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Disordered eating practices in gastrointestinal disorders

Satherley, R; Howard, Ruth; Higgs, S

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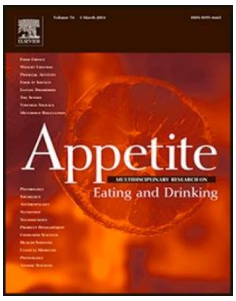

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Disordered Eating Practices in Gastrointestinal Disorders

Satherley, R., Howards, R., and Higgs, S.

University of Birmingham

Email: RXS027@bham.ac.uk

Telephone: 0121 414 4921

Fax: 0121 414 4915

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Disordered Eating Practices in Gastrointestinal Disorders

Highlights

- Evidence of disordered eating patterns in GI disease was reviewed.
- The prevalence of disordered eating in gastrointestinal disease was 5.3-44.4%
- This was associated with distress, symptom severity and dietary management.
- A conceptual model of disordered eating in GI disease was developed.

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Abstract

Purpose: To systematically review evidence concerning disordered eating practices in dietary-controlled gastrointestinal conditions. Three key questions were examined: a) are disordered eating practices a feature of GI disorders?; b) what abnormal eating practices are present in those with GI disorders?; and c) what factors are associated with the presence of disordered eating in those with GI disorders? By exploring these questions, we aim to develop a conceptual model of disordered eating development in GI disease.

Methods: Five key databases, Web of Science with Conference Proceedings (1900-2014) and MEDLINE (1950-2014), Pubmed, PsychINFO (1967-2014) and Google Scholar, were searched for papers relating to disordered eating practices in those with GI disorders. All papers were quality assessed before being included in the review.

Results: Nine papers were included in the review. The majority of papers reported that the prevalence of disordered eating behaviours is greater in populations with GI disorders than in populations of healthy controls. Disordered eating patterns in dietary-controlled GI disorders may be associated with both anxiety and GI symptoms. Evidence concerning the correlates of disordered eating was limited.

Conclusions: The presence of disordered eating behaviours is greater in populations with GI disorders than in populations of healthy controls, but the direction of the relationship is not clear. Implications for further research are discussed.

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Introduction

Disruptions to the gastrointestinal (GI) tract result in GI disorders including coeliac disease (CD), irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD). The symptoms associated with these disorders include nausea, bloating, constipation, diarrhoea, changes in weight and abdominal pain. CD, IBS and IBD can all be managed via a life-long modification of the daily diet to avoid GI symptoms (Gibson & Shepherd, 2010). Dietary plans and foods that trigger symptoms vary across GI conditions. In those with CD, it is necessary to follow a strict, life-long gluten-free diet, whereas individuals with IBD and IBS have a less structured dietary regimen that involves trial and error to identify trigger foods (NICE, 2009; Yamaoto, Nakahigashi & Saniabadi, 2009).

Dietary-controlled GI disorders may place individuals at risk for the development of disordered eating (DE) patterns. DE describes abnormal eating behaviours that may include skipping meals, binge eating, restricting certain food types or fasting (Grilo, 2006). These eating patterns are deviations from the cultural standard of 3 meals a day, which is often found in Western cultures (Fjellstrom, 2004). In this article, we use the term “Disordered Eating (DE)” to indicate any deviation from these cultural norms, including food restriction, skipping meals and over-eating. These deviations from cultural norms may be related to later development of an eating disorder but they do not necessarily indicate that an eating disorder is present. Dietary restraint, GI symptoms, food awareness and the non-specific burden of chronic illness may act as triggers for the development of DE patterns in those with CD, IBS and IBD.

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Before diagnosis, individuals with dietary-controlled GI disorders will often experience uncomfortable, embarrassing and distressing symptoms when consuming offending food items (Bohn, Storsrud, Tornblom, Bengtsson & Simren, 2013; NICE, 2009). These symptoms may become associated with certain types of food or with food in general, creating the potential for a conditioned food aversion to develop (Garcia, Kimeldorf & Koelling, 1955). This may be similar to the development of food aversions in chemotherapy patients (Berteretche et al., 2004). A fear of being contaminated by unknown food sources has repeatedly been reported in the literature across the dietary-controlled GI disorders (Sverker, Hensing & Hallert, 2005; Teufel et al., 2007). This may feed into the development of DE patterns when individuals become too afraid to consume a variety of foods and subsequently begin to restrict their intake.

All dietary-controlled GI disorders require some form of prescribed dietary restriction as part of their management. Food restriction, whether it is done as part of a medical regimen or to promote health, is associated with altered eating patterns (Johnson, Pratt, & Wardle, 2012; Herman & Polivy, 1980). The prescribed dietary restraint in IBS, IBD and CD may place these individuals at risk for abnormal eating patterns (Keller, 2008). Prescribed dietary regimens may result in the development of harmful thoughts and attitudes towards food and body weight, which may in turn, lead to inappropriate eating practices (Nicholas et al., 2007). This phenomenon has been demonstrated in those with dietary-controlled chronic health conditions including Diabetes and Cystic Fibrosis (Quick, Byrd-Bredbenner & Neumark-Sztainer, 2013).

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Visible signs of illness in GI disorders are accompanied by embarrassing symptoms (Creed et al., 2006). Subsequently, individuals with GI disorders may become the target of bullying, which may contribute to a lower self-confidence and create a heightened awareness of one's body (Quick, McWilliams & Byrd-Bredbenner, 2014). In combination with essential dietary modifications and subsequent food awareness, these factors may result in those with dietary-controlled GI conditions being at greater risk for DE patterns (De Rosa, Troncone, Vacca & Ciacci, 2004).

Numerous case studies have described the co-occurrence of GI disorders and DE behaviours. The incidence of Bulimia Nervosa (BN), pica, obesity, Anorexia Nervosa (AN) and Eating Disorder Not Otherwise Specified (ENDOS) have been reported (Bayle & Bouvard, 2003; Leffler, Dennis, Edwards-George & Kelly, 2007; Mallert & Murch, 1990; Nied, Gillespie & Riedel, 2011, Oso & Fraser, 2005). In addition, the deliberate consumption of trigger foods to avoid weight gain has been indicated (Leffler et al., 2007). However, to our knowledge there has been no systematic review of the prevalence and aetiology of these difficulties in representative samples. The present work aimed to answer three questions: a) are DE practices a feature of GI disorders?; b) what abnormal eating practices are present in those with GI disorders?; and c) what factors are associated with the presence of DE in those with GI disorders?

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Methods

Search Strategy

Articles were obtained from the two databases that form Web of Knowledge: Web of Science with Conference Proceedings (1900-2014) and MEDLINE (1950-2014), as well as Pubmed, PsychINFO (1967-2014) and Google Scholar. The search criteria were formed of two categories: (i) GI disorder and (ii) terms relating to DE (see Appendix A). Retrieved articles were scrutinised for relevant citations.

Eligibility Criteria

To be included in the review, the articles had to meet stringent criteria. Only studies published during or after 1990 were included as this was a period of change for the diagnosis of GI conditions (ESPGHAN, 1990). In addition, articles had to be written in the English language and include participants between 10-80 years with a physician validated diagnosis of CD, IBS or IBD. Those articles that had not been peer reviewed were excluded, as well as case studies and case series. For a summary of the selection process refer to Figure 1.

Participants: Studies included youths and working-age adults (10-80 years) with a physician provided diagnosis of CD, IBS or IBD. Those reports focusing on other GI food-related allergies were excluded. Any articles looking at the presence of GI disorders in populations already diagnosed with an eating disorder were excluded. The relationship between eating disorder onset and subsequent GI symptoms has been well documented (Abraham & Kellow, 2013; Peat et al., 2013; Perkins et al.,

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2005); this review concerns the presence of DE in those with diagnosed GI conditions.

Outcome Measures: The articles included in the review were related to the eating patterns of those with IBS, IBD or CD. Studies were required to measure food intake or eating patterns as well as any presence of DE behaviours.

Study Design: Studies of both a qualitative and quantitative nature were included in the review. However, those that had not undergone the peer review process were excluded. Case studies and case series were excluded from the review.

Quality Assessment

Each article underwent an assessment of quality using an established tool (Kmet, Lee & Cook, 2004). Studies were independently rated by two researchers on a 3-point scale, according to established criteria, with a score of 2 (yes) indicating strong evidence for the criteria and a score of 0 (no) indicating a lack of evidence. If some evidence for the criterion was present, a score of 1 was allocated (partial). The criteria were not always applicable (NA) and these criteria were removed from the calculations. A total score was calculated ((number of yes's x 2) + partials) and this was divided by a total possible sum (28-(number of NA's x 2)). This provided a total quality score ranging between 0 and 1. Scores closer to 1 were suggestive of better quality. Difference in ratings between the reviewers was minor and resolved through

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consensus. All of the papers included in the review had high quality scores (M=0.89; see Table 1).

Extraction of Data

Participant Characteristics

Sample size, GI diagnosis, age and exclusion criteria were extracted.

Intervention/Study

The research topics that were examined (e.g. Prevalence of DE in GI disease) and the experimental procedure was extracted. Information concerning the method of eating behaviour or dietary assessment was also recorded.

Comparator/Control Group

The presence and characteristics of the control groups were noted.

Outcome Measure

We extracted the percentage prevalence of DE behaviours evident in the samples, as well as the types of DE behaviours (bingeing, restriction, vomiting) and any factors that were associated with or predicted DE behaviours.

Study Design

The study design was noted, whether it was within-subjects or between-subjects and whether it was a qualitative or quantitative investigation.

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Results

This section will contain a brief overview of the selected studies. After applying the critical appraisal criteria, 9 articles were available for review. These articles used mixed methods. The data from these articles are presented in Table 1.

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178 *Participant Characteristics*

179 Only three of the investigations excluded male participants (Arigo et al., 2012; Fletcher et
180 al., 2008; Guthrie et al., 1990). The remaining six papers had a majority of female
181 participants. The average age of participants across the studies was 29.9 years (10-80 years).
182 Surprisingly, there was a lack of information concerning body mass index across the papers.

183 *Comparator/Control Groups*

184 Five of the studies used control groups (Addolorato et al., 2012; Guthrie et al., 1990; Okami
185 et al., 2011; Sullivan et al., 1997; Tang et al. 1997). Information about the participant
186 characteristics was lacking in two of the papers (Okami et al., 2011; Sullivan et al., 1997).

187 *Outcome Measure*

188 DE patterns were assessed in all of the papers; however, only four of the studies provided
189 information concerning the prevalence of DE across the samples (Addolorato et al., 1997;
190 Arigo et al., 2012; Guthrie et al., 1990; Karwautz et al., 2008). Seven papers provided
191 information concerning the correlates of DE.

192 A range of variables were measured but there was no common assessment of eating
193 patterns. Two of the articles used the Eating Disorder Examination Questionnaire (EDE-Q;
194 Hilbert et al., 2007), two used the Eating Attitudes Test (EAT; Garner, Olmstead, Bohr &
195 Garfinkel, 1982) and three used the Eating Disorder Inventory (EDI; Garner, 2004). Other
196 measures of DE and body image were related to general psychosocial well-being
197 questionnaires.

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Study Design

The majority of studies used a cross-sectional design, except Fletcher et al. (2008) who used a qualitative design and Karwautz et al. (2008) who used a two-stage qualitative design.

Synthesis of Results

We discuss the studies in three categories according to the aims of the review: those looking at the prevalence of eating pathology in GI disease, those reporting the types of DE displayed and those that examined the correlates of DE in those with GI disease.

Studies Concerning the Prevalence of Disordered Eating in GI Disorders

Four of the articles reported the prevalence of patterns suggestive of DE, although this was assessed using differing methods (Addolorato et al., 1997; Arigo et al., 2012; Guthrie et al., 1990; Karwautz et al., 2008). Across these four papers there were a total of 691 participants with GI disease. Of these, 23.43% displayed eating patterns that were suggestive of DE. Across these papers, DE patterns ranged between 5.3-44.4% in those with GI disease.

Prevalence rates for the Eating Disorders Examination (Fairburn & Beglin, 1994) ranged between 22-29.3% (Arigo et al., 2012; Karwautz at al., 2008). These scores are in excess of the scores reported for the general population (10%; Solmi, Hatch, Hotopf, Treasure & Micali, 2014). However, those papers using the EAT (Garner, Olmstead, Bohr & Garfinkel, 1982) reported lower prevalence rates (Guthrie et al., 1990; Sullivan et al., 1997). Only one of the papers reported lower prevalence of DE in participants with GI disease than healthy controls (Sullivan et al., 1997). Unfortunately, Sullivan et al. (1997) reported only the means

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for the EAT scores and did not report what percentage scored above the cut-off criteria. However, they acknowledge that a subgroup of their participants with IBS may have engaged in DE practices.

Studies that assessed eating patterns via a food diary reported that for participants with GI disease had lower intake than healthy controls (Addolorato et al., 1997; Fletcher et al., 2008). Addolorato et al. (1997) found that individuals with IBD had a daily calorie intake that was significantly lower than that of controls. Furthermore, 37.2% of those with Crohn's disease and 44.4% of those with ulcerative colitis showed evidence of malnutrition, indicating that these individuals are not meeting their daily dietary needs. Although DE was not assessed, a lack of food intake was observed in this group, the cause of which remains unclear.

When combined, the evidence indicates that the presence of DE may be greater in those with GI disease than the reported norms for healthy controls. The conflicting results may be accounted for by the differing use of screening tools as well as factors such as the duration of diagnosis and the type of medical support received.

Studies Concerning the Types of Disordered Eating

Eight of the articles made some reference to the type of DE that was presented by participants (n=2988). This largely depended on the method used to assess DE. However, the majority of articles described DE as a whole, rather than breaking it into subtypes.

Food restriction was commonly referred to throughout the articles (Addolorato et al., 1997; Fletcher et al., 2008; Okami et al., 2011). Individuals with GI disease ate more irregular meals and skipped meals more frequently than control participants (Okami et al., 2011).

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Although consumption of less food was observed in those with GI disorders, it is not clear why this was the case and if intentional food restriction was the cause. Fletcher et al. (2008) found that individuals reported using food restriction as a way to cope with their GI symptoms, often avoiding food when engaging in social activities. Participants said that they would not eat during the day but would eat normally when in the home during the evening, resulting in an abnormal pattern of food intake. In contrast, Tang et al.'s (1997) findings are suggestive of a purging eating pathology. Tang et al. (1997) found that those IBS patients who reported greater vomiting symptoms were more likely to endorse the beliefs of the Bulimia subscale of the EDI. These individuals had thoughts of vomiting as a means of weight reduction but did not necessarily engage in these behaviours. Tang et al. (1997) suggest that those IBS patients with severe vomiting and high scores on the Bulimia subscale (EDI) may have a characteristic in common with people with eating disorders, i.e. the desire to lose weight.

Kauwautz et al.'s (2008) findings may shed light on the types of DE present in those with GI disease. When looking at the weight loss mechanisms used by these participants, Kauwautz et al. (2008) found that 58.1% used dieting behaviours, 12.9% used excessive exercising, 19.4% used vomiting and 3.2% used laxatives. This suggests that a range of DE behaviours across the clinical spectrum were present, with a majority choosing to restrict their food intake.

Studies Concerning the Correlates and Co-morbidities of Disordered Eating

Seven of the articles made reference to factors associated with higher DE scores. Of particular interest is the reoccurrence of psychological distress, symptom severity and dietary management alongside higher DE scores.

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Out of the nine articles reviewed, six reported a relationship between DE and psychological distress (Arigo et al., 2012; Addolorato et al., 1997; Fletcher et al., 2008; Guthrie et al., 1990; Okami et al., 2011; Sainsbury et al., 2013). Eating disorder risk was associated with a reduced quality of life, maladaptive coping mechanisms, depression and perceived stress (Addolorato et al., 2011; Sainsbury et al., 2013). Furthermore, greater anxiety and depressive symptomatology was found in those presenting with eating disturbances (Addolorato et al., 1997; Guthrie et al., 1990; Okami et al., 2011). Addolorato et al. (1997) explain that the reason for undernourishment in this patient group is not clear but suggest that it might result from a fear of GI symptoms when consuming food. Fletcher et al.'s (2008) findings suggest that this may be due to anxiety in unfamiliar settings, as participants would restrict their intake in unfamiliar settings due to fears of cross-contamination. Anxiety and depression both seem to be key factors in the development DE in those with GI disorders.

Symptom severity was referred to across the papers (Arigo et al., 2012; Sainsbury et al., 2013; Tang et al., 1997). It is not clear at what point symptom severity is most important, with some reports suggesting that symptom severity prior to diagnosis may lead to the development of DE patterns (Sainsbury, et al., 2013), and others suggesting it is the frequency of symptoms during the course of the disease (Tang et al., 1997). More bulimic-type thoughts were reported in those who experienced more extreme vomiting symptoms, however, this does not necessarily translate into behaviour; these individuals acknowledged the use of vomiting as a weight loss strategy but did not necessarily engage in this behaviour (Tang et al., 1997). Arigo et al. (2012) reported that symptom severity was not associated

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with DE practices. The role that symptom severity plays is not clear and it may only play a role in the development of DE in a subset of those with GI disease.

Adherence to dietary regimens shows evidence of being related to DE practices, particularly in those with CD. Arigo et al. (2012) found that management of the prescribed diet was associated with a decreased range of psychological stresses, but was also linked to greater DE concerns and behaviours. This indicates that those who monitor their food intake more closely, to follow their prescribed dietary regime, may be at risk of DE. Karwuatz et al. (2008) reported that those with eating pathology also had significantly higher gluten antibody markers, suggesting poorer dietary self-management. Those with eating pathology also had a higher BMI and 85.7% reported the pathology as appearing after the onset of their CD.

Discussion

This paper points towards some important factors that need to be considered in the management of patients with GI disorders. There is an indication that individuals with GI disorders may be more at risk of developing DE practices than the general population.

One aim of the review was to examine the prevalence of DE in those with GI disease. DE patterns are present in a subset of those with GI disorders and the prevalence exceeds the rates found in the general population. The prevalence rates identified in this review (5.3-44.4%) are similar to those found in other dietary controlled chronic health conditions (Markowitz et al., 2010; Shearer & Bryon, 2004). Quick, McWilliams & Byrd-Bredbenner (2012) found that those with dietary-controlled health conditions were twice as likely to have been diagnosed with an eating disorder compared to controls. The constant need to

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monitor food intake may place these individuals, and those with GI disorders, at risk for DE behaviours (Schlundt, Rowe, Pichert & Plant, 1999; Grilo, 2006). However, it is not clear whether the GI disorder is contributing any additional risk factors towards the development of DE, above and beyond that of other dietary controlled chronic health conditions.

The types of DE that were present in those with GI disease were also examined. The majority of papers presented in the review indicated that a restrictive eating pathology was most common. Although there was evidence for bulimic patterns of behaviour as well as excessive exercising, food restriction was more frequently reported. It is not clear why these behaviours are more common and if this finding will be replicated in larger samples. However, it may be that those with GI disorders are more likely to fit the psychological profile of someone with a restrictive eating disturbance. However, the majority of investigations simply examined eating disorder risk. This assesses the presence of food restriction, bingeing and purging behaviours. Therefore, it is difficult to get a clear picture of what types of DE are most prevalent in those with GI disorders. In addition, an extensive range of eating patterns such as emotional eating, over eating and nocturnal eating patterns have not been examined. This should be addressed in future research because the ranges of DE practices are associated with distinct psychological profiles (Cassin & von Ranson, 2005). Moreover, the majority investigations did not assess the presence of subclinical eating pathology. Future studies should also consider the role of subclinical eating symptoms in GI disorders; due to their risk of malnutrition, any deviation from traditional eating patterns may have a significant impact in this subset of the population.

Another aim of this review was to examine the correlates of DE in GI disease. Psychological distress, symptom severity and dietary adherence were found to be associated with the

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presence of DE patterns. Anxiety, depression and impaired quality of life were reported in those with DE patterns across the majority of papers. This is not surprising because psychological distress is frequently associated with altered eating patterns in those both with (Colton, Olmsted, Daneman & Rodin, 2013) and without chronic disease (Patrick, Stahl & Sundaram, 2011; Santos, Richards & Bleckley, 2007). However, the specific role that psychological distress plays is not clear. Distress may be both a cause and a consequence of DE behaviours. However, Arigo et al., (2012) suggested that anxiety might be playing a unique role in those with GI disease. According to Arigo and colleagues the fear and anxiety surrounding GI symptoms may lead to DE practices of a restrictive nature. Individuals with GI disease may be so anxious and fearful of the GI symptoms that have been associated with food consumption in their past, that their fear and anxiety results in an aversion to unfamiliar food types and subsequent food restriction.

GI symptom severity was may also play an important role in the development of DE patterns. The role that GI symptoms play in the development of DE appears rather complex. Some authors report that greater symptoms prior to diagnosis increases DE risk (Sainsbury et al., 2013), whereas others report that greater symptoms throughout their diagnosis led to greater DE risk (Tang et al., 1997). In addition, both poor (Fletcher et al., 2008; Karwautz et al., 2008) and good dietary management (Arigo et al., 2012) have been associated with DE patterns. It is possible that there are at least two pathways that lead to increased risk of DE in patients with GI symptoms. On the one hand, individuals who do not follow their dietary regimen experience GI symptoms throughout their diagnosis. These individuals may not be concerned about their diet, and choose to consume their trigger foods for a variety of reasons. This group could be using their trigger foods to promote weight loss. These

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findings are in line with case studies of individuals with CD, IBS and IBD where deliberate consumption of trigger foods has been reported in order to aid weight loss (Leffler et al., 2007; Mallert & Murch, 1990). In those with good dietary management, their GI symptoms may be playing a unique role in the development of DE patterns. Hypothetically, the presence of GI symptoms may create a food aversion in these individuals, causing alterations to their eating patterns (Garcia et al., 1955). These individuals may be extremely anxious and concerned with the preparation and potential cross-contamination of their food products. Concerns around cross-contamination and anxiety around unfamiliar foods is frequently found across the GI disorders (Schneider & Fletcher, 2008; Sverker, Hensing, & Hallet 2005). Although high concern around unknown food items may be advantageous in some situations, this may also feed into the development of DE patterns. A hypothetical framework based on these two pathways has been developed.

A Hypothetical Framework

Based upon the literature presented in the review, a conceptual model of DE patterns in GI disorders has been developed (Figure 2). The model depicts the theoretical relationship between a collection of GI disorders and DE patterns; however, it is likely that each GI disorder will have a more specific relationship with eating behaviour but to develop specific models more focussed research is required.

The model begins at diagnosis. When diagnosed with a chronic health condition, depending on the individual's circumstances, some will adapt well and accept the condition but for others denial may play a role (Alvani, Parvin, Seyed & Alvani, 2012). Coping with any form of chronic illness creates both physical and psychological challenges (Turkel & Pao, 2007). This

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can contribute to psychological distress, coping problems and a lack of compliance to a medical regime (Seiffge-Krenke & Skaletz, 2006; Suris, Michaud & Viner, 2004).

Pathway one describes the potential development of DE patterns for those who have adapted well to their condition. These individuals may have greater GI symptoms at diagnosis; the implementation of their treatment and prescribed dietary regimens is effective in resolving these GI symptoms. Sainsbury et al. (2013) found greater symptoms at diagnosis to be important in the development of DE patterns. These individuals may be anxious about experiencing these GI symptoms again. They may overestimate the negative consequences of their condition and develop the belief that all foods have cross-contamination potential. As a result, these individuals follow their dietary regimens extremely well, like those described by Arigo et al. (2012). Due to their strict dietary self-management, uncertainty surrounding the content of food may be intolerable for this group. High concerns and anxiety around the preparation and cross-contamination of food dominate their thoughts and behaviours. This may result in the consumption of a limited range of foods or eating only in well-known environments. This is similar to the experiences Fletcher et al. (2008) described in those with IBS and IBD. These individuals may restrict their food intake during the day, in order to cope with their anxiety around cross-contamination and food preparation issues and subsequently there is the potential for an excessive amount of food to be consumed in the evening when in the home. These individuals display the food restriction that was found throughout the papers and this is associated with their anxiety surrounding GI symptoms that was described by Arigo et al. (2012) and reported under nutrition in these groups.

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Individuals in pathway two do not adapt well to their diagnosis and experience distress. When starting their treatment and prescribed dietary regimens, these individuals may react with fear when their weight is restored to a healthy level after diagnosis. This group may believe that their dietary regimen is causing them to gain weight, which leads to dysfunctional illness beliefs and behaviours regarding their dietary regimen. Poor dietary management may follow and the consumption of trigger foods may be motivated by the belief that this can aid with weight loss. These beliefs may lead to a lack of adherence to the prescribed dietary regimen, continued GI symptoms and psychological distress (Lohiniemi, Maki, Kaukinen, Laippala & Collin, 2000; Roth & Ohlsson, 2013). This explains the poor dietary management and increased symptom severity throughout diagnosis, described by Arigo et al. (2012), Tang et al. (1997), Fletcher et al. (2008) and Kawautz et al. (2008). Individuals in pathway two may be at risk for a clinically significant eating disorder.

Strengths and Limitations of Review

The prevalence of GI disorders is increasing rapidly and this is expected to increase as diagnostic measures improve (Lohi et al., 2007; Molodecky et al., 2012; West, Fleming, Tata, Card & Crooks, 2014). We believe our review brings together an important area of research for the first time. We outline gaps in the current literature and pose a number of important research questions that will need answering in the future. This review also highlights several limitations that need to be addressed in order to develop research into DE practices in GI

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disease. The development of a model of DE in GI disease is of use clinically and provides a guide for future research. However, there is a need to explore the underlying causes of DE patterns in GI disease and explore the functions that these eating patterns may have for this group. In addition, the studies described in the review failed to report long-term outcomes. It is essential for future research to prioritise the long-term effects of DE in GI disease.

Only nine articles were included in this review, which highlights the need for research in this population. Despite this limitation, these nine articles had strong quality scores and eight of these articles suggested that DE was occurring in participants with GI disease, suggesting that the findings are reliable. Due to improved diagnostic measures and better access to services, GI diagnosis is increasing rapidly (Lohi et al., 2007; Molodecky et al., 2012; West, Fleming, Tata, Card & Crooks, 2014; WGO, 2009). As more of the population is diagnosed with GI disease, there becomes a need to explore and highlight the psychosocial and physical consequences of GI disease. This includes DE patterns. An increased awareness of this phenomenon should improve awareness amongst healthcare professionals and ultimately can lead to early detection or prevention of the problem in those with GI disease.

Unfortunately, the results could not be combined in a meta-analysis due to the differing methodologies, outcomes and populations. The development of the hypothetical model of DE in GI disease provides a framework to guide future research. There is a need for studies to document the levels of adherence and anxiety around food in those with GI disease. In addition, the function that these eating patterns may have, should be addressed from the patient perspective.

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It is important to note that the majority of individuals with GI disease will not go on to develop DE. Nevertheless this review indicates that some individuals with GI disease will eat in a manner that deviates from the cultural norms of three meals a day (Fjellstrom, 2004). Some behaviours that could be considered disordered may actually result from features of the food environment which make it difficult to stick to a prescribed diet such as gluten free foods being unavailable. Further research is needed to explore the specific eating patterns associated with GI disease and how these patterns relate to external constraints on the diet.

Conclusions

The evidence indicates that those with dietary-controlled GI disorders may be at increased risk for DE practices. This is likely to interact with the presence of GI symptoms and psychological distress. The limited research in this area is concerning as it impacts both the physical and psychological well-being of this group. There is a need to fully examine the prevalence of this phenomenon in the GI population, as well as the interaction between the two disorders. These findings may help with plans to manage such cases effectively in order to improve physical health and well-being.

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Appendices

Appendix A: Search Criteria

Figure 1. Overview of search strategy

Figure 2. Hypothetical framework between GI disorders and disordered eating

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706 Table 1 *A summary of studies included in the review*

Author	GI Disorder	Experimental Group	Control Group	Exclusion Criteria	Study Type	Eating Behaviour Measure	Other Measures	Disordered Eating Prevalence	Disordered Eating Type	Correlates of Disordered Eating	Quality Score (0-1)
Arigo, Anskis & Smyth (2012) USA	Coeliac Disease	177 females over 18 years (M=39.2 years)	NA	Under 18 years, 23 removed due to insufficient data	Correlational design	Eating Disorders Examination (Fairburn & Beglin, 1994)	Dietary Compliance Scale (Casellas, Vivancos & Maladelada, 2009), Celiac Disease Symptom Questionnaire (Hauser et al., 2007), Short-Form Health Survey (Ware & Sherborne, 1992), Perceived Stress Scale (Cohen, Kamarck & Mermelstein, 1983), Centre for Disease Studies Depression Scale (Radloff, 1977)	22%	Restraint, Eating Concern, Shape Concern and Weight Concern	Illness symptoms, gluten-free diet compliance, depression	0.91
Karwautz, Wagner, Berger, SInreich, Grylli & Huber (2008) Austria	Coeliac Disease	283 adolescents (10-20 years; M=14.8 years).	Adolescents with Type I Diabetes	NA	Two stage design: between participants and qualitative interviews	Eating Disorder Inventory (Rathner & Waldherr, 1997), Eating Disorder Examination Questionnaire (Hilbert et al., 2007), Eating Disorder Examination (Hilbert, Tuschen-	IgA Anti-Endomysial and IgA Trangluti mase antibodies	29.3%	4.8% lifetime history of eating disorder, 3.9% current eating disorder, 10.2% lifetime history of subclinical eating disorder, 10.7% current subclinical eating disorder.	Poor compliance with gluten-free diet	1

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						Caffier & Ohms, 2004)					
Addolorato, Capristo, Stefanini & Gabarrini (1997) Italy	IBD	79 patients with IBD (M=35 years)	36 healthy controls (M=36 years)	Those receiving steroid therapy or having had previous surgery	Between subjects design	BMI, 7 day food diary	Physical Morbidity Index (Andrews, Barczack & Allan, 1987), STAI (Grillion, Ameli, Footh & Davis, 1993), Zung Self-Rating Depression scale (Zung, Richards & Short, 1965),	37.2% of Crohn's Disease, 44.4% of Ulcerative Colitis	Malnutrition	Anxiety, depression	1
Guthrie, Creed & Whorwell (1990) United Kingdom	IBS/IBD	152 female outpatients with IBS (M=39 years).	34 with IBD and 37 with peptic ulcer	NA	Between subjects design	Eating Attitudes Test (EAT; Garner, Olmstead, Bohr & Garfinkel, 1982)	Psychiatric Assessment Schedule (Dean, Surtees & Sashidharan, 1983)	5.3%	Preoccupation with desire to be thinner, food controlling life, engaging in dieting behaviour and too much time and consideration to food.	NA	0.77
Fletcher, Jamieson, Schneider & Harry (2008) Canada	IBS/IBD	8 females (18-23 years), 5 with IBS and 3 IBD	NA	NA	Qualitative interviews	14-day food diary	Background questionnaire, semi-structured interview	NA	NA	Lack of compliance with medical regimen	0.85
Sullivan, Blewett, Jenkins & Allison (1997) United Kingdom	IBS	48 patients with IBS, 31 with IBD	28 healthy controls	NA	Between subjects design	Eating Attitudes Test(Garner, 1982)		NA	Dieting, bulimia, food preoccupation, oral control	NA	0.62
Tang, Toner, Stuckless, Dion, Kaplan & Ali (1997) Canada	IBS	43 female and 17 male IBS patients (M=36.8 years).	Predetermined normative sample: 271 healthy controls (M=20.3 years)	NA	Between subjects design	Eating Disorder Inventory (Garner & Olmstead, 1984)	Daily GI symptom diary (Neff & Blanchard, 1987)	NA	Bulimic thoughts	Female, vomiting symptoms	0.91

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Okami et al., (2011) Japan	IBS	626 students, IBS symptoms aged 18-29 years	NA 1140 healthy controls without IBS symptoms	Over 30 years, previous diagnosis of IBD	Between subjects design	Non-Validated questionnaire	Rome II (Thompson et al., 1999), HADS (Hatta et al., 1998), METS (Ministry of Health, Japan, 2006)	NA	Irregular meals and meal skipping	Anxiety, depression	0.91
Sainsbury, Mullan & Sharpe (2013) Australia	Coeliac Disease	390 members of a coeliac society (M=44.2 years)	NA	NA	Correlational design	Eating Disorder Inventory (Garner, 2004)	WHO QoL measure (Murphy et al., 2000), Depression Anxiety Scale (Lovibond & Lovibond, 1995), the Coping Inventory for Stressful Situations, Coeliac Dietary Adherence Scale (Leffler et al., 2009), Perceived Behavioural Control Scale (Sainsbury & Mullan, 2011)	NA	Restraint, Eating Concern, Shape Concern and Weight Concern	QoL, severe GI symptoms at diagnosis, depression, anxiety, stress, emotion-focussed coping	1

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