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AVERSIVE SIDE-EFFECTS OF INTESTINAL SURGERY FOR EXTREME OBESITY: POSSIBLE MECHANISMS OF POSTOPERATIVE WEIGHT LOSS

by

Brenda Bernadette Toner

B.A., Queen's University, 1975

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the department

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ABSTRACT

It has been assumed that malabsorption of fat and protein is the main cause of weight loss after jejunoileostomy. This assumption had not been tested quantitatively until a study by Pilkington et al. (1976). They found that a reduction of caloric intake was largely responsible for post-operative weight loss.

This study hypothesized that the reduction of caloric intake following jejunoileostomy is a function of unpleasant side effects such as diarrhea, bloating, abdominal pain and nausea experienced in conjunction with food consumption. It was assumed that unpleasant effects associated with eating following jejunoileostomy have aversive effects, that is, act as punishers which reduce food intake. If the hypothesis is correct there should be a correlation between frequency and severity of aversive side effects, caloric intake, and amount of post-operative weight loss.

To test the above hypothesis eighteen candidates for jejunoileostomy (13 females, 5 males) agreed to complete six test sessions. The sessions were given at pre-op, two weeks post-op, and one, two, three, and four months post-op. At each test session they completed the following: (1) caloric intake records for 3 consecutive days; (2) questionnaires designed to measure frequency and pleasantness/unpleasantness of a list of items,

some of which are potential side effects of jejunoileostomy. Eleven of the initial eighteen patients completed this intensive repeated measures design.

The results showed that patients ate significantly fewer calories two weeks and one, two, three and four months post-operatively, compared to pre-operatively. Furthermore, it was found that there is a relationship between frequency and severity of some "aversive effects" and caloric intake following jejunoileostomy. These results: (a) confirm recent studies (Pilkington et al., 1976; Bray, 1976; Condon, 1978) showing that caloric intake is reduced after jejunoileostomy; and (b) are consistent with the hypothesis that certain "aversive effects" of the operation are correlated with reduced caloric intake.

Acknowledgements

I would like to thank several people who contributed to this project: to the subjects who gave me their time; to Dr. John Palmer who explained surgical techniques to me; to Drs. Harvey Moldofsky, Peter Herman and Errol Marliss for their helpful suggestions; to my supervisor Dr. Barry Beyerstein, for his patience and advice; to Dan for his support and understanding.

Table of Contents

List of Tables

List of Figures

INTRODUCTION

During the last twenty years, intestinal bypass surgery has been used in some patients for the treatment of extreme obesity. Payne and Dewind (1956) were the first to investigate short circuiting the intestine (jejunoilecstomy) for obese patients. Since then an estimated 12,000 - 20,000 such operations have been performed in the United States (Iber, 1977). Unfortunately, no comparable data are available for Canada. The technique used in the original operation has been modified several times and new revisions are still evolving. The operation remains controversial for two main reasons:

1) uncertainty about relative benefits versus possible medical and psychological side effects;
2) disputes concerning which factors contribute to weight loss post-operatively.

Both these issues will be dealt with in subsequent sections.

The Operation

The two operative procedures used at present include:

1) End-to-side jejunoileostomy. It is referred to as "the fourteen + four operation" with the proximal 14 inches of the jejunum anastomosed end to side, to the terminal ileum 4 inches proximal to the ileocecal valve. (See Fig. 1)
2) A modification of (1) consists of a conversion of the end-to-side anastomosis to an obligatory end-to-end restoration of bowel continuity. Such a procedure

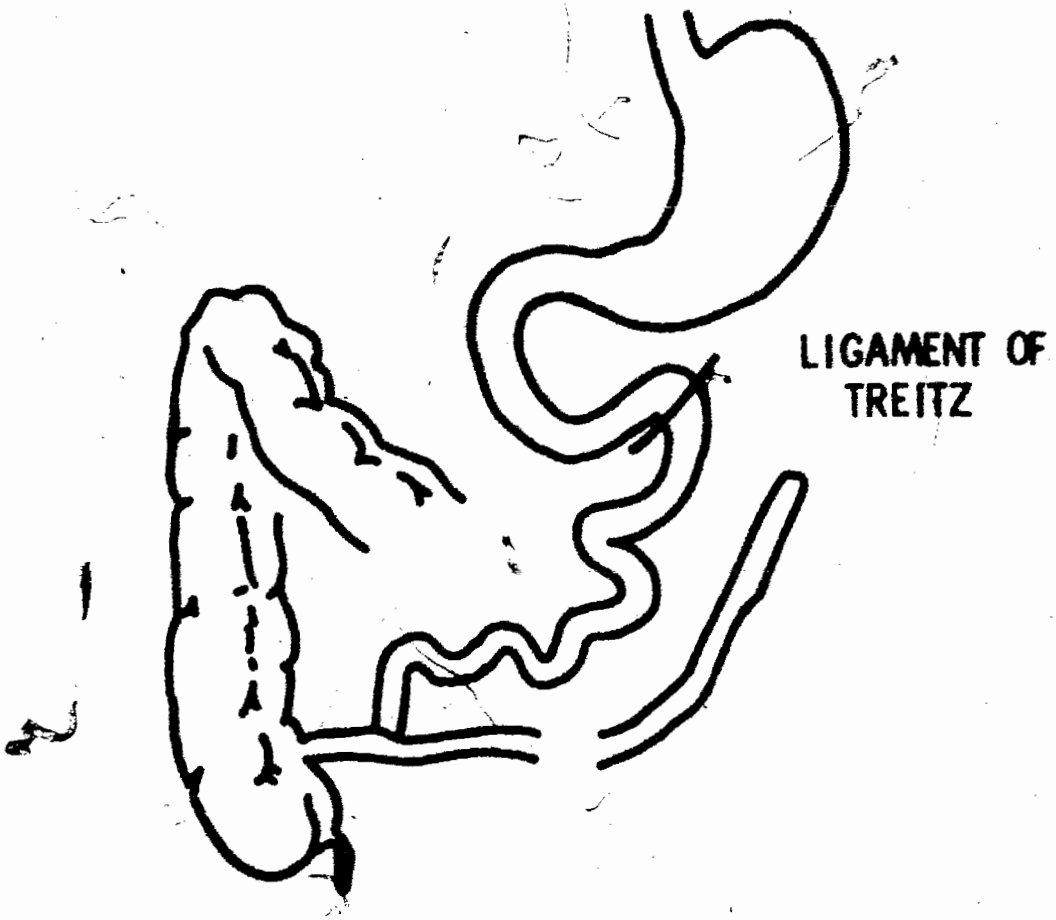


Fig. 1 End to side jejunoileostomy
Payne - Dewind (1969)

requires a second anastomosis of the distal end of the bypassed segment to a portion of the functioning gastrointestinal tract. (See Fig. 2) The primary intent of the two anastomoses approach is to minimize reflux into the bypassed-intestinal segment and the unpredictable absorption of calories, as well as cholesterol and bile acids, in hyperlipidemic obese patients.

In both techniques a large portion of the small intestine is bypassed rather than removed and, accordingly, the operation is reversible. Intestinal continuity has been restored in almost 8% of patients (Iber, 1977). The reasons for attempting jejunoileal bypass reversal are many and varied. But improper selection of poorly motivated patients and severe refractory metabolic aberrations constitute frequent reasons for attempting restoration (Dean, 1977).

Physical Costs and Benefits

Medical Complications:

a) Mortality: The average operative mortality of intestinal bypass is 3%. However, there is much variability among medical centers, ranging from 1.4 to 14% mortality (Iber, 1977).

b) Progressive liver disease: Cirrhosis and hepatic failure occur in 1 to 3% of patients (Abramowicz, 1978). Death related to hepatic disease has been found to range from 0.8% in a sample of 123 patients to 8% in 2,359

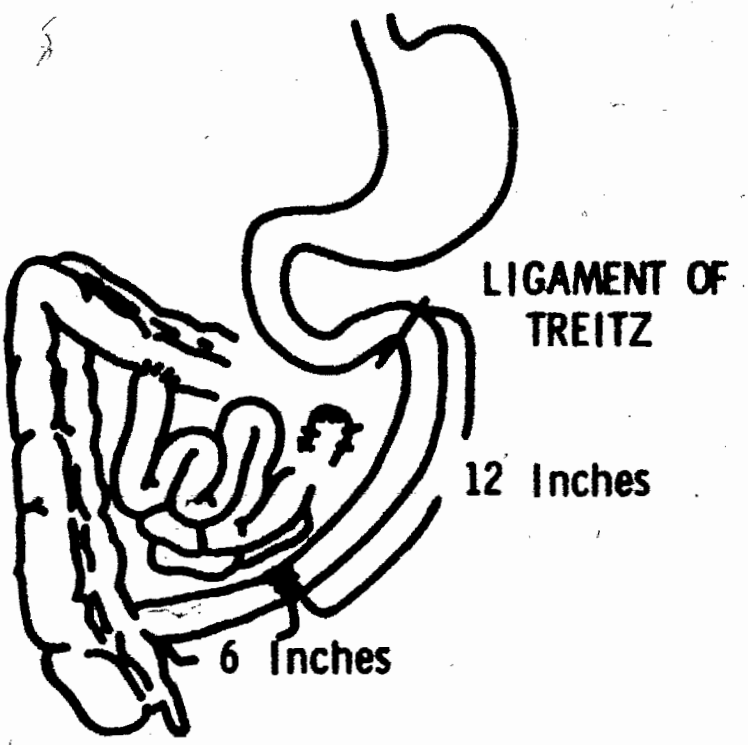


Fig. 2 End to end jejunoileostomy
Scott et al (1971)

patients (Holzbach, 1977).

c) Renal impairment: 15 to 30% of patients develop urinary calculi (stones) as a result of increased absorption of dietary oxalates and decreased urine volume. Oxalate crystal deposits with the renal parenchyma have led to focal interstitial nephritis and irreversible renal failure. In some patients an immune type of nephritis, which can be severe, has been reported (Abramowicz, 1978).

d) Diarrhea: Severe diarrhea occurs in most patients post-operatively. By six months the diarrhea usually decreases to less than four semi-formed stools per day. However, some patients have reported that they still have diarrhea which persists up to 2 years after surgery. Factors contributing to post-operative diarrhea include: shorter bowel, irritant effects of unabsorbed bile acids and bacterial overgrowth in the excluded intestinal segment. Foul smelling flatus and abdominal distention after meals persist for years in some patients (Abramowicz, 1978).

e) Malnutrition: Important nutrients such as amino acids, protein, vitamins and minerals are malabsorbed. Especially severe is the depletion of calcium and potassium which can produce tetancy (muscles remain in excited state) (Corso, 1974) and potassuim loss which may lead to severe hypokalemia. Some patients show

secondary effects of malnutrition, hair loss, muscle wasting, hypoproteinemia and bone demineralization.

f) Enteritis: According to Brenick (1976), abdominal pain, fever, exacerbation of diarrhea and other signs of inflammatory bowel disease suggest the presence of bypass enteropathy, which is possibly related to anaerobic bacterial overgrowth in the excluded loops and the functioning small bowel (Corrodi, 1978). Anorectal disorders, including fissures, abscesses and hemorrhoids, can also develop.

Possible Medical Benefits

These potential complications must be balanced against the possible beneficial effects of surgery (or of resulting weight loss). These include: lowering of cholesterol and triglyceride levels, lessened effort in breathing, improvement of varicosities, lowered cuff-measured blood pressure and hypertension, disappearance of diabetes, improved possibility of fertility and lowered risk of heart failure. O'Leary found the following beneficial effects in a sample of 230 patients up to 10 years after jejuniolecstomy. (a) All of the 55% of patients who were diabetic pre-operatively have shown a post-operative reduction in their insulin requirement. (b) Pre-operatively, 12% of the patients had hypercholesterolemia and 46% had hypertriglyceridemia. All of the former patients and 88% of the latter have had their serum lipid concentrations returned to normal within six months post-operatively. However, the

long-term effect of this change is unknown. (c) Pre-operatively, 39% had hypertension (diastolic pressures greater than 90 mmHg when measured with a thigh cuff on the upper arm). Post-operatively, approximately one-third of the patients have required no antihypertensive medications. One-third seem to require less medication, but one-third are clearly not improved. (d) All of the patients with Pickwickian syndrome (11%) improved post-operatively. However, O'Leary concluded that the long-term effect of jejunoileostomy is not yet known.

Psychosocial Costs and Benefits

In addition to the foregoing medical risks and benefits, the relative psychosocial advantages and benefits must be weighed against corresponding disadvantages when making decisions.

Psychological disorders

Crisp and Kalucy (1977) found short-term irritability, depression, tiredness and anxiety were common post-operatively, especially during rapid weight loss. Abram et al. (1976) found in over one-third of their patients a post-operative increase in neurotic and interpersonal problems or the emergence of psychosis. Winkleman and his colleques (1975) found psychiatric problems developed in 8 of 26 patients following intestinal bypass surgery.

Psychological Benefits

In sharp contrast to the above studies, Solow (1977) claimed that his bypass patients showed an improvement in activity levels, mood, self-esteem, and interpersonal and vocational

effectivenesss. Several other studies have suppcrted Solow's favourable estimates of the effects of bypass surgery (Brewer et al., 1974; Gazet et al., 1974; Castelnuovo-Tedesco et al., 1976; Salmon, 1971; Halberg et al., 1975). Possible reasons for discrepancies among these and the studies which found a preponderance of negative effects (presented in the preceding section) will be discussed below.

Factors Affecting Positive and Negative Outcomes

Frequency and severity of medical and psychosocial complications are related to a number of factors. The major ones include:

a) surgeon's experience with intestinal bypass operations: Iber (1977) found that mortality rate varied between 3% in centers where intestinal bypass operations were performed frequently to 13% in centers where these operations were infrequent;

b) variations in patient selection: the following criteria were suggested by Dewind (1969) for patient selection (Because some surgeons adhere to this 'rule of thumb' more precisely than others, this might contribute to the variability of post-operative complications reported in the literature.):

   i) Weight more than 100 lbs. over standard for height, sex and age.

   ii) Failure of conventional forms of treatment (behavior modification, Weight Watchers, diets,

etc.)

iii) Presence of one or more of the following:

Hypertension

Pickwickian syndrome (characterized by obesity, excessive daytime somnolence and sleep apnea)

Abnormal glucose tolerance

Menstrual dyscrasias

Infertility

Degenerative arthitis of hips, knees, or feet

Frank diabetes mellitus

Hyperlipidemia

iv) Stable adult life pattern (surgeons' or psychiatrists' evaluation).

v) Acceptance of expected hazards (i.e., informed consent of patient).

vi) Agreement to undergo revision (modification of operation or reversal if necessary).

Mechanisms of post-operative weight loss

The end-to-side and end-to-end jejunoileostomy (see pages 2 and 4) were initially held to be effective because the shortened intestine produced malabsorption of fat and protein, resulting in weight loss subsequent to surgery. Several studies reported rapid weight loss during the first four to six months, with a decline in rate of loss, reaching a plateau between the second

and third year post-operatively (Dewind, 1969; Mersheimer, 1977; Dean, 1977; Campbell, 1977; Iber, 1977; Castelnuovo-Tedesco, 1976).

However, these studies did not measure or record factors that might contribute to the variable pattern of weight loss in different patients. Some authors offered post hoc explanations for the rapid weight loss within the first few months after surgery, but none systematically measured variables which bear upon these explanatory hypotheses.

Pilkington et al. (1976) were the first to look more closely at the pattern of weight loss after jejunoileostomy. Their findings brought into question the hypothesis that post-operative weight loss results from intestinal malabsorption. They reported measurements of calories lost in faeces which showed that malabsorption did not decrease two years after jejunoileostomy when weight was no longer being lost. They concluded instead that dietary restriction was largely responsible for initial weight loss and increased food intake for weight maintenance in the plateau period.

Two subsequent studies have supported Pilkington's results. Bray et al. (1976) concluded that essentially all of the weight loss in the 22 patients studied could be accounted for by the reduction in caloric intake. Condon et al. (1978) reported that in 65 jejunoileal bypass patients the entire group ate significantly fewer calories 1-9 months post-operatively than they had pre-operatively. Thus the three studies contradict the

traditional view stated by Stanstead (1976), "Jejunoileostomy is effective for the obvious reason that it causes intestinal malabsorption." This older view is incompatible with new data from those studies which have qualified pre- and post-operative patterns of eating and weight loss.

The aims of the present study, then, are:

To replicate previous work indicating that patients eat less post-operatively than pre-operatively; and, to suggest possible reasons for this reduction.

It is hypothesized that if caloric intake is reduced it will be as a function of the unpleasant side effects experienced in conjuction with food consumption. More concisely, it is argued that jejunoileostomy works because it is a form of aversive therapy. A negative correlation between frequency and severity of aversive side effects (as perceived by the patient) and post-operative caloric intake is predicted. In aversive conditioning, punishment is delivered when the individual performs an undesirable behaviour such as overeating. The incidence of the undesirable behaviour therefore tends to be reduced (Wolpe and Lazarus, 1966). This study examines the hypothesis that the unpleasant consequences associated with eating after jejunoileostomy (e.g., diarrhea, nausea, upset stomach, bloating and foul-smelling stools) act as punishers which reduce food intake. In as much as the explanation for why these patients reduce their caloric intake post-operatively remains a topic of debate in the field, this forms the focal

point of this thesis.

METHOD

Subjects

Eighteen candidates (13 females, 5 males) for jejunoileostomy agreed to participate in the study. They ranged in age from 19 to 48 years ($\bar{x}$ = 35.8) and weighed 67-259 lbs. over standard for height, sex and age. Seventeen patients met the selection criteria for jejunoileostomy outlined in the Introduction (Dewind, 1969) and were accepted for surgery. The eighteenth patient who weighed only 67 lbs. over her ideal weight was also accepted for surgery. All patients signed consent forms and were clearly told that the study was for research purposes and would not influence their treatment at the Toronto General Hospital. Eleven of the initial eighteen patients completed this intensive repeated measurement study. These included four men and seven women ranging in age from 19 to 48 years and weighing 114-259 lbs. over standard for height, age and sex (see personal data, Table 2). Only these eleven were included in the statistical analysis and will be discussed in detail. The remaining seven patients dropped out of the study at various stages of completion. These patients decided not to complete the study for various personal reasons (e.g., too busy, no interest).

Surgical Techniques

In this study jejunoileostomy was performed by two experienced surgeons who used different techniques. Surgeon I performed jejunoileostomy on 16 patients using a slight

modification of the end-to-side method described by Payne and Dewind, 1956 (cf. page 1 et seq.). Surgeon II performed jejunocileostomy on the remaining 2 patients using the end-to-end method as described by Scott, 1971 (cf. page 2).

Procedure

After the patient had been accepted for surgery, he or she was seen by the experimenter and asked to participate in the study. At the following six test sessions they were required to complete detailed eating records and answer a questionnaire concerning frequency and noxiousness of various symptoms. The times were:

1) pre-operation (T1)
2) post operation - 2 weeks (T2)
3) post operation - 1 month (T3)
4) post operation - 2 months (T4)
5) post operation - 3 months (T5)
6) post operation - 4 months (T6)

Measures

a) a daily record of 24 hour food intake for three consecutive week days (chosen by experimenter). The patient listed all food consumed during the given day. For each food item, patients listed its size or weight, time of day eaten, whether it was eaten at home or out and whether this was a typical day (see Appendix B). The experimenter then calculated the total number of calories reported by each subject per day using Bowes and Church's (1970) estimation of caloric content of

foods.

b) an aversion questionnaire designed by the experimenter to measure frequency and degree of pleasantness/unpleasantness of 43 items, some of which are potential side effects of jejunoileostomy. If the patient had never experienced an item he was asked to rate how he thinks he would feel if he experienced the item in question. The questionnaire had three different forms for use during three independent time spans:

Form I (History form) asked,
"How often have you experienced or done the following ..." This form was used to measure a history of the patient's experience with the 43 items. The history form was given to the patient once before the operation - "T1". A copy of this form is included as Appendix B).

Form II asked,
"How often since the last questionnaire have you experienced or done the following ..." This form was given 5 times after the operation. The times for use of this form were test sessions T2 through T6 (see Appendix C).

Form III asked,
"How often today have you experienced or done the following ..." This form was given in conjunction with each dietary log and

consequently it was given 18 times to each patient (see Appendix D).

All patients were mailed questionnaires which they completed and mailed back to the experimenter after each test interval. The experimenter provided self-addressed envelopes as an incentive to return the completed questionnaires. While mailing questionnaires contributed to methodological problems (see Discussion) it was the best method available as 11 of the 16 patients lived outside the Toronto area.

Aversion Questionnaire

The aversion questionnaire was designed by the experimenter after consulting clinical observations of symptoms in jejunioleostomy patients. Prior to initiating this study it was tested for clarity in a pilot study on fifteen obese patients and modified accordingly. Most of the 43 variables were derived from a careful search of the jejunoileal bypass literature. Any potential changes in variables associated with jejuncileostomy were listed and viable list of items eventually were agreed upon by Drs. Marliss, Moldofsky, Herman and the experimenter. These consulting doctors felt that a few items which were never mentioned in the literature to be associated with jejunoileostomy should be added: blurred vision, toothache, chest pains, having self control, constipation. This was simply done to observe how post-operative patients would respond to potential physical and psychological problems that were unrelated to the operation.

RESULTS

Changes in Overall Caloric Intake Following Surgery

Table 1 summarizes the change in subjects' caloric intake over the six testing sessions. As predicted, Analysis of Variance (ANOVA) showed a significant decrease in caloric intake over time ($p < .0001$). The Duncan's Multiple Range Test indicated that the caloric intake at T1 (pre-operation) was significantly greater than the remaining 5 times post-operatively. However the 5 post-operative times were not significantly different from each other. Subjects, not surprisingly, differed from each other with regard to caloric intake ($p < .001$). There were no significant differences among days (D) within testing sessions (T) nor T x D interactions.

Rate of Weight Loss

The average rate of weight loss varied among the 5 testing times post operatively. The greatest mean weight loss was recorded at T2, X = 21.2 lbs.; followed by T4, X = 14.4 lbs.; T3, X = 11.5 lbs.; T5, X = 10.9 lbs.; and T6, X = 9.1 lbs. However, the time interval between T2 and T3 is 2 weeks compared to 1 month between each of T4, T5 and T6. Therefore, if we take the period between T1 and T3 together it forms a 1 month interval and we find a clear decrease in the rate of weight loss over time. (T2,3 = 33.7 lbs., T4 = 14.4 lbs., T5 = 10.9 lbs., and T6 = 9.1 lbs.). Individual pre-operative weights and subsequent weight loss are presented in Table 2.

Table 1

Analysis of Variance and Duncan's Multiple Range Test.
Change in Caloric Intake Pre- and Post-operatively.

	Time (T)	Mean Daily Caloric Intake
pre-op:	T1	2525.27*
post op:	T2 - 2 wks.	1259.92
	T3 - 1 mo.	1301.89
	T4 - 2 mos.	1124.57
	T5 - 3 mos.	1193.67
	T6 - 4 mos.	1359.58

*p. < 0.0001

Note: Weight loss may occur at times when there is no significant caloric intake reduction.

Table 2

Subjects' Initial Weight, Weight Loss, Age and Sex

Subject	Wt. (lbs.)	Wt. above standard for ht. age, sex (lbs.)	Wt. loss (4 months post op)	Age	Sex
1	360	203	82	19	M
2	297	127	97	30	M
3	385	220	75	40	M
4	380	213	75	29	M
5	264	124	47	46	F
6	410	259	57	46	F
7	265	114	40	46	F
8	300	164	60	48	F
9	383	243	83	41	F
10	273	138	53	32	F
11	263	145	68	24	F

Relationship between Caloric Intake and Frequency of Unpleasant Side Effects following Jejunoileostomy

Table 3 displays partial correlations between questionnaire items and caloric intake with subject effect removed by multiple regression. As predicted, there is a negative partial correlation between the frequency of most unpleasant side effects of the operation and caloric intake. As symptoms such as bloating, soreness of rectal area, diarrhea, bowel movements during the night, nausea, cramps in abdomen, vomiting, upset stomach, foul-smelling stools, losing weight, loss of appetite, stomach rumbling and belching increase in frequency, the number of calories eaten decreases.

Caloric intake and unpleasantness/pleasantness ratings of questionnaire items

As expected, Table 4 shows for several items a positive partial correlation between caloric intake and position on the unpleasantness/pleasantness continuum. Accordingly, the less unpleasant patients considered symptoms such as bloating, stomach rumbling, depression, diarrhea, disturbed sleep, taking medication, bowel movements during the night, nausea, belching, foul-smelling stools, feeling embarrassed, cramps in abdomen, belching and upset stomach, the more calories they tended to consume. The corollary of this statement is the more unpleasant (aversive) these variables were considered to be, the less calories were eaten. Means for Frequency and Pleasantness/Unpleasant Ratings are presented in Appendix E.

Table 3
Partial Correlation Between Caloric Intake and Variable Frequency

Variable	Partial Correlation	F
Blurred Vision (1)	-0.12	2.49*
Losing Weight (2)	-0.49	52.95
Snoring (3)	0.29	16.96*
Being Complimented (4)	-0.29	15.42*
Stiff Joints (5)	-0.03	0.14
Bloating (6)	-0.25	11.45*
Loss of Appetite (7)	-0.32	19.96*
Toothache (8)	-0.36	26.15*
Drinking Alcohol (9)	0.32	20.54*
Tiredness (10)	-0.11	2.08*
Feeling Self Confident (11)	-0.12	2.65
Soreness of Rectal Area (12)	-0.28	14.01*
Depression (13)	-0.08	1.19
Stomach Rumbling (14)	-0.18	5.40*
Eating Salad (15)	-0.13	2.96*
Being Energetic (16)	-0.21	7.94*
Diarrhea (17)	-0.49	53.03*
Feeling Attractive (18)	-0.31	18.51*
Disturbed Sleep (19)	0.06	0.63
Taking Medication (20)	-0.16	4.57*
Eating Sweet Foods (21)	0.03	0.15
Bowel Movement During Night (22)	-0.10	3.71
Shortness of Breath (23)	0.02	0.10
Headache (24)	-0.03	0.16
Strenuous Exercise (25)	-0.29	15.17*
Nausea (26)	-0.30	16.36*
Cold Hands and Feet (27)	-0.23	9.84*
Cramps in Abdomen (28)	-0.34	22.66*
Vomiting (29)	-0.20	7.18*
Daytime Sleepiness (30)	0.05	0.41
Increased Hunger (31)	0.04	0.24
Belching (32)	0.23	9.85*
Eating Spicy Foods (33)	-0.19	6.62*
Having Self Control (34)	-0.15	4.07*
Chest Pains (35)	0.07	0.86
Upset Stomach (36)	0.29	15.13*
Constipation (37)	-0.12	2.41*
Heartburn (38)	0.09	1.47
Foul Smelling Stools (39)	-0.22	8.71*
Feeling Embarrassed (40)	-0.21	8.13*
Eating Fried Foods (41)	0.24	10.22*
Drinking Coffee (42)	0.12	2.37*
Drinking Milk (43)	-0.20	6.87*

* with subject effect removed by multiple regression
$p < .05$

Table 4
Partial Correlation Between Caloric Intake and Patients' Reports of Pleasantness/Unpleasantness

Variable	Partial Correlation	F
Blurred Vision (1)	0.02	0.10
Losing Weight (2)	-0.17	5.22
Snoring (3)	0.18	5.56*
Being Complimented (4)	-0.11	2.05*
Stiff Joints (5)	-0.21	7.78*
Bloating (6)	0.29	15.32*
Loss of Appetite (7)	-0.02	0.05
Toothache (8)	0.29	15.23*
Drinking Alcohol (9)	0.42	37.34*
Tiredness (10)	0.07	0.86
Feeling Self Confident (11)	-0.00	0.00
Soreness of Rectal Area (12)	0.14	3.65*
Depression (13)	0.18	6.49*
Stomach Rumbling (14)	0.27	12.55*
Eating Salad (15)	0.08	1.21
Being Energetic (16)	-0.20	7.34*
Diarrhea (17)	0.46	46.68*
Feeling Attractive (18)	0.00	0.00
Disturbed Sleep (19)	0.21	8.27
Taking Medication (20)	0.35	23.84*
Eating Sweet Foods (21)	0.01	0.01
Bowel Movement During Night (22)	0.27	13.04*
Shortness of Breath (23)	0.11	1.96*
Headache (24)	0.02	0.10
Strenuous Exercise (25)	-0.34	21.74*
Nausea (26)	0.20	9.17*
Cold Hands and Feet (27)	0.42	37.19*
Cramps in Abdomen (28)	0.31	18.31*
Vomiting (29)	0.07	0.82
Daytime Sleepiness (30)	0.22	9.06*
Increased Hunger (31)	-0.10	1.60
Belching (32)	0.30	16.28*
Eating Spicy Foods (33)	-0.06	0.63
Having Self Control (34)	-0.20	7.04*
Chest Pains (35)	-0.05	0.41
Upset Stomach (36)	0.19	6.46*
Constipation (37)	-0.15	3.74*
Heartburn (38)	0.23	9.74*
Foul Smelling Stools (39)	0.05	0.43
Feeling Embarrassed (40)	0.26	12.85*
Eating Fried Foods (41)	-0.18	5.85*
Drinking Coffee (42)	-0.04	0.25
Drinking Milk (43)	-0.02	0.06

Note: on a seven point scale, "extremely unpleasant" = 1; "extremely pleasant" = 7.
* $p < .05$

Weight loss as a function of unpleasantness/pleasantness ratings of questionnaire items.

Subjects were divided into two groups according to the amount of weight they had lost four months after the operation. Group 1 (N = 5) lost between 75-97 lbs. while Group 2 (N = 6) lost between 40-68 lbs. Comparison of the groups' responses to each of the 43 questionnaire items was made. Only 5 of 86 ANOVAs were significant. This could be expected through chance alone. They showed:

a) subjects who lost the most weight (G1) found loss of appetite "mildly unpleasant" while subjects who lost less weight (G2) found loss of appetite "mildly pleasant" ($p < 0.02$);

b) G1 rated cold hands and feet as "moderately unpleasant" compared to G2's ratings of "mildly unpleasant" ($p < 0.005$);

c) drinking coffee was "mildly unpleasant" to neutral for G1 compared to "mildly pleasant" for G2 ($p < 0.05$). However, G1 drank significantly less coffee than G2 ($p < 0.01$). Furthermore, drinking coffee significantly decreased over time ($p < 0.0001$). G1 "rarely" drank coffee before the operation and "never" drank coffee after the

* Treatment x Blocks design (1 within, 2 between)
Statistical analysis system (SAS)

operation. G2 drank coffee "often" pre operatively (T1), "never" at T2 and T3 and rarely at T4, T5 and T6;

d) as shown in Figure 3, there is no difference in pleasantness/unpleasantness ratings of eating sweet foods between groups or over time. Figure 4 shows a significant decrease in frequency of 'eating sweet foods' from pre-op to post-op.

This result does not support Bray's (1976) report that patients develop an aversion to sweets following jejunoileostomy.

Weight loss as a function of reduced caloric intake

Using Bray's (1976) formula (an average of 3,500 cal/day are required for weight maintenance during the first year after jejunoileostomy), this study found that approximately 50 of the average 67 lbs. weight loss (or 75% of weight loss) by 4 months post-operatively could be accounted for by reduced caloric intake.

Changes in pleasantness/unpleasantness ratings

ANOVA* found that the following variables were rated as significantly less unpleasant pre-operatively compared to post-operatively: losing weight, taking medication, cold hands and feet, foul-smelling stools, diarrhea, bowel movements during the night and cramps in abdomen. There were no significant days by times interactions.

Figure 3

Pleasantness/Unpleasantness Ratings for Sweet Foods

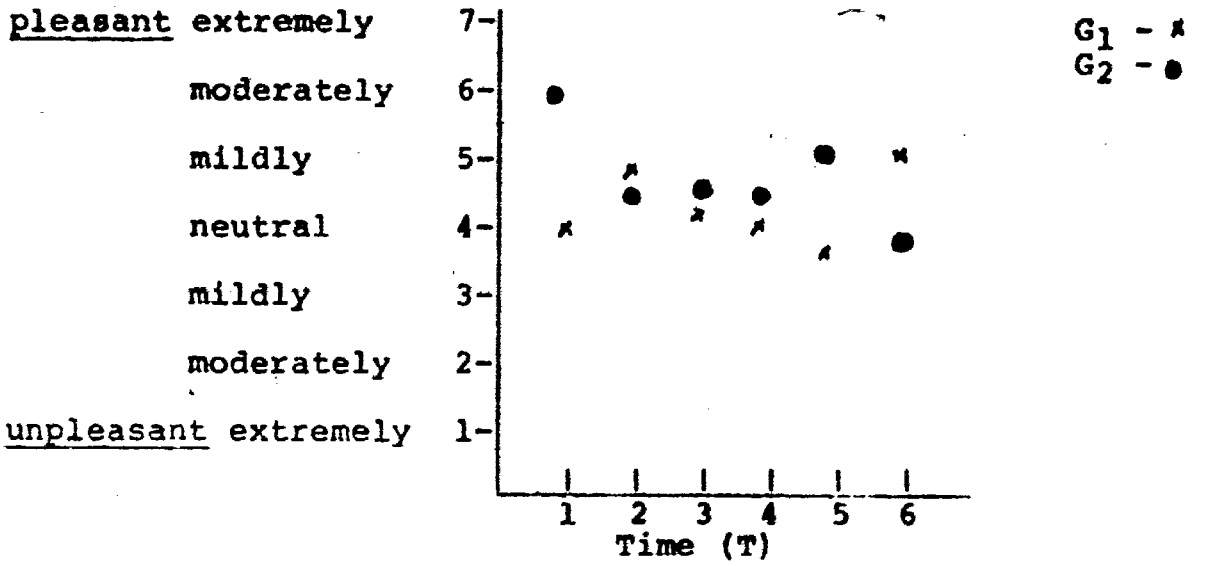
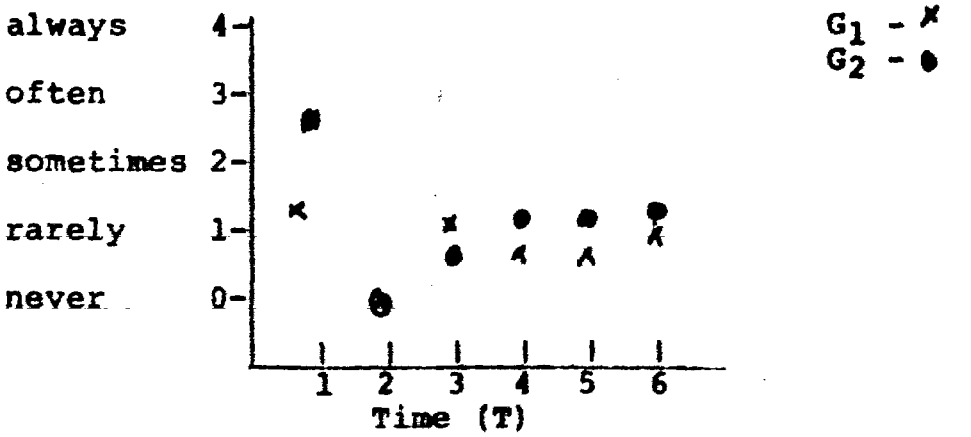


Figure 4

Frequency Ratings for Sweet Foods



T = p 0.005

Changes in frequency of reported side effects

ANOVA* found the the following variables significantly increased in frequency from pre-op to post-op: disturbed sleep, cold hands and feet, cramps in abdomen and vomiting. ANOVA and Duncan's multiple range test found that the following variables significantly increased in frequency over time in the following way: stomach rumbling, (T1 - T6, T4 - T3, T5, T2); diarrhea, (T1 - T5, T6, T4, T3 - T3, T2); bowel movement during the night, (T1 - T6, T5, T4 - T5, T4, T3, - T3, T2); and foul-smelling stools, (T1 - T4, T6, T2, T3, T5). There were no significant days by time interactions.

Subjective ratings

At each test session subjects were asked if they were eating more, less or about the same compared to before the operation. In concurrence with the daily logs, they generally said that they were eating less, the only exception being at four months (T6). A few subjects reported eating about the same as before the operation. Then the patients were asked to write why they were eating more, less or about the same now compared to pre-operatively. These examples are typical of responses given by subjects:

1) lack of appetite
2) not feeling well

* ANOVA (1 between, 1 within) (SAS package)

3) felt bloated all day

4) fear of having tc go to the bathroom

5) I am starved, but do not want to eat because I will have to go to the washroom

6) stomach gets filled up faster

7) the sight and smell of food makes me sick and food is ugly

8) everytime I look at food I get diarrhea which is a good reason not to eat

9) lost interest in food because I feel rotten

10) diarrhea hurts

11) food bothers my stomach

12) I try not to eat after 6 p.m. because I have to go to the washroom, my stomach rolls, I get gas, cannot sleep and I am always hungry in the evening, soreness of rectal area.

13) fear of diarrhea

DISCUSSION

This study has shown that the patients tested ate less post-operatively than pre-operatively. During all testing periods within the four months following surgery, patients ate significantly less than they did when they were tested before the operation. This finding is consistent with the recent data on caloric restriction following jejunoileostomy (Pilkington, 1976; Bray, 1976; Condon, 1978). But is this caloric deficit large enough to account for the extent of the weight lost following surgery?

Caloric decrease and weight loss

Bray (1976) concluded that reduced caloric intake could account for most of the weight loss in all of their 22 intestinal bypass patients post-operatively. In an earlier study (1970) these authors established that an 'average' of 3,500 cal/day are required for weight maintenance during the first year after jejunoileostomy. Thus for the first post-operative year these patients would require 1.27 million cal. to maintain their weight. Bray et al. (1976) estimated from dietary histories that the average patient's caloric intake during that period was 741,600 cal. This is a caloric deficit of 528,000. Since each pound of fat contains approximately 3,500 cal., a loss of 150 lbs. would equal 525,000 cal. or essentially all the caloric deficit.

Using Bray's method of estimation, this study found that roughly 50 of the average 67 lbs. weight loss (or approximately

75%) by 4 months post-operatively could be accounted for by reduced caloric intake. While this accounts for a major portion of weight loss, the remainder would seem to be due to other factors such as intestinal malabsorption or changes in metabolism.

Changes in frequency rating and caloric intake

The hypothesis that there is an association between increased frequency of unpleasant effects experienced following jejunocileostomy and a decrease in caloric intake was supported in this thesis. While each negative correlation between the unpleasant variable and calories does not account for a large variance, most are statistically highly significant (cf. Table 3). It might be wondered why cold hands and feet and caloric intake are negatively correlated or related at all. Patients rapidly losing weight for any reason usually report that they are always cold, especially in their extremities. Furthermore, Table 4 shows that as cold hands and feet become more unpleasant subjects eat less.

Changes in pleasantness/unpleasantness ratings and caloric intake

Ratings of unpleasantness changed for a number of variables between pre- and post-operative measures. For example, subjects who were asked to rate diarrhea, bowel movements during the night, and cramps in abdomen before the operation rated them as less unpleasant than at all times after the operation when the frequency of these side effects had increased. Does this mean that these variables are not perceived to be as unpleasant if you

'rarely' or 'never' experience them, compared to when their frequency increases? ANOVA showed that the degree to which patients rate these symptoms unpleasant significantly increased over time ($p < .0001$). Losing weight was rated as significantly more unpleasant post-operatively than when rated pre-operatively. But subjects reported that the frequency of having lost any amount of weight did not change between pre-operative and post-operative testing times. In other words all of these patients had a great deal of experience with losing weight before the operation. In fact they were chronic dieters and had all been exposed to conventional weight reducing programs. But it seems that losing weight was never perceived to be as unpleasant in their experiences pre-op. as it now became after the operation. This difference is extremely important in defence of this thesis' hypothesis: that jejunoileostomy may function as an aversive therapy. Losing weight after the operation was reported by the subjects in the present study to be unpleasant. And why is it so? Because of diarrhea, foul-smelling stools, nausea, vomiting, bowel movements during the night, soreness of rectal area, bloating, stomach rumbling, cramps in abdomen, and upset stomach which are associated with a decrease in caloric intake.

Reduced caloric intake following jejunoileostomy in rats

The only animal study to date which measured caloric intake following jejunoileostomy is reported by Sclafani et al. (1978). They performed jejunoileostomy on obese rats and sham surgery on

lean controls. Two groups of obese rats were used; 1) female rats made obese with ventromedial hypothalamic (VMH) knife cuts; 2) female genetically obese Zucker rats.

Following surgery the VMH rats reduced their food intake and lost some weight but not to the same extent as the obese rats. Both bypass groups consumed less sucrose and milk solutions within the first month post-operatively but returned to near baseline levels within the second post-operative month. The results of Sclafani et al. are in keeping with the increasing evidence that reduced caloric intake is the major cause of weight loss produced by jejunoileostomy. They further suggest a comparison in selective appetite reduction between rat and man: jejunoileostomy reduces the appetite for sweet foods in both obese VMH rats and obese humans although this appetite recovers in bypass rats within the 2nd month and it is not clear that it does in bypass humans (Bray et al., 1976).

Bray et al. (1976) found that most of his 22 patients had a dislike for most sweet food following surgery. Preferences for concentrated solutions of sucrose and glucose were reduced after surgery but ratings for citric acid and salt solutions were not altered.

The present study found that subjects decreased their intake of sweet foods following surgery but their perceived pleasantness/unpleasantness ratings did not change during that time. Most patients found eating sweet foods mildly pleasant before the operation as well as after surgery. However,

following surgery patients on average reported eating sweet foods 'rarely' or 'never'. If they 'never' ate sweet foods post-operatively they would have to rate them as "how they think they would feel." Perhaps if they had been presented with sucrose and glucose solutions post-operatively as Bray did with his patients, we might have picked up a change in unpleasantness. Although it could be argued that tasting and spitting out concentrated sucrose solutions does not conjure up images of pleasantness as does your favourite dessert, even though sweetness levels may be similar.

In rats, learning about the aversive (as opposed to positive) consequences of foods (e.g., poisons) occurs especially rapidly. Usually one pairing of a new food with an aversive gastrointestinal event, even with delays up to several hours, is adequate to produce a strong aversion which may be remembered over many months (Rozin, 1968). Since many of the side-effects reported by human bypass patients are gastcintestinal, it is possible that learned aversions to foods consumed after the operation may be of a similar nature.

Methodological Problems

High drop out rate and lack of motivation

High patient drop out rate and low patient motivation to return questionnaires once they had agreed to do so are issues that warrant concern. In some cases it took several long distance phone calls to patients in order to motivate them to mail back the completed questionnaires. In three cases the experimenter

had to drive outside the City of Toronto to personally collect the questionnaires. Perhaps the needed motivating factor is to integrate treatment with research but then we get into ethical issues. In the present study we were obligated to tell patients that the study was for research purposes only. They were clearly told that their decision to participate in the study would in no way affect their hospital treatment. So each patient did his or her own private cost-benefit analysis. The study was an intensive repeated measures design which required their participation for five months. The study had little benefit for the patient except perhaps the satisfaction that he or she was contributing to research which might help others.

Caloric intake: self report

Validity of using self-report of food intake relies exclusively on the accuracy of the reports. The experimenter stressed to all patients the fact that for this study to be of any use they were requested to conscientiously record all food intake. The department of Nutrition at the University of Toronto designed the daily food record that was used in this study. This method was considered to be the most reliable, valid approach for self estimation of caloric intake. However, there was no simple way of assessing the reliability of the patients' self reports.

Summary

In this study we have demonstrated that patients ate significantly less up to 4 months after jejunoileostomy than before surgery. It was estimated that a major portion of the

weight loss after surgery could be accounted for by their reduced caloric intake. Furthermore, we found that reduced caloric intake was correlated with an increase in frequency and unpleasantness of most of the unpleasant side effects of this surgery. This relationship was supported by patients' subjective ratings which typically stated that they were eating less because of unpleasant side effects following surgery. These results are in keeping with accumulating evidence that malabsorption is not the major cause of weight loss after jejunoileostomy. Rather, reduced caloric intake can account for most of the weight lost.

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Appendix A

INSTRUCTIONS FOR RECORDING YOUR FOOD INTAKE

A complete and accurate food record is essential in assessing your food habits.

1. DO NOT CHANGE your established food habits during this study. Eat as you normally do.

2. As soon as possible after each meal or snack, please record on the accompanying forms, everything that you ate or drank.

3. Please do this for three consecutive weekdays. (three day periods) eg. Monday, Tuesday and Wednesday; Tuesday, Wednesday and Thursday; or Wednesday, Thursday and Friday.

4. USE A NEW FORM FOR EACH DAY.

5. Indicate where each meal/snack was eaten, (Home-H, Out-O) and the time that it was eaten. Packed lunches count as home meals.

6. For each food item the following information is required:

   AN ACCURATE DESCRIPTION OF THE FOOD ITEM
   eg. Milk - whole, 2%, skim, reconstituted skim, cream, etc.
   Bread - white, whole wheat, rye, french, kaiser, etc.
   Fruit - fresh, frozen, canned, sweetened, 35% syrup, etc.
   Juice - canned, reconstituted frozen, fresh, bottled, sweetened, unsweetened, vitaminized, etc.
   Vegetables - raw, fresh, canned, frozen, baked, boiled, fried, etc.
   Protein foods - meat, fish, poultry, egg, cheese
   state type, cut, how prepared eg. grilled, roasted, fried etc.

B. THE QUANTITY - see below

<u>Special Instructions for Recording the Amount of Food Eaten.</u>

Measure the size of the glasses, cups, and cereal bowls you use at home with a standard measuring cup. Measure the spoons you use with a standard measuring spoon set. Then use these measures to estimate food eaten. This way you do not need to measure each time.

<u>Abreviations</u>

Teaspoon	- tsp.	Slices	- sl.
Tablespoon	- Tbsp. or T	Pat	- pat
Ounce	- oz.	Small, medium large	- sm., med., lg.

Weighing - if you have scales weigh all the items that are not easily measured like meats etc.,

Dimensions - when its not possible to weigh or measure, indicate dimensions. eg. sponge cake 3"x2"x1", or roast beef 2 sl. 4"x3"x1/4".

Resaurant meals - for meals eaten out, please try and estimate by eye, as best you can, the portion size.

Common Measures and Equivalents

1 cup	- 8 fluid ounces	1 Tbsp.	- 3 tsp
1 fl. oz.	- 2 tbsp.	1 lb.	- 16 oz.

7. Indicate brand names of commercially prepared mixed or combination foods

eg. Liptons cup-a-soup - Tomato
Kraft's French dressing
Sarah Lee chocolate cake

Enclose labels if possible, where you think the information may be helpful.

8. Include recipes for all homemade items. The method is not required but the quantities of the main ingredients are. Record the recipes on the form provided. Record the total of the protein that you ate.

eg Beef stew

1 lb beef
1 lb potatoes
1/2 lb carrots
1 cup diced turnips
2 med. onions
1/4 cup flour
2 Tbsp. corn oil

Portion eaten: 1/6

eg. Four bean salad

1 cup kidney beans
1 cup lima beans
1 cup yellow wax beans
1 cup green beans
2 onions sliced
1 cup diced celery
1/4 cup sugar
1 cup French dressing
Total yield: 6 cups
Portion eaten: 1 cup

- For sandwiches list ingredients separately

Bread, whole wheat	2 sl.
Ham,	2 oz.
Lettuce	1 lg leaf
Mayonnaise	1 tsp
Butter	1 tsp

- also do this for coffee, tea, etc.

coffee	1 cup
sugar	2 level tsp.
10% cream	1 creamer

9. CHECK LIST

HAVE YOU INCLUDED THE AMOUNT AND KIND OF

Spread on bread, toast, rolls, baked potatoes, etc.
Sugar and cream/creamer in coffee or tea.
Milk and sugar in cereal
Salad dressing, ketchup, etc.
Fats, oil, used in cocking, frying, salads, etc,
Syrups, sauces, gravies etc.
Pickles, relish, olives, etc.
Chips, nuts, popcorn
Jams, jellies, preserves, candy, etc.
Alcoholic beverages, soft drinks, etc.

Appendix B

1. HOW OFTEN HAVE YOU EXPERIENCED OR DONE THE FOLLOWING:

   NEVER (0) RARELY (1) SOMETIMES (2) OFTEN (3) ALWAYS (4)

2. IF "RARELY" OR MORE

   HOW PLEASANT/UNPLEASANT HAS IT BEEN TO EXPERIENCE THE FOLLOWING

3. IF "NEVER"

   HOW PLEASANT/UNPLEASANT DO YOU THINK IT WOULD BE TO EXPERIENCE OR DO THE FOLLOWING

	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
BLURRED VISION								
LOSING WEIGHT								
SNORING								
BEING COMPLIMENTED								
STIFF JOINTS								
BLOATING								
LOSS OF APPETITE								
TOOTHACHES								
DRINKING ALCOHOL								
TIREDNESS								
FEELING SELF CONFIDENT								
SORENESS OF RECTAL AREA								
DEPRESSION								
STOMACH RUMBLING								

NEVER (0) RARELY (1) SOMETIMES (2) OFTEN (3) ALWAYS (4)

	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
EATING SALAD								
BEING ENERGETIC								
DIARRHEA								
FEELING ATTRACTIVE								
DISTURBED SLEEP								
TAKING MEDICATION								
EATING SWEET FOODS								
BOWEL MOVEMENTS DURING THE NIGHT								
SHORTNESS OF BREATH								
HEADACHES								
STRENUOUS EXERCISE								
NAUSEA								
COLD HANDS AND FEET								
CRAMPS IN ABDOMEN								
VOMITING								
DAYTIME SLEEPINESS								
INCREASED HUNGER								
BELCHING								
EATING SPICY FOODS								
HAVING SELF CONTROL								
CHEST PAINS								

Appendix C

1. HOW OFTEN SINCE THE LAST QUESTIONNAIRE HAVE YOU EXPERIENCED OR DONE THE FOLLOWING:

   NEVER (0) RARELY (1) SOMETIMES (2) OFTEN (3) ALWAYS (4)

2. IF "RARELY" OR MORE (SINCE THE LAST QUESTIONNAIRE)

   HOW PLEASANT/UNPLEASANT HAS IT BEEN TO EXPERIENCE THE FOLLOWING

3. IF "NEVER" (SINCE THE LAST QUESTIONNAIRE)

   HOW PLEASANT/UNPLEASANT DO YOU THINK IT WOULD BE TO EXPERIENCE OR DO THE FOLLOWING

	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
BLURRED VISION								
LOSING WEIGHT								
SNORING								
BEING COMPLIMENTED								
STIFF JOINTS								
BLOATING								
LOSS OF APPETITE								
TOOTHACHES								
DRINKING ALCOHOL								
TIREDNESS								
FEELING SELF CONFIDENT								
SORENESS OF RECTAL AREA								
DEPRESSION								
STOMACH RUMBLING								
EATING SALAD								

	NEVER (0)	RARELY (1)	SOMETIMES (2)	OFTEN (3)	ALWAYS (4)			
	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
UPSET STOMACH								
CONSTIPATION								
HEARTBURN								
FOUL SMELLING STOOLS								
FEELING EMBARASSED								
EATING FRIED FOODS								
DRINKING COFFEE								
DRINKING MILK								

NEVER (0) RARELY (1) SOMETIMES (2) OFTEN (3) ALWAYS (4)

	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
BEING ENERGETIC								
DIARRHEA								
FEELING ATTRACTIVE								
DISTURBED SLEEP								
TAKING MEDICATION								
EATING SWEET FOODS								
BOWEL MOVEMENTS DURING THE NIGHT								
SHORTNESS OF BREATH								
HEADACHES								
STRENUOUS EXERCISE								
NAUSEA								
COLD HANDS AND FEET								
CRAMPS IN ABDOMEN								
VOMITING								
DAYTIME SLEEPINESS								
INCREASED HUNGER								
BELCHING								
EATING SPICY FOODS								
HAVING SELF CONTROL								
CHEST PAINS								
UPSET STOMACH								

	NEVER (0)	RARELY (1)	SOMETIMES (2)	OFTEN (3)	ALWAYS (4)			
	0 - 4 FREQUENCY	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
CONSTIPATION								
HEARTBURN								
FOUL SMELLING STOOLS								
FEELING EMBARASSED								
EATING FRIED FOODS								
DRINKING COFFEE								
DRINKING MILK								

Appendix D

1. HOW OFTEN TODAY HAVE YOU EXPERIENCED OR DONE THE FOLLOWING:

   NEVER (0) RARELY (1) SOMETIMES (2) OFTEN (3) ALWAYS (4)

2. IF "RARELY" OR MORE (TODAY)

   HOW PLEASANT/UNPLEASANT HAS IT BEEN TO EXPERIENCE THE FOLLOWING:

3. IF "NEVER" (TODAY)

   HOW PLEASANT/UNPLEASANT DO YOU THINK IT WOULD BE TO EXPERIENCE OR DO THE FOLLOWING:

	0 - 4 FREQUENCY	TIME	UNPLEASANT EXTREMELY	UNPLEASANT MODERATELY	UNPLEASANT MILDLY	NEUTRAL	PLEASANT MILDLY	PLEASANT MODERATELY	PLEASANT EXTREMELY
BLURRED VISION									
LOSING WEIGHT									
SNORING									
BEING COMPLIMENTED									
STIFF JOINTS									
BLOATING									
LOSS OF APPETITE									
TOOTHACHE									
DRINKING ALCOHOL									
TIREDNESS									
FEELING SELF CONFIDENT									
SORENESS OF RECTAL AREA									
DEPRESSION									
STOMACH RUMBLING									

CODE NO:_____

DAILY FOOD RECORD

DAY OF WEEK :_____

(Use a new form each day)

DATE:_____

TIME HOME-H or OUT- O	FOOD ITEM AND DESCRIPTION ONE ITEM PER LINE	AMOUNT WT or MEASURE	COMPUTER CODING DO NOT FILL	

WAS THIS A FAIRLY TYPICAL DAY? YES_____ NO_____

IF NO. EXPLAIN_____

_____

CODE NO

RECIPE SHEET

MAIN INGREDIENTS	PORTION SIZE EATEN