workforce entirely and moving onto a disability pension [52].

The discrepancy between “explained” and “unexplained” or “functional” gastrointestinal conditions is blurred and changing with new developments in e.g. understanding of pain and neuropathology. For some psychosocial outcomes the distinction may be less relevant: A recent study by Kisely and colleagues [53] found that the difference in functional outcomes between explained and unexplained symptoms were rather small. In addition, there seems to be a relatively low correspondence between organic findings and the degree of suffering from the symptoms [54,55]. Finally, welfare schemes influence access to sickness absences, and the Norwegian system is known as relatively generous. Still, studies from US populations also suggest GI complaints are associated with occupational consequences [1,22], and the associations between GI complaints, other symptoms and mental illnesses, is consistent in the international literature. Our main finding of an independent effect of GI complaints should therefore also be informative beyond a Norwegian context.

Conclusions

A high level of gastrointestinal complaints predicts objectively ascertained long term sickness absence. This was consistent across varying definitions of long term sickness absence. Our results confirmed the close relationships between GI complaints, depression and anxiety, but at the same time this did not seem to explain the work related functional outcomes of GI complaints. The presence of other somatic symptoms seems more important in understanding functional outcomes of GI complaints, lending support to theories of commonalities across symptom representations. Future work using more advanced latent class and path analytic techniques will help our understanding of how these symptom patterns combine and contribute to complex behaviours such as sickness absence.

For clinicians our results would suggest that management of the investigation and treatment of any underlying pathology in those with GI complaints should continue to be augmented by helping the individual manage their behaviour and disability. This is not just a focus on identifying and treating comorbid psychological illness, which is important, but would involve a nuanced understanding of individual’s beliefs about their symptoms, the causes and implications. Identifying maladaptive behavioural responses to GI symptoms may help people improve their psychosocial outcomes. In this respect the work concerning illness perceptions, and demonstrations that tackling these can improve work related outcomes [56] may prove fruitful for clinicians and rehabilitation providers. Finally, our data do not pinpoint which aspects of GI complaints lead to long term absence from work. It could be the activity limitations associated with symptoms such as pain, or that, anecdotally, people often take time off work whilst they are being investigated. Beliefs that work somehow contributes to or perpetuates these symptoms, or may be a cause of a disease, can also contribute to people wanting sickness absence. It may even be that common factors such as early childhood experiences can explain the association [57,58]. Future clinical studies could benefit from including sickness absence as an outcome of interest, as it is an outcome of high societal and individual relevance, and help identify which aspects of gastrointestinal conditions lead to these poorer sequelae.

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Author details

1Faculty of Psychology, University of Bergen, Bergen, Norway. 2Institute of Medicine, University of Bergen, Bergen, Norway. 3Division of Mental Health, National Institute of Public Health, Bergen, Norway. 4Brain and Mind Research Institute, Sydney Medical School, University of Sydney, Sydney, Australia

Authors’ contributions

SD and MK planned the study, carried out analyses and drafted the manuscript. IW, AM and NG contributed to interpretation of results and revised the manuscript for important content. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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