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Background: In clinical studies there is a strong relationship between gastrointestinal symptoms, anxiety and depression. The results may be biased, however, since anxiety and depression will influence the decision to consult a doctor. The aim of this study was to investigate the relationship between these symptoms in the population. **Methods:** In the Health Study of Nord-Trøndelag County of Norway (HUNT) a questionnaire concerning physical and mental health, demographic and life-style factors was sent to all inhabitants aged 20 years and above (a total of 94,197 persons). Valid questionnaires were returned by 62,651 persons (66.5%). Presence of nausea, heartburn, diarrhoea and constipation during the last year was self-reported. Anxiety disorders and depression were based on self-ratings of the Hospital Anxiety and Depression Scale (HADS). **Results**: 48% of the population reported one or more of the four gastrointestinal symptoms. Based on the HADS ratings, 15.3% of the population had an anxiety disorder and 10.4% a depression. Anxiety disorder was most strongly associated with nausea (OR 3.42). Anxiety was also associated with heartburn, diarrhoea and constipation, but weaker than with nausea. Depression was less strongly associated with the four gastrointestinal symptoms. Demographic factors, life-style factors and extra-gastrointestinal complaints could not explain the effect of anxiety disorders and depression on these gastrointestinal symptoms. **Conclusions**: In this population study there was a strong relationship between gastrointestinal symptoms, anxiety disorders and depression. These findings suggest that mental disorders in patients with gastrointestinal symptoms are not merely a consequence of selection bias in patient materials but connected to the symptoms themselves.

Key words: Anxiety; community; depression; epidemiology; gastrointestinal symptoms; psychosomatics

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Gastrointestinal symptoms (GIS) are common in the community, with a prevalence of single symptoms of 40%–70% (1, 2). The most prominent GIS are abdominal discomfort, nausea, heartburn, bloating, diarrhoea and constipation. About 1/3 of persons with GIS seek medical examination. The main reason for consulting a doctor is often not the degree of complaints, but anxiety and worry about the complaints (3–5). Only a minority of subjects with GIS have an organic condition that can explain the symptoms, and most patients are diagnosed as having functional dyspepsia (FD) or irritable bowel syndrome (IBS). The prevalences of FD and IBS in the population are about 10% and 20%, respectively (5).

There is a strong association between functional gastrointestinal conditions and psychological symptoms. Patients with IBS and FD have elevated levels of mental symptoms, such as depression, anxiety, somatization and neuroticism, compared to healthy controls and patients with organic gastrointestinal disorders (6–12). The prevalence of mental disorders in clinical samples with GIS is about 60%–85% (7–9), while the prevalence in community samples is only about 10%–15% (10, 13–16). Subjects who seek medical consultation for their GIS have more psychological problems than non-consulters (19). For most patients, clinical examination and reassurance by the family doctor has a calming effect and relieves the GIS, while for patients with anxiety and depressive disorders such treatment is not enough and the GIS persist. These patients are therefore frequently referred to clinics of gastroenterology. It is important to study functional GIS in the population in order to understand this relation. Samples recruited from clinical settings are unlikely to be representative of the population with functional GIS. These patients are probably a selected group with increased GIS levels and more psychopathology (17, 18). The best predictors for consultation for GIS are the duration of symptoms and psychological factors, such as the severity of depression and patients' views on the causes of their illness (19). The difference in psychological distress between patients with functional GIS in clinical settings and individuals with such symptoms in the general population indicates that the psychopathology seen in patients with functional GIS may be of two types: one is a characteristic of the illness itself, while the other leads the individual to consult a physician.

The aims of this study are: (1) to investigate the relationship between various GIS and anxiety and depression in the

Table I. Prevalence of gastrointestinal symptoms (major complaints)

Symptoms	Male	Female	Total
Nausea	186 (0.6)	516 (1.6)	702 (1.2)
Heartburn	1492 (5.2)	1504 (4.7)	2996 (4.9)
Diarrhoea	489 (1.7)	630 (2.0)	1119 (1.8)
Constipation	430 (1.5)	1818 (5.7)	2248 (3.7)
More than one GI symptom	260 (0.9)	607 (1.9)	867 (1.4)

Total *n* is 60998. Numbers are *n* (%).
All gender differences are statistically significant (chi-square *P* < 0.05).

population; (2) to examine if the relation between GIS and mental symptoms can be explained by other variables; and (3) to compare the association between GIS and anxiety/depression with the associations to other variables.

Materials and Methods

The health study of Nord-Trøndelag County of Norway (HUNT) comprised all adults aged 20 and above, a total of 94,197 inhabitants. Nord-Trøndelag County consists mainly of rural areas with three small towns. Socio-demographically, the population resembles the mean of the Norwegian population, with the exception of a somewhat lower educational level.

From August 1995 to April 1997, HUNT sent a questionnaire covering demographic factors, questions about physical and mental health, and life-style factors like consumption of coffee, alcohol use and smoking, to the adult population of Nord Trøndelag. Of the persons invited, 62,651 took part, which gave a response rate of 66.5%.

The GIS reported were nausea, heartburn, diarrhoea and constipation experienced during the last year. The intensity of these symptoms was rated as `no complaints', `minor complaints' or `major complaints'. Anxiety and depressive symptoms were self-rated by the Hospital Anxiety and Depression Scale (HADS) (21). To avoid confusing the somatic symptoms of depression and anxiety with those caused by medical conditions, only items covering emotional and cognitive symptoms have been included in HADS. This makes the test particularly suitable for application in medical settings. HADS consists of two sub-scales, the anxiety sub-scale (HADS-A) and the depression sub-scale (HADS-D). Each sub-scale consists of seven items, and the range of scores on each item is 0–3. Cut-off points on each of the sub-scales of 7/8 for possible and 10/11 for probable diagnosis of anxiety and depression have been recommended (22). The

Table II. Principal components analysis of gastrointestinal symptoms

Symptoms	Factor 1	Factor 2
Diarrhoea	0.75	−0.20
Nausea	0.69	0.29
Heartburn	0.60	0.25
Constipation	0.21	0.93
Eigenvalue	1.50	0.93

Numbers are factor loadings.

psychometric properties are demonstrated to be satisfactory in the Norwegian translation (23). In this study we have used a cut-off point of 8 on each of the sub-scales.

Statistics

The data were analysed by SPSS version 9.0. Principal component analysis with oblique rotation was performed to explore the empirical basis for symptom clustering. To estimate the relative effect of common risk factors known to be related to GIS, block-wise logistic regression was used. The effects were labelled risk factors, although the cross-sectional design does not allow a conclusion on causality. Block 1 contained depression and anxiety; block 2 included demographic factors like sex, age, education, work-load and civil status; block 3 life-style factors like smoking, meals, physical exercise and consumption of alcohol and coffee; and in block 4 extra-intestinal somatic conditions like angina pectoris, cancer and muscle-skeletal complaints were tested. Levels of significance were set to $P < 0.05$. Weighting according to the procedure used in the National Comorbidity Survey (24) was performed to adjust for differences in response-rate according to age and gender, and also minor age and gender differences between the population of Nord-Trøndelag County and the population of Norway.

Results

Of the 94,197 inhabitants in Nord Trøndelag, 60,998 (65%) responded to questions about GIS as well as HADS; 29,279 (48%) reported at least one GI complaint (minor and major complaints) during the last year. Heartburn was the most frequent symptom (28%), while 20.2% complained of constipation, 15.3% reported diarrhoea and 12.5% complained of nausea. Major complaints of at least one (among four possible) GIS were reported by 6,030 individuals (9.9%). Prevalences of the four different symptoms (major complaints) are given in Table I. Females had more GI symptoms than men. This was most significant in constipation, where the

Table III. Prevalence of anxiety and depression

Symptoms	Male	Female	Total	P-value
Anxiety	12.5%	17.9%	15.3%	0.001
Depression	10.4%	10.4%	10.4%	NS

Table IV. Odds ratio for anxiety and depression in gastrointestinal symptoms

Models		Nausea	Heartburn	Diarrhoea	Constipation
Anxiety	Crude	3.42 (2.89–4.04)	1.90 (1.73–2.09)	2.21 (1.91–2.55)	2.35 (2.12–2.60)
	Adjusted (block 2)	2.96 (2.49–3.53)	1.91 (1.74–2.10)	2.05 (1.77–2.38)	2.15 (1.94–2.39)
	Adjusted (blocks 2 and 3)	2.89 (2.42–3.44)	1.89 (1.72–2.08)	1.99 (1.72–2.31)	2.16 (1.95–2.40)
	Adjusted (blocks 2, 3 and 4)	2.47 (2.07–2.95)	1.61 (1.46–1.78)	1.67 (1.43–1.93)	1.86 (1.67–2.07)
Depression	Crude	1.47 (1.21–1.79)	1.46 (1.31–1.62)	1.42 (1.20–1.68)	1.73 (1.54–1.94)
	Adjusted (block 2)	1.74 (1.42–2.13)	1.30 (1.17–1.45)	1.46 (1.23–1.74)	1.63 (1.45–1.84)
	Adjusted (blocks 2 and 3)	1.64 (1.34–2.01)	1.28 (1.15–1.43)	1.42 (1.20–1.69)	1.60 1.43–1.80)
	Adjusted (blocks 2, 3 and 4)	1.49 (1.21–1.83)	1.16 (1.04–1.30)	1.27 (1.07–1.51)	1.46 (1.30–1.65)

Numbers are odds ratios (with 95% confidence intervals).

In block 2 the effects are adjusted for demographic factors (age, gender, education, workload and civil status). In block 3 the effects are adjusted for health-related behaviour (alcohol and coffee consumption, smoking, physical activity). In block 4 the effects are adjusted for extra-gastrointestinal somatic symptoms (cancer, angina, muscular skeletal complaints, osteoporosis, Fibromyalgia, Rheum. Arthritis, Artrosis, Mb. Bechterew and other m-s conditions).

prevalence for women was about four times greater than for men. The prevalence of nausea was nearly three times greater in women than in men.

Principal components analysis was performed to explore the empirical basis for clustering of GI symptoms (Table II). Only one factor with an eigenvalue >1 emerged. That factor contained nausea, heartburn and diarrhoea, and constipation was the only variable loading on the other factor. The internal consistency between the four GIS was low, with a Cronbach's alpha coefficient of 0.42. From this we concluded that there was no empirical basis for clustering of GIS into syndromes. Consequently, the relation between each of the GIS and the mental symptoms was studied separately.

Among the participants in HUNT, 15.5% (M/F 12.5%/17.9%) had an anxiety disorder and 10.4% (M/F 10.4%/10.4%) depression (Table III). The prevalence of depression increased with age, while anxiety disorder was most prominent in the middle-aged, with a slightly decreasing prevalence in the older age groups.

Odds ratios (OR) for anxiety and depression in the four GIS, adjusted for demographic factors, health-related behaviour and extra-gastrointestinal conditions, are given in Table IV. The results are presented in three steps

(1) Crude effects of anxiety and depression on the GIS. Anxiety and depression both made significant contributions as risk factors in all four GIS. Anxiety increased the risk more strongly than depression. Nausea was the GIS most strongly associated with anxiety, with an OR of 3.42.

(2) The effects of anxiety and depression adjusted for demographic factors (block 2), life-style (block 3) and extra-GIS (block 4). Demographic factors, life-style factors and extra-GIS could only partly explain the association between anxiety disorder, depression and GIS. For anxiety disorder, age and gender contributed to some extent to explain this association and the same did extra-GIS like cancer, angina and muscle-skeletal complaints. However, the association between anxiety and GIS could not be explained by any of the life-style factors. For depression, demographic factors, life-style and extra-GIS could only to a minimal degree explain the association with GIS.

(3) The direct effect of demographic factors, life-style and extra-gastrointestinal conditions on the GIS. Among demographic variables, age and gender contributed most strongly. Younger women (age 20–39) were especially prone to complain of nausea (OR 2.14) and middle-aged women (age 40–59 years) had a high risk of complaining of constipation (OR 2.20). Younger persons (age 20–39 years) were more prone to complain of heartburn and diarrhoea (OR 1.46 and 2.12).

No consumption of coffee and alcohol, in contrast to moderate use, and high consumption of coffee were significantly associated with nausea (OR 1.71, 1.43 and 1.32, respectively). In heartburn and diarrhoea, there was a significant association with high consumption of alcohol (OR 1.43 and 1.57). Smoking was a negative risk factor in constipation (OR 0.83), leading to the conclusion that smokers are less prone to constipation than non-smokers.

Of the extra-GIS, angina, cancer and muscle-skeletal complaints all contributed significantly in nausea (OR 1.97, 1.84 and 1.61, respectively). In heartburn and constipation, angina and muscle-skeletal complaints also had significant contributions (OR from 1.53 to 1.69), while in diarrhoea, cancer and muscle-skeletal complaints contributed significantly (OR 1.70 and 1.94).

Discussion

The greatest strength of this study is the large number of people surveyed. It is the largest community-based study of GI symptoms. Of the 94,197 subjects invited in HUNT, 60,998 (65%) responded to questions about GIS as well as HADS. The National Health Interview Survey (NHIS) studied IBS in about 18,000 individuals (25). Other epidemiological studies have consisted of about 1000 to 6000 subjects (13, 19, 26–27). The prevalences of GI symptoms in these studies were 30%–69%. The variations in prevalences were mainly due to differences in numbers and kind of GIS studied. In our study, the prevalence of GIS was 48%, covering nausea, heartburn, diarrhoea and constipation, and heartburn was the most frequent symptom with a prevalence of 28%.

Factor analyses of GIS have indicated clustering of symptoms into syndromes, indicating FD and IBS as separate diagnostic entities (5, 10). Principal components analysis of the four symptoms in our study did not confirm these findings. Only one factor with eigenvalue >1 emerged. This factor contained nausea, heartburn and diarrhoea, while constipation was the only variable loading on the other factor. Differences in numbers and kind of symptoms studied may account for these differences in factors. In our study, only four GIS were examined, while in studies where FD and IBS came out as separate entities, about 50 GI symptoms were analysed. Our findings are in accordance with those of Agreus et al. (15), who reported no tendency for GIS to form separate symptom clusters corresponding to specific IBS and FD factors.

There was a strong association between anxiety, depression and the four GI symptoms. In terms of causality, there are two possibilities: (1) Anxiety and depression can be a result of worry about GIS, or a consequence of being bothered by symptoms over time, or (2) GIS can be an expression of the anxiety disorders or depression. In this cross-sectional study, the pattern of causality cannot be elucidated

Controlling for demographic and life-style factors, as well as extra-GI conditions did not reduce the strength of the association between GIS and anxiety disorders and depression substantially. Anxiety disorder, compared to depression was more strongly associated with GIS, and no other co-variable was so strongly associated with GIS as anxiety. Earlier studies of community samples have also reported a strong association between anxiety disorder, depression and GIS. In the Epidemiologic Catchment Area (ECA) study, subjects who had at least one GIS were significantly more likely to have experienced life-time episodes of major depression, panic disorder or agoraphobia compared to subjects without GIS (14). In the Zurich study (16), they concluded that functional stomach complaints were significantly associated with major depression, sub-threshold panic disorder, agoraphobia and social phobia. These findings may confirm the hypothesis that the psychopathology connected with functional GIS can be a characteristic of the illness itself and not merely a consequence of illness-behaviour.

There was only a slight reduction in the effect of anxiety disorder and depression on the GIS symptoms when demographic and life-style factors as well as extra-GIS were controlled for. Age and sex affected this relationship to some degree. This may reflect the fact that the prevalences of anxiety, depression and GIS were unequally distributed between men and women.

Life-style factors (smoking, consumption of alcohol and coffee) did not reduce the effect of anxiety disorder and depression on GIS to any substantial degree. Extra-gastrointestinal conditions (angina, cancer and muscle-skeletal complaints), however, were of some significance. Chest pain is a common symptom in all anxiety disorders. The diagnosis of angina in this study was based on self-report and not verified by any clinical investigation. Only a minority of patients complaining of chest pain are diagnosed with heart disease, and about 40% of patients with angina have been reported to have a panic disorder (28). Data from HUNT (Dahl et al., pers. comm.) indicate that subjects reporting angina have a higher score on anxiety than subjects without angina. From this we can reason that at least some of the subjects in HUNT reporting angina in fact have anxiety disorders, and this may explain the effect of angina on anxiety disorders and depression as risk factors for GIS. The contribution of muscle-skeletal complaints in reducing the effect of anxiety and depression on the GI symptoms may be explained by the concept of somatization. Many patients who consult gastroenterologists for functional GI conditions have in addition multiple somatic complaints from other parts of the body, like dizziness, headache, fatigue and muscle-skeletal pain. They often overuse medical resources with frequent consultations at general practitioners and widespread use of physical examinations, medications and sick leave. This pattern of behaviour is referred to as somatization, a phenomenon closely related to anxiety. In an earlier study, patients with FD reported more extra-gastrointestinal somatic symptoms than patients with duodenal ulcer and healthy controls did, and they also had more sick leave. However, the main reason for sick leave was not the GIS, but muscle-skeletal complaints (11). Likewise, patients who primarily presented muscle-skeletal complaints to their GP were frequently reported also to have functional GI conditions (29). The association between anxiety disorders, depression and the GIS may also be due to the psychological distress experienced by many patients with cancer, angina and muscle-skeletal disorders.

There were also some direct effects of demographic factors, life-style factors and extra-gastrointestinal somatic conditions on the GIS. Prevalence of GI symptoms varied with age and gender. This is in accordance with findings from other studies, where females reported more GI symptoms than men did. Abstinence from coffee was connected with all GI symptoms, especially nausea. This may be explained by the fact that many people get digestive complaints from coffee and consequently are abstinent. A similar explanation may be given for the fact that abstinence from alcohol was a risk factor in nausea. High consumption of alcohol was associated with heartburn and diarrhoea. This is in accordance with earlier findings (26). Other life-style factors were of minimal importance. In conclusion, contrary to what is usually claimed, life-style factors were only weakly connected with GIS. The direct effects of extra-GIS (angina, cancer, muscle-skeletal complaints) on GIS may be related to side effects from treatments or be consequences of the conditions themselves.

The prevalence of anxiety disorders was 15.3%, and 10.4% had depression. Selective serotonin reuptake inhibitors (SSRIs) are widely used in the treatment of these disorders. Nausea and other GIS are common side effects in these medications (30) and may contribute to the association between anxiety, depression and GIS. We have no information about treatment with SSRIs in our population.

Only a few GIS were studied by us. However, the prevalence of these symptoms was in accordance with the prevalence of GIS from other community studies. We had no information about the prevalences of organic GI conditions such as duodenal ulcer, liver diseases and inflammatory bowel diseases. The prevalences of these conditions in the population are low (1%–2%, 31), so the contribution from these disorders would not have changed the results substantially.

Conclusions

In this large community sample, anxiety and depression were strongly associated with GIS. Anxiety was of particular importance; no other factor was so strongly associated with GI symptoms as anxiety. The contribution of factors such as age and gender, life-style and extra-gastrointestinal conditions did not reduce the effect from anxiety and depression to any substantial degree. The close connection between anxiety, depression and GI symptoms seems to be related not just to the illness behaviour, but also to the illness itself.

Acknowledgements

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