FUNCTIONAL GASTROINTESTINAL DISORDERS:
RELATIONS BETWEEN PSYCHOSOCIAL FACTORS,
SYMPTOMS AND SENSORIMOTOR
DISTURBANCE

ETHELLE JEANETTE BENNETT
BA (HONS)

A thesis submitted in fulfilment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Departments of Psychological Medicine and Medicine
University of Sydney

March, 1999
ABSTRACT

Although a vast literature attests to the belief that psychosocial disturbance is an important component of functional gastrointestinal disorders (FGID), the relation of life stress, psychological distress and personality to the development of these disorders is poorly understood. The broad objective of this thesis is to provide data on relations between psychosocial factors and FGID, especially irritable bowel syndrome (IBS) and functional dyspepsia (FD), in representative outpatient samples. Issues not previously addressed are examined in a series of studies. The first two studies are concerned with relations between psychosocial factors, extraintestinal (somatic) symptoms and the number and type of FGID syndromes present at consultation and, in IBS patients, the prospective relation of psychosocial factors to changes in symptom intensity over 16 months. The last three studies relate psychosocial factors to gastrointestinal (GI) transit, motor, and sensory function in FGID, abnormalities in these parameters representing the putative origin of symptoms in FGID. In total, 350 patients participated, representing a 95% participation rate.

Important features of the methodology include the use of a recently standardised symptom-based classification system for FGID, an objective and reliable interview-based life stress instrument (The Life Events and Difficulties Schedule), and sophisticated and sensitive technologies to assess GI transit, motor and sensory function. Novel measures, which conceptually take into account the chronic, fluctuating and recurrent course of IBS and FD syndromes, and the tendency of these syndromes to coexist, are also included. Thus, measures of symptom outcome assess the number of syndromes present, while the symptom intensity variable reflects the severity and frequency of both FD and IBS symptoms, if both are present. Similarly,
with respect to altered transit, and motor and sensory function, physiological outcome variables reflect not only the presence of an abnormality but the number of regions affected, and the type and number of abnormalities present.

Cross-sectional findings showed for the first time that psychosocial disturbance is associated with FGID symptomatology in a quantitative manner, that chronic life stress threat is central to this process and this stress-related process is a prominent feature of a particular group of syndromes (ie IBS/FD) defined primarily by the presence of pain and discomfort. A combination of psychological, social and biological factors combined to predict the number of FGID syndromes present at entry into the study. Prominent among them was an angry, reactive and anxious (neurotic) personality, chronic life stress threat, increased coping, poor emotional support and increased age. In addition to a greater number of FD/IBS syndromes, individuals with an anger-reactive response style had experienced more intense pain and discomfort, and displayed more complete sensorimotor disturbance.

Longitudinal data demonstrated (also for the first time) the strength, consistency and unequivocal direction of the relation of chronic threat to symptom intensity over time. Almost all of the within subject variance in symptom intensity levels (assessed on 3 occasions over a 16 month period) was explained by the severity of chronic threat during the previous 6 months or more. For 76% of IBS patients, the presence vs the absence of one or more highly threatening chronic stressors predicted with considerable precision, the long-term clinical outcome. Thus, no patient exposed to even one such stressor improved clinically (ie by at least 50%) over the follow-up period, while in contrast, all patients who improved clinically did so in the absence of such a stressor. For 24% of patients, however, failure to improve clinically could not
be explained by any psychological, social (including life stress) or demographic factor included in this study.

Key risk indicators of a poor outcome at 16 months were identified - chronic life stress threat, the severity of baseline GI symptomatology, and female gender. Life stress is important because it alone determined the magnitude and direction of change in symptom intensity over time, while the severity of baseline GI symptomatology revealed the extent of improvement required to achieve a recovery, and female gender predicted the presence of a larger number of FD/IBS syndromes in women long-term. Widespread hypomotility, which was almost exclusive to women in this study, represents one factor that may inhibit improvement (or rate of improvement) for women over time.

Finally, these findings have identified a psychophysiological subgroup, with underlying psychosocial, motor (and perhaps also sensory) dysfunctions that are more specific for women than men, and which does not seem to be distinctive of any particular FGID subgroup.
STATEMENT OF ORIGINALITY

The studies of this thesis represent original research undertaken by the author in the University of Sydney Department of Psychological Medicine and The Department of Medicine and Gastroenterology at Royal North Shore Hospital, Sydney, Australia.

The author was responsible for the initiation and conduct of the work which was performed under the joint supervision of Professor C C Tennant and Professor J E Kellow.

All psychosocial data were collected, processed and interpreted by the author. This included an extensive life event stress and emotional support interview and the presentation of these data as vignettes to an experienced team of life stress raters. The administration and scoring of psychological instruments and the interpretation of test scores were also carried out personally. Data preparation and statistical analysis was performed by the author with the assistance of Dr. M Jones and Ms C-A Badcock, Biostatisticians, Department of Clinical Computing and Health Information Systems, Royal North Shore Hospital, and Dr A Taylor, Statistician, Macquarie University, Sydney, Australia.

Scintigraphic studies of gastrointestinal transit were performed by the Department of Nuclear medicine, Royal North Shore Hospital, and with the particular assistance of Dr A Scott, Dr R Höschl and Mr B Shuter. Manometric and sensory studies of the small bowel were performed in the Gastrointestinal Investigation Unit of Royal North Shore Hospital by Dr. P Evans.

STATEMENT OF ETHICS

All subjects who participated in these studies gave written informed consent. The protocols were approved by the Medical Research Ethics Committee of the Royal North Shore Hospital, Sydney, Australia.
The following papers have been published, or submitted for publication, as a result of the studies which form the basis of this thesis.

**Original Articles:**


**Abstracts**


In addition, aspects of this work were delivered at the following national and international meetings:


6. International College of Psychosomatic Medicine, 14th World Congress on Psychosomatic Medicine, Cairns, Australia, 31 August - 5 September, 1997.
ACKNOWLEDGEMENTS

I am indebted to Prof. Christopher Tennant of the Department of Psychological Medicine and Prof. John Kellow of the Departments of Medicine and Gastroenterology for their input, support and encouragement during their joint supervision of this project.

I wish to thank Prof. Tennant for giving me the opportunity to learn and participate in the life stress field, to members of his life stress team - to Dr. Janet Beaurepaire for her early training in life stress procedures, Ms Kathy Palmer and others who gave generously of their time and expertise to rate hundreds of life stress vignettes, to Dr. Michael Jones for his early statistical input in this project, and to Ms Caro-Anne Badcock and Dr. Alan Taylor for their special guidance and advice with the statistical analysis.

I am sincerely grateful to Prof. Kellow, without whose expertise, guidance and encouragement this project would not have been possible. His meticulous attention to detail and careful scrutiny of my work throughout has been inspirational.

I am grateful to Dr. Peter Evans who conducted the manometric studies with great skill and performed data analysis of the relevant motor and sensory parameters. The expertise and time contributed by Mr B. Shuter, Dr. R. Höschl and Dr A Scott of the Department of Nuclear Medicine, Royal North Shore Hospital, is also gratefully acknowledged.

Finally, I would like to say a special thank you to my husband, Andy, for his unfailing support, encouragement, and patience. It is much appreciated.
## CONTENTS

ABSTRACT ............................................................................................................. 2  
STATEMENT OF ORIGINALITY ........................................................................ 5  
STATEMENT OF ETHICS ..................................................................................... 5  
PUBLICATIONS .................................................................................................. 6  
ACKNOWLEDGEMENTS ...................................................................................... 8  
CONTENTS ........................................................................................................... 9  
LIST OF ABBREVIATIONS ................................................................................. 18  
LIST OF FIGURES ............................................................................................... 19  
LIST OF TABLES ................................................................................................. 20  

### CHAPTER 1 INTRODUCTION

1.1 BACKGROUND ............................................................................................... 22  
  1.1.1 Overview And Research Outline ............................................................ 22  
  1.1.2 Definitions ............................................................................................ 25  
    Irritable bowel syndrome (IBS) ................................................................. 27  
    Functional dyspepsia (FD) ........................................................................ 27  
  1.1.3 Epidemiology ......................................................................................... 28  
    Irritable bowel syndrome ........................................................................... 29  
    Functional dyspepsia .................................................................................. 30  
    Overlap among functional gastrointestinal disorders (FGID) ............... 31  
  1.1.4 Altered Digestive Tract Function In IBS/FD ........................................... 31  
    Dysmotility and altered transit .................................................................. 32  
    Hypersensitivity .......................................................................................... 34  
    Central nervous system - enteric nervous system dysregulation ......... 36  
    Stress and gut function .............................................................................. 37  
    Key issues .................................................................................................... 37  
  1.2 PSYCHOLOGICAL ASPECTS OF IBS/FD .................................................... 38  
    1.2.1 Psychological Morbidity in IBS/FD ...................................................... 39  
      A brief historical perspective ................................................................... 39
1.5 RESEARCH AIMS AND HYPOTHESES .............................................. 104

1.5.1 Aims .......................................................................................... 104

Symptom-related outcome ............................................................ 104

Study 1: Cross-sectional evaluation of psychological,
           social and extraintestinal features of FGID .................. 104

Study 2: Longitudinal evaluation of life stress in IBS ............. 105

Gastrointestinal motility outcomes .......................................... 106

Study 3: Evaluation of gastric emptying in FD ....................... 106

Study 4: Evaluation of whole gut transit in FGID .................. 106

Study 5: Evaluation of jejunal function in FGID .................. 107

1.5.2 Hypotheses ................................................................................. 107

Symptom-related outcomes ....................................................... 108

Study 1: Cross-sectional evaluation of psychological,
           social and extraintestinal features of FGID ............ 108

Study 2: Longitudinal evaluation of life stress in IBS .......... 108

Gastrointestinal motility outcomes .......................................... 109

Study 3: Evaluation of gastric emptying in FD ....................... 110

Study 4: evaluation of whole gut transit in FGID ............... 111

Study 5: evaluation of jejunal function in FGID ............... 111

CHAPTER 2 METHODS

2.1 SUBJECTS .................................................................................. 112

2.1.1 Eligibility Criteria .................................................................. 113

2.1.2 Subject Recruitment ............................................................... 114

2.1.3 Recruitment Statistics ............................................................. 115

   Eligibility ............................................................................... 115

   Response rate ...................................................................... 116

2.1.4 Subject Characteristics ............................................................ 117

   Age and gender ................................................................. 117

   Demographic characteristics ............................................. 118
Stress-related characteristics (past, recent and present) .......... 119
Symptom characteristics .............................................. 120

2.2 EXPERIMENTAL PROTOCOL ........................................ 122

2.2.1 Outline .......................................................... 122

All studies ............................................................. 122
Symptom-related ...................................................... 122
Gastrointestinal motility studies .................................... 122

2.2.2 Longitudinal Design ............................................. 123

2.3 GASTROINTESTINAL SYMPTOM AND MOTILITY ASSESSMENTS ............ 125

2.3.1 Diagnostic Categories ........................................... 125

2.3.2 Gastrointestinal Symptomatology .............................. 127
Symptom intensity ..................................................... 127
Symptom constancy .................................................. 128
Symptom duration .................................................... 128

2.3.3 Extraintestinal (Somatic) Symptoms ................................ 128

2.3.4 Techniques to Assess Sensorimotor Function .................... 129

2.3.5 Motility Outcome Variables ..................................... 129
Study 3: Evaluation of gastric emptying in FD ..................... 130
Study 4: Evaluation of whole gut transit in FGID.................. 130
Study 5: Evaluation of jejunal sensorimotor function in IBS .... 131

2.4 PSYCHOSOCIAL ASSESSMENTS .................................... 132

2.4.1 Semi-structured Interview ....................................... 132
Social stressors ......................................................... 132
Intimate emotional support ......................................... 134

2.4.2 Psychological Questionnaires .................................... 136
Emotional distress / current mood state ............................ 136
Depression ............................................................. 136
State anxiety .......................................................... 138
Personality ............................................................. 139
Trait anxiety ............................................................ 140
Extraversion and neuroticism ....................................... 141
Trait anger ................................................................. 143
General hypochondriasis ........................................... 145
Coping style .............................................................. 147
Defense style ............................................................ 147
Locus of control of behaviour ...................................... 149
Anger expression / suppression .................................... 150
Suppression of emotions .............................................. 152
Mental adjustment to a chronic stressor ....................... 153

2.4.3 Demographic Questionnaire ................................... 154

2.5 Statistical Analysis .................................................. 155

Study 1: Cross-sectional evaluation of psychological,
  social and extraintestinal features of FGID .............. 155
Study 2: Longitudinal evaluation of life stress in IBS ...... 156
Study 3: Evaluation of gastric emptying in FD ............. 158
Study 4: Evaluation of whole gut transit in FGID .......... 158
Study 5: Evaluation of jejunal function in FGID .......... 159

CHAPTER 3 RESULTS

3.0 Overview of Study Sequence .................................... 162

3.0.1 Symptom-Related Outcomes .................................. 162

  Study 1: Cross-sectional evaluation of psychological,
  social and extraintestinal features of FGID .............. 162
  Study 2: Longitudinal evaluation of life stress in IBS ... 163

3.0.2 Gastrointestinal Motility Outcomes ....................... 163

  Study 3: Evaluation of gastric emptying in FD ............ 163
  Study 4: Evaluation of whole gut transit in FGID ......... 164
  Study 5: Evaluation of jejunal function in FGID ......... 164

3.1 Study 1: Cross-Sectional Evaluation of Psychological,
  Social and Extraintestinal Features of FGID .............. 165
3.1.1 Patterns of Association Between Psychological and Extraintestinal Factors and FGID…………………………………………………………… 165
Number and type of FGID syndrome(s)…………………………165
Gastrointestinal and emotional symptoms in FGID………………167
Symptom intensity……………………………………………….167
Emotional distress…………………………………………….167
Chronic life stress in FGID………………………………………..170
3.1.2 Predictors of Number and Type of FGID…………………………173
Psychological, social and demographic features…………………173
Extraintestinal features…………………………………………..178
Chronic life stress threat and gastrointestinal, extraintestinal and emotional symptomatologies. ………………………………181
Summary of results for cross-sectional relations in FGID……… 183

3.2 STUDY 2: LONGITUDINAL EVALUATION OF LIFE STRESS IN IBS………………184
3.2.1 Patterns of change in life stress and symptom intensity over time….. 184
Within-subject relations……………………………………………189
Covariance over three time-frames…………………………………189
Time-lag relations (with and without relevant covariates)…..189
The role of personality, coping, emotional distress, age and gender…………………………………………………….191
Life stress predictors of any improvement or lack of improvement in symptom intensity over 16 months 192
Life stress predictors of clinical improvement or no clinical improvement over 16 months……………………………192
3.2.2 Relations Between Life Stress, Symptom Intensity and Depression...194
Depression and symptom intensity………………………………194
Life stress, depression, symptom intensity, and number of FGID………………………………………………………194
Gender………………………………………………………………196
Summary of results for relations with IBS over time …………..197

3.3 STUDY 3: EVALUATION OF GASTRIC EMPTYING IN FUNCTIONAL DYSEPSIA199
3.3.1 Control and Suppression of Anger……………………………………199
4.2 STUDY 2: LONGITUDINAL EVALUATION OF LIFE STRESS IN IBS ............ 232
4.2.1 The Special Effects of Chronic Life Stress Threat
on Symptoms Over Time..................................................232
Aspects of Design ........................................................232
Strength, consistency and unequivocal direction
of effects over time.........................................................234
The nature of the provoking stressor.................................236
Stressor threshold .........................................................238
4.2.2 Other Effects on Long-Term Outcome................................239
Summary .................................................................240
4.3 STUDY 3: EVALUATION OF GASTRIC EMPTYING IN FUNCTIONAL DYSPESIA242
4.3.1 Control and Suppression of Anger.................................242
4.4 STUDY 4: EVALUATION OF WHOLE GUT TRANSIT IN FGID.......... 246
4.4.1 Gender and Psychological Features..............................246
Gender.................................................................247
Psychological features.................................................248
4.4.2 Features of normal transit .........................................249
4.5 STUDY 5: EVALUATION OF JEJUNAL SENSORIMOTOR FUNCTION IN IBS..... 251
4.5.1 Relations Between Psychosocial, Sensory and Motor Dysfunction… 251
Sensorimotor dysfunction ...........................................252
Motor (fasting and postprandial) dysfunction .......................252
Fasting motor (only) dysfunction ...................................252
Pain sensitivity ..........................................................254
4.6 SYNOPSIS OF FINDINGS ................................................................. 255
4.7 CONCLUSIONS ................................................................................. 256
4.8 CLINICAL IMPLICATIONS ............................................................. 257
4.9 LIMITATIONS OF THE STUDY AND DIRECTIONS FOR FUTURE RESEARCH .... 259

REFERENCES ...................................................................................... 261 - 290

APPENDICES
Appendix A  Functional Gastrointestinal Disorders (FGID) .............. A-1
Appendix B  Diagnostic criteria for the FGID used in this study .......... A-2
Appendix C  Psychological factors in IBS and FD (cross-sectional)....... A-3
Appendix D  Psychological factors in IBS and FD (longitudinal)......... A-27
Appendix E  Life stress in IBS and FD (cross-sectional)................. A-32
Appendix F  Life stress in IBS and FD (longitudinal)...................... A-36
Appendix G  Prevalence of current psychiatric illness in FGID .......... A-38
Appendix H  Prevalence of lifetime psychiatric illness in IBS .......... A-39
Appendix I  Symptom characteristics of the total sample................. A-40
Appendix J  Symptom intensity scale .................................................. A-41
Appendix K  Gastrointestinal motility assessments (Study 3)......... A-42
Appendix L  Gastrointestinal motility assessments (Study 4)......... A-43
Appendix M  Gastrointestinal motility assessments (Study 5)......... A-44
Appendix N  Extraversion-Introversion Questionnaire ...................... A-47
Appendix O  Neuroticism Questionnaire .......................................... A-48
Appendix P  Hypochondriasis Questionnaire .................................. A-49
Appendix Q  Defense Style Questionnaire ........................................ A-50
Appendix R  Locus of Control of Behaviour Questionnaire ............. A-53
Appendix S  Mental Adjustment to Chronic Stressor Questionnaire .... A-54
Appendix T  Demographic Questionnaire .......................................... A-56
Appendix U  Post-Hoc Statistical Adjustments ................................. A-57
LIST OF ABBREVIATIONS

CD          chronic difficulty
CNS         central nervous system
DL          dysmotility-like dyspepsia
DT          delayed transit
EIS         extraintestinal symptoms
FBD         functional bowel disorders
FC          functional constipation
FD          functional dyspepsia
FGID        functional gastrointestinal disorder(s)
GE          gastric emptying
GI          gastrointestinal
IBS         irritable bowel syndrome
ITT         intestinal transit time
LEDS        Life Events and Difficulties Schedule
MMC         migrating motor complexes
NT          normal transit
RL          reflux-like dyspepsia
RoE         rate of emptying
SE          standard error
SI          symptom intensity
STAI        State-Trait Anxiety Inventory
T1/2        half emptying time
UL          ulcer-like dyspepsia
UFD         unspecified functional dyspepsia
UFBD        unspecified functional bowel disorder
**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Overall eligibility and response statistics.</td>
<td>116</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Schematic illustration of the longitudinal study design.</td>
<td>124</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Widespread diversity in gastrointestinal and emotional symptoms in FGID.</td>
<td>169</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Distribution of chronic stressors (n = 451) across seven life stress categories; percentages represent the relative frequency of each category of chronic stressors (as a proportion of all chronic stressors).</td>
<td>172</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Graphic representation of: a) the 3-way linear relation between emotional symptoms (state anxiety), the number of FGID syndromes present in an individual, and the number of extra-intestinal symptoms (EIS); and b) the relation of chronic life stress threat to each of these dimensions. Probability values are shown for each linear relation determined from Pearson correlation analysis. See text for correlation coefficients.</td>
<td>182</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Mean chronic (life stress) scores for threat and goal-frustration at entry, 6 months and 16 months.</td>
<td>185</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Mean symptom intensity (SI) scores at entry, 6 months and 16 months.</td>
<td>185</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Summary of demographic and psychosocial features of widespread delay in transit and normal transit in patients with functional GI disorders.</td>
<td>210</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Graphic summary of the psychosocial predictors of motor (i.e. fasting and postprandial) dysfunction and sensorimotor dysfunction.</td>
<td>217</td>
</tr>
<tr>
<td>Table</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Table 1</td>
<td>Research outline</td>
<td>26</td>
</tr>
<tr>
<td>Table 2</td>
<td>Patients failing to meet eligibility criteria</td>
<td>115</td>
</tr>
<tr>
<td>Table 3</td>
<td>Age and gender distribution in each study sample and total sample</td>
<td>118</td>
</tr>
<tr>
<td>Table 4</td>
<td>Subject characteristics</td>
<td>121</td>
</tr>
<tr>
<td>Table 5</td>
<td>Summary of psychological and social variables per study</td>
<td>136</td>
</tr>
<tr>
<td>Table 6</td>
<td>Prevalence of functional dyspepsia syndromes and functional bowel disorders within the patient sample (n=188)</td>
<td>166</td>
</tr>
<tr>
<td>Table 7</td>
<td>Prevalence of functional dyspepsia (FD) subgroups in the irritable bowel syndrome population (n=122)</td>
<td>168</td>
</tr>
<tr>
<td>Table 8</td>
<td>Severity of threat and goal frustration: proportion of FGID patients exposed to at least one such chronic stressor</td>
<td>171</td>
</tr>
<tr>
<td>Table 9</td>
<td>Pearson correlation coefficients of relations between psychological, social and demographic factors and type and number of FGID</td>
<td>174</td>
</tr>
<tr>
<td>Table 10</td>
<td>Psychosocial predictors of number of functional gastrointestinal disorder syndromes: the regression model of best fit</td>
<td>176</td>
</tr>
<tr>
<td>Table 11</td>
<td>Psychosocial predictors of type of FGID syndrome: logistic regression models</td>
<td>177</td>
</tr>
<tr>
<td>Table 12</td>
<td>Pearson correlation coefficients of relations between extraintestinal symptoms / behaviours and type and number of FGID</td>
<td>179</td>
</tr>
<tr>
<td>Table 13</td>
<td>Extraintestinal symptom predictors of type of FGID syndromes: logistic regression models</td>
<td>180</td>
</tr>
<tr>
<td>Table 14</td>
<td>Proportion of patients with same, worse, improved symptom intensity and life stressor chronic threat, and/or goal-frustration over 16 months of follow-up</td>
<td>186</td>
</tr>
</tbody>
</table>
Table 15: Proportion of IBS patients exposed (+) and not exposed (-) to one or more chronic stressor that was highly threatening and/or highly goal-frustrating

Table 16: FGID diagnosis at 16mo

Table 17: The presence of one or more highly threatening chronic difficulty (0 to 6 months), significantly predicts symptom intensity at 16 months alone and after controlling for baseline covariates

Table 18: Clinical improvement as a function of the presence or absence of one or more highly threatening chronic difficulty during the previous 10 months

Table 19: Summary of final predictor models for clinical and life stress outcomes at follow-up (16 months)

Table 20: Models of solid gastric emptying in terms of combinations of psychological factors with independent statistically significant Effects

Table 21: Models of liquid gastric emptying factors in terms of combinations of psychological factors with independent statistically significant effects

Table 22: Summary of differences in age, gender, depression and hypochondriasis between patients with normal transit in all three regions (NT), delayed one transit in one region(DT1) and delayed transit in two or more regions (DT2)

Table 23: Psychological and demographic predictors of widespread delayed transit: logistic regression models

Table 24: The prevalence of FGID syndromes for each gut transit subgroup - normal transit (NT), delayed transit in one region (DT1), and delayed transit in two or more regions (DT2)

Table 25: Psychological characteristics according to jejunal sensitivity and postprandial motor activity: data presented as mean (standard deviation) scores

Table 26: Logistic regression models of jejunal sensitivity and motor activity in relation to combinations of psychological characteristics