The Canterbury Ileal Pouch-Anal Anastomosis Study

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Abstract

Background and aim: Inflammatory bowel disease (IBD) is an increasingly prevalent chronic disease, frequently with an early age of onset and no cure. It is important to ascertain which treatments are effective and cost-effective, in order to optimise treatment and rationalise use of resources. One of the treatments for IBD is surgery, commonly restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA). This study aimed to collect information regarding complications, outcomes, quality of life, disability and cost information of all IPAA patients in the Canterbury region, New Zealand, which will enable comparison to be made to international research and provide crucial information to aid treatment decisions.

Method: This population study aimed to recruit all patients with IPAA performed between 1984 to 2013 in the Canterbury region, New Zealand, and collected information on demographics, indications, complications, functional outcomes, quality of life (QoL), disability and direct and indirect costs. Data was sourced from hospitals and primary care facilities. Further information was gathered from participants who completed the Short-Form 36 Questionnaire (SF36), the Inflammatory Bowel Disease Questionnaire (IBDQ), the Inflammatory Bowel Disease Disability Index (IBD-DI) and the Indirect Costs Questionnaire through structured interviews and online questionnaires.

Results: In total there were 136 IPAA patients; 95 were eligible for the study after review (mean follow up of 11.5 years). Eighty-six completed the SF36, 81 completed the IBDQ, and 84 completed the IBD-DI. Twenty-four percent of patients had at least one early complication and 77% had at least one late complication. The average IBD-DI score was -1.0, which showed less disability than a cohort of UC patients on medical therapy in Sydney (p value = 0.04). The IBDQ and IBD-DI were highly correlated (r = 0.84, p value <0.01). The annual average direct costs were NZD$930.42, and the average indirect costs in the last 12 months were NZD$3,825.38. Lower QoL and disability were found in those who had their position affected at work (p values <0.01) and those who had more than 100 days off work in the last year (p value <0.01 for QoL and p value = 0.012 for disability). Lower QoL and disability were associated with higher indirect and total costs (p value <0.01).
Discussion and conclusion: The IPAA patients in Canterbury, New Zealand, had a higher rate of late complications than the average rate observed internationally (2), likely due to more complete data collection from multiple sources. The quality of life in the Canterbury cohort was comparable to international data (4-8). Perioperative complications and high costs of care were associated with higher levels of disability. The Canterbury IPAA recipients experienced less disability than medically managed UC patients in Sydney. Indirect costs accounted for 80% of total costs, and should not be underestimated.
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Peer reviewed publications arising from the work described in this thesis


Peer reviewed conference proceedings arising from the work described in this thesis

Oral presentations


Poster presentations


Table of contents

1. Chapter 1. Introduction and literature review................................................. 1
   1.1 Ileal pouch-anal anastomosis................................................................. 1
   1.2 Inflammatory bowel disease................................................................. 1
   1.3 Ulcerative colitis.................................................................................... 3
   1.4 Medical therapy...................................................................................... 4
   1.5 Surgical treatment.................................................................................. 5
   1.6 Indications for surgery........................................................................... 7
   1.7 Complications......................................................................................... 10
   1.8 Functional outcomes............................................................................. 15
   1.9 Quality of life......................................................................................... 17
   1.10 Disability.............................................................................................. 23
   1.11 Costs..................................................................................................... 27
   1.12 Conclusion and future research............................................................. 30
2. Chapter 2. Methods......................................................................................... 32
   2.1 Population cohort................................................................................... 32
   2.2 Inclusion and exclusion criteria.............................................................. 33
   2.3 Recruitment............................................................................................ 34
   2.4 Consent.................................................................................................. 35
   2.5 Data collection....................................................................................... 36
   2.6 Statistical analysis methods.................................................................... 39
3. Chapter 3. Results.......................................................................................... 40
   3.1 Participant identification......................................................................... 40
   3.2 Participant recruitment.......................................................................... 41
   3.3 Participant demographics....................................................................... 43
   3.4 Surgical complications.......................................................................... 45
   3.5 Functional outcomes............................................................................. 46
   3.6 Quality of life........................................................................................ 46
   3.7 Disability................................................................................................ 57
   3.8 Correlation between IBDQ and IBD-DI.................................................. 61
   3.9 Comparison with Sydney cohort............................................................ 61
   3.10 Work disability and education.............................................................. 62
List of tables

2.1 ACHI procedural codes associated with IPAA in CDHB
3.1 Data availability
3.2 Participant demographics
3.3 Disease type and clinical indications
3.4 Complications
3.5 Average BM frequency
3.6 IBDQ univariable analysis
3.7 SF36 components
3.8 SF36PH univariable analysis
3.9 SF36MH univariable analysis
3.10 IBD-DI univariable analysis
3.11 Comparison of Canterbury cohort versus Sydney cohort
3.12 Participant work disability and education
3.13 Direct costs univariable analysis
3.14 Indirect costs
3.15 Indirect costs univariable analysis
3.16 Total average costs over 12 months

List of figures

1.1 Global incidence of IBD
1.2 Escalating steps of UC medical therapy
1.3 Anatomy of ileal pouch-anal anastomosis
1.4 Indications for emergency surgery
1.5 Indications for elective surgery
1.6 Type and frequency of post-operative complications across all studies
2.1 The Canterbury Region, New Zealand
3.1 Patient identification and recruitment
3.2 Scatterplot between IBDQ and IBD-DI
3.3 Work productivity
## List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5ASA</td>
<td>5-aminosalicylic acid</td>
</tr>
<tr>
<td>ACHI</td>
<td>Australian Classification of Health Interventions</td>
</tr>
<tr>
<td>Anti-TNF</td>
<td>Anti-tumour necrosis factor</td>
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<tr>
<td>BM</td>
<td>Bowel motion</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CAD</td>
<td>Canadian dollar</td>
</tr>
<tr>
<td>CD</td>
<td>Crohn’s disease</td>
</tr>
<tr>
<td>CDHB</td>
<td>Canterbury District Health Board</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>DRG code</td>
<td>Diagnosis Related Group Code</td>
</tr>
<tr>
<td>FAP</td>
<td>Familial adenomatous polyposis</td>
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<tr>
<td>GI</td>
<td>Gastro-intestinal</td>
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<tr>
<td>GP</td>
<td>General practitioner</td>
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<tr>
<td>HRQoL</td>
<td>Health related quality of life</td>
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<tr>
<td>HUHC</td>
<td>High user health card</td>
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<tr>
<td>IBD</td>
<td>Inflammatory bowel disease</td>
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<tr>
<td>IBD-DI</td>
<td>Inflammatory Bowel Disease Disability Index</td>
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<tr>
<td>IBDQ</td>
<td>Inflammatory Bowel Disease Questionnaire</td>
</tr>
<tr>
<td>ICF</td>
<td>International Classification of Functioning, disability and health</td>
</tr>
<tr>
<td>IPAA</td>
<td>Ileal pouch-anal anastomosis</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>MAP</td>
<td>MYH associated polyposis syndrome</td>
</tr>
<tr>
<td>MYH</td>
<td>A gene associated with MAP</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>NZD</td>
<td>New Zealand dollar</td>
</tr>
<tr>
<td>OOP</td>
<td>Out of pocket</td>
</tr>
<tr>
<td>PHARMAC</td>
<td>Pharmaceutical Management Agency in New Zealand</td>
</tr>
<tr>
<td>PHO</td>
<td>Primary Health Organisation</td>
</tr>
<tr>
<td>RP</td>
<td>Restorative proctocolectomy</td>
</tr>
<tr>
<td>SD</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>SF36</td>
<td>Short Form 36 Health Survey</td>
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SF36MH  Short Form 36 Mental Health Survey
SF36PH  Short Form 36 Physical Health Survey
SPSS    Statistical Package for the Social Sciences – software for statistical analysis
UC      Ulcerative colitis
UK      United Kingdom
USA     United States of America
USD     United States dollar
QALY    Quality-adjusted life year
QoL     Quality of life
VS      Versus
WHO     World Health Organisation
Chapter 1. Introduction and Literature Review

1.1 Ileal Pouch-Anal Anastomosis

Ileal pouch-anal anastomosis (IPAA) is a surgical procedure that is carried out for ulcerative colitis (UC) and certain neoplastic conditions. IPAA provides continuity of the bowel and removes the need for a stoma, making it a desirable treatment option for many patients. This is particularly important as the majority of UC patients are diagnosed in their second and third decade of life, and many do not wish to live with a stoma for the rest of their lives. However, IPAA is not without possible risks and complications. Therefore, research into the long term IPAA complications, functional outcomes, quality of life, disability and costs will better inform patients, physicians and surgeons of this treatment option.

As ulcerative colitis is the main indication for IPAA, this chapter will discuss the pathology and treatment of ulcerative colitis and other indicators for IPAA; before moving on to the literature review of IPAA complications, outcomes, quality of life, disability, and costs. The review will indicate areas that require further research, which the Canterbury IPAA study will aim to address.

1.2 Inflammatory bowel disease

Inflammatory bowel disease (IBD) is a group of inflammatory diseases with unknown aetiology that affects the gastro-intestinal tract, with the two main diseases being Crohn’s disease (CD) and ulcerative colitis (UC). UC and CD are chronic, lifelong diseases often with an early age of onset. The incidence and prevalence of IBD has been rising across the world over the last 50 years (3). The UC prevalence is 505 per 100,000 persons and the CD prevalence is 322 per 100,000 persons in Europe (9). Highest incidence of UC and CD have been reported in Northern Europe, United Kingdom and North America, with lower rates observed in Asia and Africa (3). The highest annual incidence of UC was 24.3 per 100,000 person-years in Europe, 6.3 per 100,000 person-years in Asia, and 19.2 per 100,000 person-years in North America (9). The highest annual incidence of CD was 12.7 per 100,000 person-years in Europe, 5.0 per 100,000 person-years in Asia, and 20.2 per 100,000 person-years in
North America (9). Canterbury, New Zealand has the CD annual incidence rate of 16.5 per 100,000 person-years, which is a higher annual incidence rate when compared to Europe and Asia, but lower than the incidence rate in North America (10).

Time trend analysis in the majority of reviews and studies shows increasing incidence of IBD across the world (3, 9, 11-14), indicating its rise as a global disease. The trend of increasing IBD incidence and prevalence, even in developing countries, indicates that there is an environmental link to disease pathogenesis, despite its unknown disease aetiology. One New Zealand study researched possible environmental risk factors by carrying out an IBD population case-control study, which included 653 patients with UC, 638 patient with CD, and 600 controls (15). Results shows a family history of IBD, cigarette smoking, high social class at birth and Caucasian ethnicity are significant factors associated with IBD; whilst having a childhood vegetable garden and having been breastfed are protective factors against IBD (15). The large study population and low dropout rate of 3.4% give the results of this study substantial statistical power. A world-wide systematic review concurs with the study above; that IBD family history and cigarette smoking are among one of the most important disease modifying factors, as well as that appendectomy is a protective factor

Figure 1.1 - Global incidence of IBD (3)
(Reproduced from other sources as stated above)
against UC (13). The interactions between IBD pathogenesis and environmental factors are complex, and no doubt there are other risk factors that are yet to be discovered, placing an importance on future research.

**1.3 Ulcerative Colitis**

Ulcerative colitis is a chronic disease with recurrent inflammation of the colon and rectum and mucosal ulcers which spreads proximally. The cause(s) of UC is unknown. However, research show that genetics, family history and environmental factors appear to play a role in disease risk (13, 15). UC has many debilitating symptoms such as: abdominal pain, increased bowel frequency, bowel urgency, bloody diarrhoea, anorexia, anaemia, fevers and weight loss. Extra-intestinal manifestations can also develop, such as: iritis, uveitis, seronegative arthritis, ankylosing spondylitis, sacroiliitis, erythema nodosum, pyoderma gangrenosum and primary sclerosing cholangitis (1). These symptoms all contribute to the debilitating and disabling nature of ulcerative colitis.

While UC can present at any age, it typically peaks between 15 to 30 years of age and then again between 50 to 70 years of age (3, 11, 14). Majority of people develop UC under the age of 35, which is why this is a disease that affects many young people. UC has a significant burden on society, as it reduces patients’ quality of life and increases disability during the most productive years of their lives, reducing their work capacity (16-18).

Fifty to eighty percent of UC patients experience a relapsing and remitting course of disease with varying severity, which requires treatment over prolonged periods of time (19). This has a large impact on health resources, as it is an expensive disease to treat with its life long duration, and many patients require the use of expensive biologic therapies. One study ran a model-based cost-utility analysis, which shows costs for anti-tumour necrosis factor therapy is expected to be higher than £50,000 per quality adjusted life year (QALY) gained (20). However, this study has its limitations, as it is a model-based analysis and not a study on real life patients.

Due to all of the factors above, it is crucial to continue research on treatment management, in order to better inform physicians and patients of the most effective and cost-effective
therapies available. The Canterbury IPPA study aimed to research the complications, functional outcomes, quality of life (QoL), disability and costs associated with IPAA, which is a surgical treatment that is commonly used for UC. Therefore details of CD and other IBD disease were not discussed below.

1.4 Medical therapy

Current medical treatments are aimed at controlling the inflammatory disease process, but are not curative, due to unknown disease aetiology. The goal of medical therapy for UC is to rapidly induce a steroid-free remission while preventing and minimising disease complications and side effects of medications (1, 21, 22).

The choice of treatment depends on a number of factors: degree of disease activity, distribution (proctitis, left sided or extensive colitis), course of disease, frequency of relapses, extra-intestinal manifestations, previous medications, side effect profiles and the patient’s individual wishes (22).

The first-line treatment for mild to moderate UC is the use of 5-aminosalicylic acid (5ASA) preparations either orally or rectally. For moderate to severe disease, immunomodulators such as corticosteroids and azathioprine are used. For disease that is steroids dependent, steroid refractory, or azathioprine refractory, this is classed as refractory ulcerative colitis (21).

For refractory colitis, it is important to ensure that first and second-line treatments are optimised, and intravenous corticosteroids have been trialled. After that, treatment would be second-line immunomodulators and biologic agents (21, 22). Second-immunomodulators include medications such as methotrexate, tacrolimus, and cyclosporin. Biologic agents include infliximab, adalimumab, as well as numerous biologic agents new to the market.

One of the established step-up medical therapy regime for UC is shown in the diagram below (22).
1.5 Surgical treatment

If the disease is unresponsive to the medical therapy discussed above, or if the patient develops severe haemorrhage, perforation, toxic megacolon or cancer; surgical treatment will be the next step. It is estimated that 20-30% of UC patients will eventually require surgical intervention (21, 24). The decision of whether to proceed with surgery and the timing of surgery, is a difficult choice that needs to be undertaken by patients and the team treating them on a case-by-case basis.

A colectomy can cure the disease by the removal of the diseased colon and rectum; from here, the reconstruction options are either with an ileal pouch-anal anastomosis (IPAA) or a permanent stoma; the decision is dependent on multiple factors such as the extent of the disease, severity, patient age and health. A permanent ileostomy can be undesirable for
many patients, especially those in the younger age group who do not wish to have a stoma for life.

1.5.1 Ileal Pouch-Anal Anastomosis (IPAA)

Ileal pouch anal-anastomosis, also known as an ileo-anal pouch or restorative proctocolectomy, is a surgically constructed internal faecal reservoir situated where the rectum would normally be. The reservoir is formed by folding loops of the ileum back on itself and stitching or stapling it together before removing the internal walls to complete the pouch formation. The newly constructed IPAA is then connected to the anus. An IPAA removes the need for a stoma and provides continuity of the bowel. For the majority of UC patients, this is a very desirable option.

Ileal pouch-anal anastomosis was first performed in the late 1970s. The shape of an ileal pouch can be J, S, or W shaped, depending on the number of folds that is made from the terminal ileum. Over the years, techniques for IPAA have been refined. J pouches are the most common configuration for IPAA; they are stapled rather than hand-sewn and performed laparoscopically (24).

In order to reduce the risk of short and long term post-op complications, this surgery is most commonly performed in two or three stages (24-27). The first stage is a colectomy with an end ileostomy to allow the body time to heal. After three to six months, patients then proceed to the second stage, where the IPAA is created using the terminal ileum, and joined to the lower rectum/anal canal. At this point, bowel contents are still diverted through an ileostomy in order to give the IPAA time to heal without faecal contamination. After six to eight weeks, patients will proceed to the third stage, which is the closure of the temporary ileostomy. After this, bowel contents will go through the IPAA and exit from the anus (28).

Patients who are unwell at the time of the initial surgery often require the three-step operation. However, if condition permits, steps one and two can be combined into a single operation, and ileostomy closure can be performed in as few as six to eight weeks after this.
1.6 Indications for surgery

The mainstay of treatment for ulcerative colitis is medical therapy. However, it is estimated that 20–30% of patients will ultimately require surgery (21, 24, 27, 29, 30). Therefore, it is important to review the current indications for surgery to ensure that surgery is being conducted in a timely fashion.

The current indications for surgical treatment can be broadly divided into two categories: emergency and elective (24, 25, 27, 30-32). Break down of indication percentages from a large IPAA study in Japan, consisting of 1000 IPAA patients are shown below in figure 1.4 and 1.5 (25).

1.6.1 Indications for emergency surgery

- Fulminant colitis
- Severe haemorrhage
- Perforation
- Toxic megacolon
1.6.2 Indications for elective surgery

- Refractory to medical therapy
- Intolerance of medical treatment
- Frequent relapse
- Intractable, debilitating chronic disease
- Dysplasia or carcinoma
- Complications of medical therapy
- Strictures
Large studies show that approximately 20% of operations are acute, and 80% are elective (24, 25, 27, 30, 31, 33), which highlights the importance of choosing and planning for elective proctocolectomy and reconstruction.

Non-IBD indications

At times, IPAA is carried out electively for non-IBD patients to reduce cancer risk in diseases such as familial adenomatous polyposis (FAP) and Lynch syndrome. There are no alternative medical treatments for this group of patients. Therefore, the only treatment is to proceed with a colectomy with IPAA/ileostomy for cancer excision or cancer prophylaxis. However, the details of this indication are outside the scope of this thesis and will not be discussed further.

1.6.3 Timing of elective surgery

The indications for surgical intervention are well established, as shown above. Failure of medical therapy is the most common indication for surgery (24, 25, 27, 31, 34). However, deciding what constitutes as failure of medical therapy is highly debated and at times
subjective topic. For those patients with moderate to severe disease, it is often difficult to know when to cease medical therapy and to go on to elective surgery. This is a joint decision that is made between the patient, gastroenterologist and surgeon, based on the patient’s disease severity, occupation, lifestyle, morbidity, quality of life, and personal choice. Emphasis is placed on a full explanation of these factors so that the patient is fully involved in the final decision making (24).

Over the years, referral patterns and indications for surgery have changed (35). Patients are having surgery earlier, especially if their disease is refractory to medical therapy. Many large and robust studies and reviews have indicated that quality of life after IPAA surgery is comparable to those in the general population without IBD (4, 6, 8, 35-41).

1.7 Complications

IPAA surgery, as it is for any surgery, is not without potential risks and complications. This section explores the complications and long-term functional outcomes for IPAA surgery. Complications that were experienced by IPAA patients can be split in early complications (<30 days post IPAA surgery) or late complications (>30 days post IPAA surgery). Common early complications are haemorrhage, wound infection and pelvic sepsis. Common late complications are strictures, pouchitis, fistula, and pouch failure. Pouchitis and pouch failure are late complications that I will explore further in the chapters below.

A Canadian study in 2017 analysed post-operative data from 758 patients and found the following early complications: 17.8% had pelvic abscess(es), 17.7% had small bowel obstruction(s), and 14.3% had wound infection(s) (42). For late complications, this study found 7.3% of patients had anal stricture(s), and 3.4% had pouch fistula(s) (43). The strengths of this study by Zittan et al is that data was collected from a large institution, which has performed over 2200 IPAA, and that it was a recent study that was carried out last year. Limitations of this study was that it was a retrospective analysis, which may present bias, as well as the fact some outpatient files were incomplete and disregarded in the analysis.
The early complication rates from the above study are comparable to a 1995 study by Fazio et al with 1005 patients, which shows early complication rate of 27.5% (43). However, the late complication rate from this historic study was 50.5%, which was much higher than the recent study Zittan et al (44). Weaknesses from this study is that it was a retrospective analysis, which can present with selection and information bias. The study had data from patients between 1983 and 1993; this data may be out of date and no longer relevant to our current population of patients, due to multiple factors which may have changed over time.

A large systematic review in 2016 shows early complication rate range from 9%-65%, and late complication rates were between 17%-55% (2). The strengths of this systematic review is that it was recent, systematic, and included 28 studies. Some limitations of this review is that due to the marked heterogeneity of the study methods, patient population, duration of follow up and approaches to procedures used (open vs laparoscopic), it was not possible to carry out a meta-analysis of the systematic review.

The rate of early, late, and overall complications range widely between 20%-50% in different studies (2, 35, 42-49). Many of the studies that were reviewed in this literature search had robust study methods, large study populations and thorough systematic reviews. However, these studies were not without various limitations, most of which is that the data analysis was carried out retrospectively. It is uncertain as to why the rate of complications are so different between these different studies. The only conclusion that can be reached from current research, is that the potential complications from IPAA surgery is not to be underestimated, and the benefits of the surgery must be weighed up against the potential risks.
Pouchitis

Pouchitis is defined as idiopathic, non-specific acute inflammation of the ileum that has been used to construct the artificial reservoir that is the ileal anal pouch. Pouchitis is considered to be one of the most common late complications for IPAA, and it is found to be more common in patients with UC and CD than patients with FAP (45, 50). The rate of pouchitis in current research range between 12.6%-55% (2, 44, 45, 47). In a 2016 systematic review of 28 studies, Peyrin-Biroulet found the mean incidence of pouchitis to be 29% (2). This figure was difficult to ascertain, due to the different study population numbers, methods, and duration of follow-up that was included in the 28 studies.

Some may only have one or two episodes of pouchitis in their lifetime; for others, it can be recurrent and debilitating to the point of leading to pouch failure. A recent study by Lorenzo et al analysed functional outcomes and complications from 205 patients with IPAA, and found chronic and recurrent pouchitis in 12.6%, and pouch failure in 10.8% (47). The limitation of this study was its method of retrospective analysis, as well as small population numbers all from a single centre.

Furthermore, it was shown in a study with a follow up over 20 years, that the incidence of pouchitis increased with time; from 40% patients reporting at least one episode over 10 years of follow up, to 70% of patients reporting at least one episode over 20 years of follow
This 2007 study had many strengths; it was a prospective study with a large study population of 1885 patients with IPAA, with 20 years of follow up. However, one limitation to note is that the data is all from a single centre, it was not a multi-centre study.

In conclusion, pouchitis has been found to be one of the most common late complications of IPAA surgery, with a varying range of prevalence across different studies. Pouchitis can be a significantly debilitating complication, and its effects on quality of life should not be underestimated.

**Pouch failure**

Pouch failure rate is an important piece of information that patients, physicians and surgeons need to be aware of. Different studies have reported different rates of pouch failure across the globe; ranging from the lower end at 0.9% (42), 1.6% after 10 years in patients older than 55 (51), to the middle ground of 5% (36, 38), and higher percentages of 12.6% after 10 years (35). One study examined the rate of pouch failure over a long period of follow up, and observed pouch failure rate to increase with the passage of time. The pouch failure rate was 4%, 6%, and 6% after five, ten, and twenty years of follow up respectively (45). This was a well-designed, large prospective study with 1885 patients and 20 years of follow up.

Pouch failure can be due to various causes. A cross-sectional study of 1554 IPAA patients in Canada showed failure rate of 6.8%, with 46.2% of these cases to be caused by septic complications (53). This is followed by the second most common cause, which is poor pouch functional results at 21.7% (52). One limitation of this study is its cross-sectional nature, where it analysed outcomes from patients who have had the IPAA for a varying length of time. This is likely to lead to biases and include possible confounders of the cause of pouchitis.

One review found that pelvic abscess(es) due to anastomotic leak is a surrogate marker for poor wound healing (53). However, this was a small review that was not systematic, and quoted only a handful of small studies. A large American study of 3,234 IPAA patients carried out in 2010, found 200 of those patients developed pelvic sepsis. This study found that pelvic
sepsis after IPAA leads to worse functional outcomes and quality of life, even when it does not lead to pouch failure (54). This study highlighted the need for careful attention to pre-operative and post-operative planning, in order to reduce the rate of pelvic sepsis after IPAA, and therefore reduce the risk of pouch failure. Limitation of this study is that it was retrospective and could have led to patient recall bias, particularly regarding quality of life.

In contrast, a different study found having pelvic sepsis post-operatively does not impair functional outcomes of the IPAAAs (55). One of the strengths of this Swedish study was that it was a prospective study, carried out over 2 years. However, it was not without some limitations; it was a small, single centred study which only included 100 patients with ulcerative colitis.

A large 2016 systematic review of 28 studies and 20,801 patients shows that rate of pouch failure has decreased from 13% between 2002-2009, to 2% between 2010-2015 (2). The quoted improved rate of pouch failure could be due to several reasons; it could indicate improved techniques, or perhaps that patients are getting earlier surgical treatment for severe UC. However, these statistics must be taken with some caution, as this review included studies with varying methods, patient numbers, and with different duration of follow up. There are likely multiple factors attributing to the quoted declining rate of pouch failure.

In conclusion, the rate of pouch failure across the world varies widely from 0.9% to 12.6% (2, 36, 37, 39, 43, 46, 52-56). The rate of complications reported varied widely due to different factors such as study method, population size and length of follow up. Further large, multi-centre, prospective studies with long duration of follow up are required to further validate the current findings.

1.7.1 Risk factors for complications

Despite its unknown disease aetiology, studies claim certain factors have been discovered to increase the risk of complications for IPAA surgery. However, research in this area is full of conflicting results, and it can be difficult to ascertain the true risk factors leading to IPAA surgical complications. Some of the possible risk factors are explored below.
**Steroids, immunomodulators and biologics**

There is conflicting information regarding whether the use of steroids, immunomodulators and biologics increase the risk of developing post-operative complications. Some studies report that the use of steroids and immunomodulators increase the rate of post-operative complications (56, 57). One of these studies (Balachandran et al) only had 54 patients; the other study by Kulayat et al was much larger and included 2427 patients. However, both of these studies were retrospective, which could lead to recall as well as selection bias.

In contrast, other studies claim that there is no correlation between immunosuppressants and post-operative complications (58, 59). However, both of these studies were small, single centre and retrospective. Cyclosporin is a second-line immunomodulator used in the treatment of inflammatory bowel disease. One study found that intravenous cyclosporin doesn't increase peri-operative complications, when compared with the use of steroids alone (60). However, this study was carried out in 2001, it was retrospective and only analysed results from 44 patients.

Another possible risk factor is the use of biologics, such as infliximab. A systematic review of five studies with 706 patients found that Infliximab increases short term post-operative complication rates (61). This was a meta-analysis, however it only included 6 studies, most of which were small and retrospective.

It is difficult to make comparisons and conclusions from these studies due to different study methods, retrospective nature, and varying duration of follow up. Therefore, it remains unclear whether corticosteroids, immunomodulators and biologics increase the risk of post-operative complications in IPAA.

**Crohn’s disease**

The use of IPAA for Crohn’s disease (CD) has long been debated, due to the nature of CD being able to affect any part of the gastrointestinal system. Restorative proctocolectomy, such as IPAA, will not be able to cure CD or prevent disease recurrence.
Multiple studies have found patients with CD to have higher complication rates and pouch failures (47, 49, 62). One study identified 35% of its pouch failures are patients with Crohn’s disease (47). This study had the strength of prospective data collection and analysis, compared to many other studies which are retrospective; however, it was not a large study and only included 205 patients. A study by Wolters et al shows CD patients has higher morbidity and mortality, as well as higher costs (49). This study had many strengths which adds to its statistical power; it was a prospective, multi-centre study spanning across nine countries, included 2201 patients, and had the follow up over 10 years. Therefore, CD should be considered as a relative contraindication for IPAA.

**Gender**

In a large study of 3407 patients with a median follow up over 10 years, the authors found that females were more likely to develop bowel obstructions, pouch related fistulas, faecal incontinence, urgency, higher daily stool frequency, and pouch failures than males (63). The limitations of this study was that it was single centre and retrospective. However, this risk factor is not found to be echoed in other large IPAA studies. Therefore, whether gender is a risk factor for IPAA complications still remains unclear.

**Delayed surgery**

The timing of surgery can be a complicated and difficult decision. This is dependent upon many factors such as disease severity, acute complications, physician recommendations and patient choice. One study has found delayed surgery for acute severe colitis to be a risk factor for IPAA complications (64). However, this was a small, retrospective and single centre study. The definition of ‘delayed surgery’ in itself, varies widely and is subjective. This topic has not been widely researched due to the different definitions of delayed surgery, which has led to different study methods and analysis. Therefore, it remains difficult to assess ‘delayed surgery’ as a risk factor for IPAA complications.
**Age**

For many operations, increasing patient age is a risk factor for complications. However, for IPAA, patients over the age of 65 has been found to have the same complication rates as the younger patient group under the age of 65. Many studies have shown that the older patient group reports good functional outcomes, quality of life, and surgery satisfaction (35, 45, 47, 48, 51, 65). Majority of these studies had many strengths, including large study population, prospective data collection and analysis, and long duration of follow up (20 years). A systematic review found the only difference is that the older patient group is more susceptible to dehydration post operation (65), this review included 12 recent studies. In conclusion, current literature has found increasing patient age is not associated with higher risk of post-operative complications.

**1.8 Functional outcomes**

Functional outcomes of the ileal pouch are an important aspect of life for patients after their IPAA operation. This is particularly relevant with the early age of onset of ulcerative colitis. After IPAA surgery, pouch function will have a significant and ongoing impact on quality of life and disability.

Commonly measured functional outcome end points in IPAA studies are: defaecation frequency in 24 hours, nocturnal defaecation frequency, day time leakage, night time leakage, urgency and ability to defer defaecation. New research has shown that incomplete evacuation is an emerging factor that has been identified as a significant contributor to pouch function (66, 67).

Reported mean stool frequency per 24 hours is consistent between many large international studies, and recorded to be between five to seven bowel motions per 24 hours (2, 42, 45, 47-49, 65, 68-72).

Daytime leakage is an important functional outcome. One Indian study reports daytime continence is perfect in 81% of IPAA patients. However, this study had major limitations, as it was a single centre study which only had 31 patients (72). Daytime leakage was reported
to be more common in patients over the age of 65, by a systematic review and a large prospective study (45, 65). Both of these studies had significant strengths in their research methods, study numbers, and length of follow up. An American study found that despite the fact incontinence is more common in older patients (p value = 0.002 at three years), “most patients felt that their condition had improved or that they had no restrictions after IPAA” (51). Strengths of this study is that it was a prospective study, involving a sizable study population of 2002 IPAA patients, and followed them up with the average duration of 10.1 years. Limitation of this study would be that it was a single centre study.

A recent, large, multi-centre UK study of 2491 patients, shows that nocturnal leakage was 8% at one year, rising to 15.4% after 20 years; urgency experienced in 5.1% at one year, rising to 9.1% after 15 years (48). These figures concur with other large studies and systematic reviews which surveyed the pouch function over a long period of follow up between 10 to 20 years, of which they all conclude that with the passage of time there is a notable increase of daytime and night time defaecation frequency, as well as nocturnal leakage and urgency (2, 43, 45, 47-49).

Despite the increase of defaecation frequency, leakage and urgency, 80%-90% of patients still report good functional outcomes, quality of life and satisfaction with their IPAA, and would recommend the surgery to others (2, 35, 36, 42, 45-48, 65, 72). Therefore, IPAA still remains a good surgical option for patients with ulcerative colitis, associated with a good quality of life, even for patients over the age of 65.

1.8.1 Sexual function

Many studies do not include sexual function as a common end point. However, of the few studies that did include this, they found that women after IPAA experience worse sexual function (69, 73-75). In particular, one multi-centre study of 255 females found that approximately 30% of women experiences worse sexual function after IPAA surgery, compared to those who didn’t have surgery (70). This was a well-designed prospective case-control study; however it was limited by its relatively small population size. Another study found 25.7% of men experienced retrograde ejaculation after IPAA surgery (74). However, this was a small, single centre study that only involved 59 male patients. Another study
showed that 36% of patients reported reduced or absent sexual activity, compared to 19% pre-operatively (76). This was again however, a small population study.

An Italian study of 205 patients with a follow up over 20 years, found that over time, sexual function declined during follow up (47). However, this finding could be biased and multifactorial, as sexual function in the general population also declines over time. Three further studies found that for the majority of IPAA patients, sexual satisfaction, desire, and coital frequency has either been maintained at the same level or it has improved after IPAA surgery (77-79).

It is difficult to come to a conclusion regarding sexual function and IPAA surgery, due to the fact most of the studies had significant limitations of study method, single centre, and a small study population. Therefore, it can only be suggested, that IPAA surgery may improve sexual function for the majority of patients, whilst worsen sexual function for others.

1.9 Quality of life

Quality of life (QoL), the patients’ perspective on their lives with the effects of the disease, has long been an important measure when evaluating the success of any treatment. This is especially important for inflammatory bowel disease as it is a chronic, debilitating disease with an early age of onset. The quality of life of a 20-year-old and how it might be for the rest of their lives, will impact immensely on their ability to obtain a job, work productively, create and maintain relationships, or have a family. Their contribution and integration with society rests on their quality of life.

Health Related Quality of Life (HRQoL) (4), and Quality-Adjusted Life Year (QALY) (80) are commonly used QoL measures. In 1989, McMaster University in Canada developed a questionnaire specifically for IBD patients - the Inflammatory Bowel Disease Questionnaire (IBDQ) (81). In 2000, a UK research team adapted the IBDQ to better fit the British population, and named it the UK IBDQ (82).
Quality of life research methods

Ideally, researchers would conduct randomised controlled trials that directly compare the quality of life of patients on medical therapy versus surgical treatment. However, it is difficult to compare these two groups due to the different disease severities of patients in each group. As a result, studies have attempted to address this gap in research by using analytic models (80). One such study was conducted by Park et al; it carried out 10,000 simulations via Markov analysis, and concludes that early colectomy in the severe disease group has less lifetime cost and more QALY when compared to persistent medical therapy (80). This study is then of course limited by the fact is was based purely on simulations.

Current research in this area is limited by the lack of direct comparison between medical and surgical treatment. The next best method is to compare QoL before and after IPAA surgery, or compare IPAA with matched controls from the general population; these methods are widely used in IPAA research.

1.9.1 Quality of life of patients with IPAA

Amongst current literature, there is conflicting evidence regarding the quality of life of patients with an ileal pouch-anal anastomosis (4, 6, 35-37, 83-87) in comparison to the general population. Research of both side of the debate are laid out below.

A large number of robust studies show that ileal pouch patients have a good quality of life that is comparable with the general population (6, 36, 37, 73, 74, 80, 83, 85, 86, 88-90). One such study is Heiken et al’s systematic review, which include 33 studies and 4790 patients with an ileal pouch. The reviewers conclude that the Health Related Quality of Life (HRQoL) of IPAA after 12 months post-operatively are indistinguishable from the HRQoL of the normal healthy population, and it improved QoL for patients compared to their QoL before the operation (86). However, this review does point out that it was limited by the poor quality of the majority of the studies it reviewed, only three studies were of what they referred to as ‘high quality’ (87).
These results are consistent with the findings of a large American study which shows that functional outcome and QoL are either good or excellent in patients with IPAA; concluding pouch surgery is an excellent option for IBD treatment (36). This study has many strengths, as it was a large, prospective study which involved 3707 pouch patients with an average follow up period of 87 months. The main limitation of note, is that it was an observational study, and did not have a control group to compare results with. Another study that supports this conclusion was by Heikens et al, it has sequential follow up of pouch patients post-operatively at 6, 12, 24 and 36 months. This study finds that QoL and health status increases after IPAA surgery and reaches levels comparable with those of the healthy reference population (37). However, this study has major limitations, as it only looked at 32 patients with IPAA and 30 controls. The small study population would be susceptible to selection bias, and the results would not have good statistical power.

Similarly, two other studies with matched controls reached the same conclusion (37, 85). One of these studies is a well-designed study with 370 patients, along with matched controls over a period of 15 years of follow up. Results show that pouch function positively correlates to QoL, and that those with good pouch function have the same QoL as the reference population. This study also shows that those with pouch failure have worse QoL when compared to both the group with good pouch function, and the reference population (85). This study had many strengths, with its robust method, moderate number of study participants with matched controls, and its long duration of follow up. The only limitation of note is that it was a single centre study, and its statistical power would be improved by a larger study population.

The study by Larson et al show that patients have better QoL, body image and sexual function post IPAA when compared to before IPAA surgery (74). This American study included 289 patients with IPAA, but was majorly limited by the fact that it had a poor response rate of 43%. This factor in itself would lead to a self-selected population, and therefore presents selection bias. Another study shows that the most important factors for QoL are health, family, restroom access, and friends (83). This was a prospective study that involved 369 IPAA patients, but was limited by its method of lack of control group for comparison.
Many studies, large and small, found that the improvement of QoL for IPAA patients is sustained long term (4, 6, 85, 90, 91). A study with 10 year follow up by Meyer et al found that greater than 85% of IPAA patients in the study has a good QoL (6). However, this study has many limitations, including small study number of 36 patients and lack of detail on the drop-out rate and length of follow up. In van Gennepp’s study, 72% were fully continent, 81% judged their QoL to be much better than prior to IPAA surgery, and 96% judged their satisfaction as “excellent” after five years post-surgery (90). This 2017 study compared 59 UC patients with 59 matched controls, with main limitations being small study population, and its limited response rate of 69%.

When asked if they would recommend this surgery to others, most of the patients said yes (6, 36, 37, 74, 86, 89, 90, 92). This question can be a fair indication of comparison of QoL before and after IPAA for each patient.

In contrast, fewer studies found the long term functional outcome and QoL of IPAA patients to be worse than the healthy reference population and other surgical groups (4, 35, 84, 93). One of these is a study which shows that 156 IPAA patients has a lower QoL than the general population (4). This study compared the 156 patients with 4152 of the general population, which was not matched-controlled, and had the drop-out rate of 29%. Both of these factors could lead to bias of results. Leowardi et al surveyed the long term functional outcome and QoL of patients with pouches, and finds that there is a decrease of 10.8% in QoL when compared to the healthy population (35). This study found the quality of life and functional results of patients who have had IPAA for 10 years or more are acceptable. However, QoL is lower than that of a healthy population (35). Strengths of this study was that it was a prospective cohort study of 197 patients with the median follow up period of 11.5 years. The limitations of this study must be noted that 29.6% did not respond to the survey, which could present as self-selection bias.

Current literature on quality of life of patients with IPAA shows a mixed conclusion; whilst a large number of studies find that patients with IPAA have a good quality of life that is comparable to those of the general population, other studies find patients with IPAA have a worse quality of life than the general population.
1.9.2 Risk factors for lower quality of life

Studies show there are independent risk factors that are likely to lower the quality of life of patients with IPAA (4, 50, 93). However, different studies report conflicting results on the effects of these factors on quality of life.

Poor pouch function has been shown to link to lower quality of life (4, 50). Andersson et al’s study shows independent factors for lower quality of life are incontinence, urgency, nocturnal frequency and pouchitis (4). This result is echoed by a large study of 4013 patients in UK with mean follow up period of 7 years, which shows that the main functional risk factors for lower quality of life are: frequency, urgency, incontinence and the use of medications (anti-diarrhoeals, antibiotics) (50). The strengths of this 2010 study is that it was prospective, included a large study population, and followed them up for the mean period of 7 years. Limitations would be its study method of a cohort study, which meant it didn’t have a control group to compare results to.

One study links poor pouch function with post-operative pelvic sepsis (92). One might believe that pelvic sepsis may be an independent risk factor for lower quality of life. Contrary to what one might assume, two different studies find that pelvic sepsis does not lead to lower quality of life (88, 92). Selvaggi et al shows that functional outcome does not correlate with the level of quality of life, which is satisfactory in 95% patients across the board, regardless of functional outcome and pelvic sepsis (92). However, the study was limited by the fact it was a single centre study with small numbers, where only 88 patients completed the study questionnaire.

One study researched patients whose pouch are salvaged despite septic complications, and finds that their quality of life is comparable to patient with IPAA without septic complications (88). Mennigan et al shows that 96% of patients with successful IPAA will achieve an adequate functional outcome and QoL (88). This was a German cohort study including 130 IPAA patients with the follow up period of one year, and drop-out rate of 31%. This study presents several limitations - it had a small study population, short duration of follow up, and a moderate drop-out rate.
A different risk factor that was reviewed, was the presence of pre-existing medical and psychiatric co-morbidities. One study reviewed the medical history of patients, and found that mental disorders, psychiatric and medical co-morbidities are risk factors for lower quality of life (93). This Germany study included 429 patients, however, it is likely to be limited by selection bias, as only 49% of the patients completed and returned the questionnaires.

Long term studies show that the functional outcome and quality of life remain stable over a long period of follow up (4, 35, 41, 83, 85, 91, 94, 95), despite certain factors worsening over time: bodily pain, physical health, and general health perception (95).

Current research of risk factors for lower quality of life show conflicting results. Some studies found that poor pouch function leads to lower quality of life, whilst others state that pouch function does not impact the level of quality of life. One area which the studies agree on, is that the level of quality of life remains stable over a long period of follow up.

1.9.3 Comparison of quality of life with other groups

IPAA versus ileostomy

For various reasons – whether it be disease severity or personal preference, patients sometimes choose to have an ileostomy over an IPAA. Studies compare the quality of life of patients with an IPAA to those with an ileostomy; these studies found that patients with an ileostomy have a similar quality of life to those with an ileal pouch (38, 96-98). In fact, one study shows that the quality of life of end ileostomy and IPAA patients are similar to the quality of life of the general population, using the SF36 Questionnaire (96). However, this was a small, single centre observational study which only included 49 patients. A systematic review by Murphy et al mirrored the same results. However, this review state that most of the studies are small, and of poor quality and statistical power (97). One study went further than showing the same level of quality of life between ileostomy and IPAA patients; it shows that IPAA patients have better body image, social and sexual function than those with an ileostomy (38). But once again, this study is limited by small study numbers of 35 patients with IPAA, and 24 patients with ileostomy.
In contrast, another study compared the quality of life of patients with Koch’s pouch, ileostomy and pelvic pouch; results show that pelvic pouch patients have the worst functional outcome out of the three groups (84). However, this study was limited by the small patient numbers of 11 Koch’s pouch, compared with 30 ileostomy and 30 IPAA.

There is limited research comparing the quality of life of patients with a IPAA to those with an ileostomy. The existing research found that patients with an IPAA have a similar level of quality of life, when compared with those with an ileostomy. Most of the studies had small study populations and were from a single centre, therefore, what conclusion that can be drawn from these studies have limited statistical significance.

**IPAA versus Medical therapy**

Making the comparison of quality of life between patients with an IPAA to those on medical therapy is important, as it will provide crucial information to patients and doctors to enable them to make better informed decisions for treatment. However, this can be a very difficult task; considering that the most common reason for elective IPAA surgery is disease resistant to medical therapy. This fact alone, indicates the vastly different disease severities of the two groups of patients. Therefore, the comparison between the two groups can be likened to comparing apples with oranges.

Nevertheless, one study explored the quality of life of UC patients receiving different therapies; it compared QoL results between patients on anti-TNF therapy, patients with an ileostomy and patients with an IPAA. Results show that there is no difference in the IBDQ score, but ileal pouch patients have a higher quality adjusted life-years (QALY) than patients with ileostomy and patients on anti-TNF therapy (98). This study had many strengths, it was a recent, large, prospective study which followed 915 patients with UC for over 2 years. However, it was limited by the fact that a much smaller pool of patients were actually compared (81 patients with IPAA and 24 patients on anti-TNF therapy). Similarly, another study shows that there is no difference in QoL and disability between the two groups, except for the fact that stool frequency is higher in the surgery group (5). However, this is a small study of 29 patients in each group, where they only included patients in medical clinical
remission, and surgical patients with no post-operative complications. This inclusion criteria can lead to selection bias, and will likely not be a true representative of the outcome in the whole patient group.

From the studies that attempted to compare quality of life between IPAA and medical therapy, they conclude that there is no difference in quality of life between the two groups. However, these studies are limited by their small population size and study methods.

**Quality of life in different ethnicities**

Inflammatory bowel disease has been shown to mostly affect the Caucasian population (3). All of the studies mentioned above are based on populations in Europe or North America, and these results do not necessarily apply to other ethnic populations. Therefore, a few studies that are conducted outside of Europe and North America deserve to be mentioned separately. One study in India shows that quality of life improves significantly from the score of 0.27 pre-operatively, to 0.77 post-operatively (the score of 1 is that of a healthy, normal person). All patients would choose IPAA again and 94% would recommend it to others. “IPAA provides good functional outcome and quality of life for Indians, as well as being culturally appropriate” (89). However, this was a small cross-sectional study that only had 31 study participants. Another study from Brazil had the same result, showing that most IPAA patients have good long-term quality of life and functional outcome that is comparable to the general population (6). Once again, this study was limited by its small study population of 36 patients.

The two studies above found that despite the lower incidence and prevalence of IBD in non-Caucasian groups; those with IBD who go on to have an IPAA, have a good quality of life and functional outcome that is comparable to the general population. However, both of these studies were of poor statistical significance, due to the limitation of small study populations.

**1.9.4 Quality of life conclusion**

Quality of life after IPAA is an important research topic due to the early age of onset of IBD. The literature on this topic presents conflicting views and results. A large number of studies
find long term QoL of pouch patients is comparable to the general healthy population (6, 36, 37, 73, 74, 80, 85, 86, 88, 89), whilst other studies find long term QoL of IPAA patients to be worse than the general population (4, 35, 84). Large number of these studies were small and of a retrospective nature, whilst others had more strength in their methodology. More research is needed in this area to reach further conclusions.

1.10 Disability

Disability, as defined by WHO, is the “human experience of impaired body functions and structures, activity limitations, and participation restrictions in the interaction with environmental factors” (99). Unlike quality of life, which is subjective, disability is an objective measure of the effects of disease. Disability refers to an individual’s inability to perform a task successfully, such as if a task required more effort or time than it would otherwise. Disability includes problems that are experienced in different areas or health domains, whereas quality of life refers to how the individual feels about these limitations and restrictions (100).

Many experts believe that disability, an objective measure of disease impact, provides more accurate information than a subjective measure such as quality of life. This information will then be used to make better informed treatment decisions. Due to the fact that IBD is a chronic, life-long disease with an early age of onset, it is important that disability is measured in this population. Researchers around the world are realising the importance of using disability as an outcome measure, and there are an increasing number of studies using disability as an endpoint.

A large number of studies have attempted to assess the level of disability associated with IPAA and IBD. However, due to the lack of an internationally recognized tool for the measurement of disability, results have been found to vary widely between different studies conducted in different centres and countries (32, 101-103).

Peyrin-Biroulet and his colleagues saw that there was a need for an internationally recognized tool to measure disability in the IBD population, and developed the Inflammatory Bowel Disease Disability Index (IBD-DI) (100). Careful steps were taken to ensure that it will
be a comprehensive index, by using the International Classification of Functioning, Disability and Health (ICF) from the World Health Organization (WHO) as a guideline for inclusion of health domains specific to IBD. Four studies (systematic review, qualitative study, expert survey and cross-sectional study) were carried out in order to ascertain which ICF classifications are most relevant to IBD, before using these classifications to develop the IBD-DI (100). The consensus conference included 20 IBD experts from 17 countries and led to the selection of 19 ICF core set categories that were used to develop the IBD-DI (101). The authors of this study self-identified some limitations of the development of the IBD-DI; samples of the qualitative studies consisted of persons from USA and France, this may have lead to selection bias and influenced the results of both studies (101).

The IBD-DI was validated in 2013 by Leong et al, and was found to be both reproducible and reliable. The study recruited 166 consecutive subjects (75 CD, 41 UC, 50 controls), and found that the IBD-DI differentiated between CD, UC and controls (medians -7, -4, +10; p-value < 0.001) with a score of >3.5 identifying controls with 94% sensitivity and 83% specificity. This study found IBD-DI correlated well to quality of life measures, changes in disease activity, unemployment and work absenteeism (104). Validation tests were carried out independently to the authors of the IBD-DI to ensure objectivity and to remove conflict of interest (105). IBD-DI was found to be a valid tool in measuring disability in IBD. However, the authors of the study did find that language simplication may make it easier for participants to complete. The IBD-DI is currently designed to be carried out via face-to-face questionnaire; self-administration would be more user friendly, but it would require further validation (105).

1.10.1 IBD and disability

Research shows that IBD patients experience a greater level of disability compare to the general population or other chronic illness (16, 87, 101, 105-107). A high level of disability has a significant economic impact, especially as IBD is a chronic illness with highest age of onset in the second and third decade, thus affecting the productive years of the patients’ lives, and therefore society as a whole. A systematic review in 2013 finds that IBD patients have a two-fold increase in work disability compare to the general population, with work
disability being worst in the young population (101). However, this review did not state its inclusion and exclusion criteria, nor its method of critical analysis of the studies.

One study that supports this conclusion, is a case-control study conducted by Boonen et al. This study finds that patients with IBD are less likely to have full time employment, more likely to have sick leave and days off, and have chronic work disability in comparison to the healthy population cohort. It shows that work disability is highest in the younger and more highly educated group of IBD patients (107). This study has many strengths, as it was a large prospective case-control study with 1395 study participants. It was however, limited by the poor response rate of the control group, only 48% returned the questionnaires. A cohort study came to similar conclusions; it found unemployment rate in IBD is higher than baseline population (105). This prospective cohort study in Norway included 495 participants, and followed them up for the duration of five years.

This result was echoed in a study by Hovik et al, which reported the results of the IBSEN study with 518 patients over 10 years of follow up. They found that IBD patients has the relative risk of 1.8 (UC) and 2.0 (CD) for work disability compared with the baseline population, with the youngest patients having the highest relative risk (106). The strengths of this study is that it was a prospective study with large study population of 518 patients, followed up over 10 years, with the low drop-out rate of 16.5%.

Another study reports that IBD patients are three times more likely to report reduced activity than the control group, but note that the employment rate is the same in both groups. This study also found that although IBD affects work quality and activities in daily life, IBD patients experience a similar amount of stress as the control group; in fact, IBD group has greater social support in place than the control group (108). This 2008 Canadian study was a cohort study of 388 participants with IBD, and compared the results to 2099 participants who were ‘matched community comparisons’. One limitation of this study is that it only included patients who were diagnosed with IBD less than seven years ago. This may give a biased/skewed view of the long term results of those with IBD.

Rubin et al found that when compared with other chronic illness cohorts, patients with UC perceive their disease more negatively, especially with regard to the psychological burden
(87). However, the survey that was used in this study was developed by the authors, and was not validated before its use. This study may suffer from selection bias as the cohort is of participants who self-selected for participation of the online surveys.

Several studies find certain factors independently attribute to an increase in disability for IBD patients (18, 109). A large study of 942 participants by Van der Valk shows that out of the 17% of UC patients who are chronically disabled, being older than 40 is a risk factor (110). This study had the strength of large study numbers, as well as the fact participants were followed up for two years. One could argue that its limitation could be that participants should be followed up for a longer period of time for a more accurate picture of the long term impact of illness. Naim et al looked at the association between out of pocket (OOP) costs and disability/morbidity of IBD patients. Higher monthly OOP costs are associated with higher work impairment and lower productivity; 13% of IBD patients in this study are on short and long term disability pension and the overall work impairment is between 10%-40% (109). This was an American cross-sectional study of 534 participants. It has the strength of large study population, but it is limited by its study method of a cross-sectional analysis, as a snapshot in time could present various bias and confounders.

In conclusion, IBD is associated with high level of disability, work disability and unemployment when compared to the general population. This has a significant economic impact, as most IBD diagnosis is made in the second and third decade of life.

1.10.2 IPAA and disability

Disability as an objective measure of the impact of disease is a new concept. At the time of the IPAA study commencement in 2013, there were no published international studies which measured the level of disability associated with IPAA. The IBD-DI, a new internationally standardized tool to assess disability levels, has not yet been applied to patients with IPAA.

The literature review did reveal a few small, historic studies which attempt to measure the level of disability associated with IPAA. One study in 1996 compare the cost, morbidity and disability between 20 patients receiving medical treatment versus 20 patients receiving surgical treatment. This study defined and measured disability as “total amount of time
(determined by the patient in a telephone interview) accumulated before returning to routine activities with an acceptable (to the patient) quality of life”. Unfortunately, this definition and method is flawed as it depended on what each individual patient defined as “acceptable quality of life”, which meant it created a subjective measure, rather than the objective measure which disability is meant to be (111). This was a small study that was qualitative rather than quantitative.

Other studies defined and measured disability with factors such as the amount of sick leave from work, ability to return to work, and whether or not they are on the disability pension/benefit (46, 68). These endpoints are more fitting with work disability, rather than true disability. These studies highlight the fact that the lack of an internationally standardised definition and measuring tool for disability during this time, is hindering efforts in measuring disability associated with IPAA across the world.

Since then, the IBD-DI was created in 2012 by Peyrin-Biroulet et al and subsequently validated in 2013 (100, 104). With the introduction of the IBD-DI, it is important to apply this to IBD and IPAA patients internationally, which will provide new information on disability that has not been previously available and enable comparison of results.

1.11 Costs

Cost and cost-effectiveness of treatments are essential to delegation of health resources in any health system. This is particularly important when it comes to treating inflammatory bowel disease, with patients requiring ongoing treatment for the rest of their lives. IBD is a debilitating disease and has a large impact on patients and their ability to work, especially during the most productive years of life. These factors regarding IBD contribute towards its high economic burden on society.

Costs can be divided into direct and indirect costs. Direct costs are costs associated directly with medical or surgical treatment at the hospital. Indirect costs are costs outside the hospital, and can include anything from GP visits, prescriptions, loss of work productivity, sick days from work, and redundancy. Due to the vast range of costs that indirect cost can include, the true extent of indirect costs is often underestimated.
Cost-effectiveness can be measured in Quality-Adjusted Life Year (QALY); this is a way to quantify the improvement of quality of life in relation to costs. Effective treatments will aid patients in improving their physical condition and ability to work.

1.11.1 Direct Costs

Research in this area is important, particularly in this current era of expensive biologic treatments. Biologics has been shown to reduce hospitalisations, surgeries, outpatient visits, improve quality of life, and reduce indirect costs, but it can contribute to significant costs (112). However, there are conflicting literature results when it comes to comparing direct cost of surgical treatments against medical treatments.

A few studies show that surgical treatments are more expensive than medical treatments alone (113-115). One study of 540 privately insured patients show the estimated surgical costs from day of surgery to 180 days post-op, is USD$90,445 (114). However, this is information obtained solely from privately insured patients, which might not represent the general population. A large study of 948 patients by Odes et al, shows that surgery is the most expensive treatment, followed by drug-responsive hospitalisations (115). Despite the strength of this study due to its large study population, the study’s limitations must be noted as well. Much of the data from this study was acquired using Markov model analysis and algorithms, this naturally reduces the power of their findings.

In contrast, the majority of the studies show that medical treatments are more expensive compared to surgical treatments (80, 98, 111, 116-118). A review by Lee at al shows that Infliximab is only cost-effective if you work from the point of view of USD$100,000/QALY gained. This review conclude that surgical treatment is better than medical therapy when it comes to costs and QALY gained in the long run, despite the initial expenses encountered immediately post-operatively (118). However, it must be noted that this review was not a systematic review, which can lead to selection and information bias.

One study utilised a different method of comparison, it retrospectively studied 60 patients for two years before surgery, and followed them up for two years post-operatively. This
method would remove many of the biases that are encountered when comparing medical groups with surgical groups, in particular the issue of differing disease severity in the two groups. The results from this study shows that the costs of the post-op period are USD$9,296 cheaper than the pre-operative period (116). This study is limited by its small study population number and retrospective nature in the methodology.

Due to the difficulties of comparing the medical and surgical patient groups, some studies used the Markov analysis method to simulate the costs and cost-effectiveness of medical and surgical treatments. One study ran one-year cycles with 20 stages. It suggests that IPAA is more cost-effective, with more QALYs gained, than biologic treatments (117). However, the absolute difference between the two groups is quite small, and the results should be interpreted with caution. Another simulation study which ran 10,000 simulation cycles using Markov model analysis, shows that early colectomy has less lifetime cost, and more QALY gained. This study conclude that early colectomy is more cost-effective, particularly in the severe disease group (80). However, results from Markov model analysis remains to be simulations, and not data from real life research; this significantly decreases the power of the study’s findings.

To add to the contrasting results of research on IPAA cost, some studies show that there is no statistically significant difference between the costs of surgical and medical therapy (111, 119). Sher et al shows that there is no difference in cost or disability between the medical and surgical group. However, the surgical group has lower morbidity than the medical group. This study goes on to conclude that patients with severe enough disease to warrant hospitalisation, should be offered the opportunity to have an IPAA (111). Limitations of this study is that it is an older study that was carried out in 1996, and had the small study population of 40 patients.

Whilst the majority of studies compared the direct costs between medical and surgical treatment, other studies looked into the main drivers of these costs (101, 119). One study shows that the driver of increased cost in the medical group is disease severity, and in the surgical group – pouchitis and permanent ileostomy increased costs (119). This cohort study followed up 120 patients for two years. A large systematic review in 2013 shows that hospitalisation, medications and surgery were the main drivers of costs (101). However,
limitations of this study is that this European systematic review did not state in their methods their search process, inclusion and exclusion criteria, nor methods of critical analysis.

In conclusion, current research on the direct costs of surgical and medical UC treatment shows conflicting results. Some studies show that medical treatment is more cost-effective, whilst others show that surgical treatment is more cost-effective. Some studies show there is no difference between the two, whilst others pursued the drivers behind the costs. However, it must be taken into account that the disparity in cost results between different countries are likely due to the differing study methods and outcome measures. The only conclusion that can be gained is that more research is needed in this area, especially studies with standardised methods of evaluating costs.

1.1.1.2 Indirect Costs

Indirect costs can be difficult to measure, and even more difficult to compare between studies as there is no standard method on this topic. Some research in this area focus on costs associated with work absenteeism due to disease severity. In one study, 28.9% reported work absenteeism in the IBD group, compared with only 18.5% in the non-IBD group (16). This is a large cohort study carried out in 2003, including 187 in the IBD group, and 10,707 in the control group. The large study population adds to the strengths of this study.

The average indirect costs per year (from work absenteeism) ranged from CAD$868 to €6,821 in different studies (16, 110, 120). A systematic review on absenteeism, presenteeism and loss of leisure reviewed 14 articles, and conclude that it is difficult to compare studies due to lack of standard method and analysis on this topic (121). This is a Canadian systematic review carried out in 2010, which did not include in their methodology the selection process, inclusion and exclusion criteria, nor method of critical analysis.

Despite the difficulty in measuring indirect cost, it is a cost that should not be underestimated. Two studies show that indirect costs can be as high as one-third of total costs (110, 121). One of these studies is by Van Der Valk et al, its strength is that it is a large
study that contained study population of 2554 patients and followed them up for two years (111). Its limitations are the methodology, as it was a cohort study, and not randomised controlled trial or case control study.

In conclusion, current research shows no consensus on the indirect costs associated with IBD. This is due to the lack of standardised method of data collection and analysis, which makes comparing results nearly impossible. However, indirect costs can account for as much as one-third of all costs. This makes indirect costs an important issue that requires further research, especially the need for a standardised method of measurement.

1.12 Conclusion and future research

There is well-documented research on IBD background, treatment options, indications for IPAA surgery, and IPAA complications. However, current literature presents conflicting information and insufficient research regarding IPAA and quality of life, sexual function, disability, work disability, costs and comparisons with medical therapy.

This study aims to address these unanswered questions in current research by conducting a population based study of IPAA patients in Canterbury with long term follow up, in order to determine the following:

1. Surgical complications
   a. Short term complications with records from primary and tertiary care
   b. Long term complications with comprehensive follow up through the hospital, outpatients, and primary care records
2. Functional outcomes
3. Quality of life
   a. Utilising standardised international questionnaires – SF36 and IBDQ
4. Disability
   a. Be the first to use the IBD-DI to assess the level of disability in an IPAA population
   b. Calculate the correlation between IBDQ and IBD-DI
   c. Work and education disability
5. Comparison of quality of life and disability data to medically treated UC patients in Sydney

6. Costs
   a. Direct costs
   b. Indirect costs – including costs from work absenteeism, loss of work productivity, alternative health resources, travel, prescriptions, tutor and cares
   c. Total costs

The hypothesis of this study is that the Canterbury IPAA population will have comparable early and late complication rates, functional outcome, quality of life and costs with international data; and that the level of disability experienced in this population will be lower than a medically treated UC patient cohort in Sydney.

This study will be the first to use the IBD-DI in an IPAA population, providing important information for comparisons of level of disability with other treatment groups. The information gathered from this study will be important for patients, clinicians and health funders to make informed decisions on UC treatments.
Chapter 2. Methods

2.1 Population cohort

This population based cohort study aimed to recruit all patients with an Ileal Pouch-Anal Anastomosis (IPAA) in the Canterbury region. For the purpose of this study, this included all patients who underwent IPAA surgery in Canterbury as well as patients who had IPAA surgery outside of Canterbury and later moved to the Canterbury region.

After the February 2011 earthquake in Christchurch, many of those who had IPAA surgery in Canterbury relocated elsewhere in New Zealand. The investigators of this study decided to include these patients as eligible participants for the purpose of this study.

2.1.1 The Canterbury region, New Zealand

Canterbury is New Zealand's largest geographical region, with an area of 45,346 km² (122). Its borders are the Conway River to the North, the Southern Alps to the west, and the Waitaki River to the south. The population of the Canterbury region is 558,800 (June 2012 estimate) (123), making it the largest region in the South Island and the second largest region in New Zealand by population.

Figure 2.1 - The Canterbury Region, New Zealand (122)
2.2 Inclusion and Exclusion criteria

**Inclusion criteria**

- They underwent IPAA surgery for the indications below
- They had IPAA surgery between 1984 and 2013
- They had ileostomy taken down prior to 1st June 2013
- They currently live in Canterbury but had IPAA surgery elsewhere, or they underwent IPAA surgery in Canterbury but later moved elsewhere, or they had IPAA surgery in Canterbury and still live in Canterbury
- They were over the age of 16
- They wished to participate in the study

**Indications that warranted inclusion**

- Ulcerative Colitis
- Crohn’s Disease
- Indeterminate colitis
- Collagenous colitis
- Familial Adenomatous Polyposis (FAP)
- MYH Associated Polyposis Syndrome (MAP)
- Lynch Syndrome

**Exclusion criteria**

- The indication for IPAA was other than those listed in the above list
- They did not have IPAA surgery in Canterbury and do not currently reside in Canterbury
- They were deceased
- They were less than 16 years of age
- On review, they did not undergo IPAA surgery
- They did not wish to participate in the study
2.3 Recruitment

Eligible participants for this study were identified using a multi-faceted approach to ensure all patients who had IPAA surgery in Canterbury between 1984 and 2013 were considered. Participants were recruited from the following sources:

Christchurch Public Hospital - All Australian classification of health interventions (ACHI) procedural codes associated with IPAA were identified through the Clinical Coding Department of Canterbury District Health Board (CDHB). All relevant ACHI procedural codes were applied in a search of the Christchurch Public Hospital theatre records and coding database to identify all IPAA procedures that were performed from 1984 to 2013.

Table 2.1 - ACHI procedural codes associated with IPAA in CDHB

<table>
<thead>
<tr>
<th>Block code</th>
<th>Clinical code</th>
<th>Clinical code full description</th>
</tr>
</thead>
<tbody>
<tr>
<td>934</td>
<td>3205100</td>
<td>Total proctocolectomy with ileo-anal anastomosis</td>
</tr>
<tr>
<td>936</td>
<td>3205100</td>
<td>Total proctocolectomy with ileo-anal anastomosis</td>
</tr>
<tr>
<td>934</td>
<td>3205101</td>
<td>Total proctocolectomy with ileo-anal anastomosis and formation of temporary ileostomy</td>
</tr>
<tr>
<td>934</td>
<td>3205101</td>
<td>Total proctocolectomy with ileo-anal anastomosis and formation of temp</td>
</tr>
<tr>
<td>936</td>
<td>3205101</td>
<td>Total proctocolectomy with ileo-anal anastomosis and formation of temporary ileostomy</td>
</tr>
<tr>
<td>934</td>
<td>3205102</td>
<td>Total proctocolectomy with ileorectal anastomosis</td>
</tr>
<tr>
<td>934</td>
<td>3205103</td>
<td>Total proctocolectomy with ileorectal anastomosis and formation of temporary ileostomy</td>
</tr>
<tr>
<td>934</td>
<td>3205103</td>
<td>Total proctocolectomy with ileorectal anastomosis and formation of temp</td>
</tr>
<tr>
<td>934</td>
<td>3206000</td>
<td>Restorative proctectomy</td>
</tr>
</tbody>
</table>
Colorectal surgeons - The surgical paper records of Christchurch Public Hospital colorectal surgeons were searched manually for IPAA procedures that were performed during the study period.

Canterbury private hospitals - The Christchurch private hospitals’ patient databases were accessed and searched for patients who underwent IPAA surgery during the study period.

The Canterbury IBD clinical database (124)- Professor Richard Gearry established the Canterbury IBD Clinical Database in 2006; this database was accessed and searched for all IBD patients with an IPAA from 2006 to 2013.

Referrals - Colleagues in the gastroenterology and colorectal surgery departments were made aware of this study and its aim to recruit all IPAA patients in Canterbury. Subsequently, colleagues have identified and referred eligible participants for this study.

Self-referrals - Patients were able to enter the study through self-referral. Advertisements with details of the study and contact details of the investigators were presented in several locations: three different waiting rooms of Christchurch Hagley Outpatients, the waiting room of Christchurch Colorectal private clinic, and the Facebook page of Crohn’s and Colitis, New Zealand.

Local support group meetings - One of the investigators of this study attended the annual Canterbury Crohn’s and Colitis meeting in May 2013, and gave a brief presentation about the study. This presentation included contact details of the investigators of this study, for those who might be eligible and interested in participating.

2.4 Consent

Consenting for participation in this study involved agreeing to complete four questionnaires and allowing investigators of this study to access medical and costs records for IPAA indication, outcomes and cost data.
All eligible participants were sent an invitation letter to join the study, along with an information sheet, consent form, questionnaire preference form and a self-addressed return envelope. Two weeks after the invitation letters were posted, follow up phone calls were made to eligible participants who did not respond to the letter. The investigator who made the phone call checked with the eligible participant whether or not they had received the invitation letter. If the letter was received, they were asked if they would like to participate in the study.

A number of eligible participants had relocated after the Christchurch February 2011 earthquake and required an invitation letter to be sent to their new address. For those who declined to participate in the study, this was noted and they were excluded from the study.

2.5 Data Collection

This study collected the following information from its participants:

- Indication for IPAA surgery
- Long term complications and outcomes
- Quality of life (SF36 and IBDQ questionnaire)
- Disability (IBD-DI)
- Direct costs
- Indirect costs

**Indications, surgical outcomes and complications** - Participants’ medical records were accessed from primary care, private and public outpatient clinics and all private and public inpatient episodes from the point of colectomy to the end of the study period. Demographic data, outcomes, details of surgical and on-going medical treatment and complications were collected by reviewing these records.

**Quality of life, disability and indirect costs** - Participants were contacted and asked to answer the following questionnaires regarding information about their quality of life, disability, and indirect costs associated with having an IPAA:
• Inflammatory Bowel Disease Questionnaire (IBDQ)
• Short Form 36 Health Survey (SF36)
• Inflammatory Bowel Disease Disability Index (IBD-DI)
• Indirect Costs Questionnaire

Participants were given the option to complete the questionnaires as a structured interview, a phone interview, on paper, or online. The only exception to this was the Inflammatory Bowel Disease Disability Index (IBD-DI), as the IBD-DI was designed to be carried out in an interview and had not yet been validated for self-reporting. Therefore, the IBD-DI was administered in either a face-to-face interview; or a phone interview, depending on the participant’s preference.

Online questionnaires were collected by using Question Pro, and data was entered into an excel database, before exporting it to SPSS for data analysis.

Sydney data - The Canterbury Ileal Pouch study was fortunate in that we were able to collaborate with the Sydney study that was being carried out concurrently at the time. The Sydney data was collected by the research team under Professor Rupert Leong, whom collected the IBDQ score and the IBD-DI score of their participants. As both the Sydney study and the Canterbury study utilised identical questionnaires, we were able to compare and contrast the results.

Indirect costs - For the purpose of this study, indirect costs refers to money that was lost due to associated symptoms or complications from their IPAA surgery which resulted in:

• Work or school absenteeism
• Loss of work productivity
• Use of alternative or complementary health resources for associated symptoms
• Travel to attend appointments or treatment
• Carers for themselves or others in their care
• Tutors
• Additional phone or internet requirements
This information was collected by using a questionnaire which one of the investigators of the study developed - the Indirect Costs Questionnaire. In the questionnaire, participants were asked to estimate their indirect costs associated with symptoms or complications from their IPAA surgery over the last 12 months. Participants were also offered the opportunity to nominate other costs that were not mentioned in the questionnaire.

Indirect costs that were incurred through work absenteeism as a result of illness were calculated by the human capital method as described by Drummond et al (125). In this method, participants were asked the number of days they had off work as either unpaid or annual leave related to IPAA, which was then transferred into hours off work and multiplied by their gross hourly wage. For those patients not in work their indirect costs are discussed descriptively as monetary values.

**Direct costs** – Annual direct cost from 2006/07 financial year to 2012/13 financial year. Data on long term direct costs associated with having an IPAA was collected from several sources: Christchurch Public Hospital, private hospitals in Canterbury, primary care, and PHARMAC. Details of each source is as below:

Christchurch Public Hospital - The costs of hospital resources were determined through the Costing Department of the Canterbury District Health Board (CDHB) and the Ministry of Health. These costs were calculated by using DRG codes, which is a unique code assigned to the patient each time they visited the hospital for either inpatient or outpatient visits. A different code is given for each service required during each visit, and the total cost for each visit was calculated accordingly. The investigators of this study have obtained all the codes and costs accrued by the patients from the CDHB Decision Support Department and Costing Department from the beginning of the 2006/7 financial year. Data prior to this financial year was unfortunately not available in the digital system.

Christchurch private hospitals - A number of the participants in the study had their IPAA, day procedures and outpatient clinics carried out in the private sector. Private hospitals were approached for all hospital costs associated with IPAA for each participant.
In the private system in Christchurch, surgeons and anaesthetists charge for fees independently of the general private hospital costs. An inflation adjusted fee estimate was applied to all participants who had surgery in the private sector.

Christchurch primary care practices - For primary care cost, it was assumed that all patients were enrolled in a Primary Health Organisation (PHO). The New Zealand Government provides subsidies to lower the cost of general practitioner (GP) visits for eligible patients that are enrolled in a PHO. The cost of GP services was estimated using the average cost of an appointment by age as obtained from Pegasus Health PHO and the 2012 yearly capitation rates provided by the Government. The capitation rates took into account whether or not the patient had a high user health card (HUHC).

Pharmaceuticals - Pharmaceutical costs that were related to symptoms and complications from their IPAA were calculated from the cost to the Pharmaceutical Management Agency in New Zealand (PHARMAC) provided by their pharmaceutical schedule. Additionally, a 4% mark-up was added to pharmaceutical costs plus a NZD$5.80 dispensing fee attributable to pharmacists. The co-payments paid by the patient were a transfer, not a cost; therefore these were not included.

**Total average cost** - The average cost of all the participants’ direct and indirect costs over the past 12 months.

### 2.6 Statistical analysis methods

Each variable of the data was first analysed descriptively using frequencies, means, medians, confidence intervals, standard deviation, range of scores, skewness and kurtosis, dependent on whether the variable was categorical or continuous. Scatter plots and other graphs were then drawn to establish the relationship between variables before further data analysis. Correlation and comparisons were made using the following tests where appropriate: Pearson product-moment correlation coefficient, multiple regression analysis, Chi-square test, and paired T-tests. Results were considered statistically significant if $p$ value $<$0.05. Paired T-tests were carried out for comparison between Canterbury and Sydney cohort.
Chapter 3. Results

3.1 Participant identification

Eligible participants for this study were identified using a multi-faceted approach as stated in the methods.

Christchurch Public Hospital - All relevant ACHI procedural codes were applied in a search through the Christchurch Public Hospital theatre records and coding database to identify all IPAA procedures that were performed from 1984 onwards. However, data prior to 1997 was not available on the system. This search yielded 98 possible eligible participants for the study. After application of the study criteria, 46 were excluded as they did not have an IPAA, and three were excluded as they were deceased.

Miscoding in the Christchurch public system - The search through clinical coding records for IPAA patients revealed a considerable amount of miscoded data within the Christchurch Public Hospital system. Out of the 98 cases identified by ACHI procedural coding, 46 were incorrectly coded; which meant that only 52% of the data was correctly coded in the results of this search. Most of the miscoded cases were colorectal malignancies which resulted in an anterior resection; no IPAA were formed in these cases despite it being coded as an IPAA.

Christchurch Colorectal surgeons - The Colorectal Surgery Department of Christchurch Public Hospital keeps a hard copy of all operation notes performed by the colorectal surgeons. These operation records were searched manually for IPAA surgery that was performed in the study period.

This search yielded 31 possible eligible participants for the study; none of whom were excluded after application of the study criteria.

Christchurch private hospitals - There are two private hospitals with operating capacity in Canterbury: Southern Cross Hospital and St. George’s Hospital. Managers from these two hospitals were approached with information and ethical approval of this study. The
Christchurch private hospitals’ patient databases were accessed and searched for IPAA procedures that were performed. Data was only available from 2006 onwards.

Seven possible participants were identified by Southern Cross Hospital, and nine possible participants were identified by St George’s Hospital. After application of the study criteria, four patients were noted to have already been identified for the study by previous search methods, and three patients were excluded as they either did not have IBD, or did not have an IPAA.

**Canterbury IBD clinical database** - Associate Professor Richard Gearry established the Canterbury IBD Clinical Database (124) in 2006; this database was accessed and searched for all IBD patients with an IPAA. From this database, 43 possible eligible participants were identified. One patient was noted to have already been identified for the study by previous search methods.

**Referrals** - Three possible eligible participants were identified via referral from colleagues in the Gastroenterology Department and Colorectal Surgery Department. None of these patients were excluded after application of the study criteria.

**Self-referrals** - Five patients self-referred for the study, three were excluded upon application of the study criteria as they did not have an IPAA.

**Possible eligible patients** - Through the various approaches in identification of all patients with IPAA in Canterbury, the final number of possible eligible participants for this study was 136.

### 3.2 Participant recruitment

**Contact rate** - The 136 patients in Canterbury with IPAA were first contacted with a study invitation letter, then a follow up phone call. Out of the 136 patients, eight were deceased, four had yet to have their stoma taken down, and 29 were unable to be contacted via mail and telephone. The white pages were searched in an attempt to get in contact with these
eligible participants, but this did not yield any results. This left us with 95 possible eligible participants for the study.

**Participation rate** - Out of the 95 possible eligible participants that were able to be contacted for the study, 86 (91%) agreed to participate in the study, while nine declined participation.

**Figure 3.1 - Patient identification and recruitment**

**Completion of questionnaire and data availability** - From the 86 participants in the study: 86 completed the Short Form 36 Health Survey, 81 completed the Inflammatory Bowel Disease Questionnaire, 84 completed the Inflammatory Bowel Disease Disability Index, and 85 completed the Indirect Cost Questionnaire. Clinical data was available for all 86 participants.
Table 3.1 - Data availability

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
</tr>
<tr>
<td></td>
<td>(Percentage)</td>
</tr>
<tr>
<td>SF36</td>
<td>86 (100)</td>
</tr>
<tr>
<td>IBDQ</td>
<td>81 (94.2)</td>
</tr>
<tr>
<td>IBD-DI</td>
<td>84 (97.7)</td>
</tr>
<tr>
<td>Indirect Cost Questionnaire</td>
<td>85 (98.8)</td>
</tr>
<tr>
<td>Clinical data</td>
<td>86 (100)</td>
</tr>
<tr>
<td>Primary care data</td>
<td>86 (100)</td>
</tr>
<tr>
<td>Hospital costs data</td>
<td>86 (100)</td>
</tr>
<tr>
<td>All data</td>
<td>81 (94.2)</td>
</tr>
</tbody>
</table>

3.3 Participant demographics

Table 3.2 - Participant demographics

<table>
<thead>
<tr>
<th>Participant characteristics (n=86)</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38 (44.2)</td>
</tr>
<tr>
<td>Male</td>
<td>48 (55.8)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>NZ European/Pakeha</td>
<td>72 (83.7)</td>
</tr>
<tr>
<td>Other European</td>
<td>5 (5.8)</td>
</tr>
<tr>
<td>NZ Maori</td>
<td>2 (2.3)</td>
</tr>
<tr>
<td>Other/Not stated</td>
<td>7 (8.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participant characteristics (n=86)</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>51.1 (12.9)</td>
</tr>
<tr>
<td>Age at surgery</td>
<td>40.1 (12.0)</td>
</tr>
<tr>
<td>Number of years since surgery</td>
<td>11.5 (7.1)</td>
</tr>
<tr>
<td>BMI</td>
<td>25.9 (4.4)</td>
</tr>
</tbody>
</table>
Out of the 86 study participants, 38 were female and 48 were male. The ethnicities of the study participants were split into New Zealand European/Pakeha, Other European, New Zealand Maori, other, or not stated. There were 72 participants that identified as New Zealand European/Pakeha; five participants identified as other European; two participants identified as New Zealand Maori; seven participants identified as other or it was not stated.

The mean age of participants was 51.1 years old, with the oldest participant being 77, and the youngest being 18. The average age at surgery was 40.1 years old, with the youngest age at surgery being 16, and the oldest age at surgery being 65. The years of retrospective follow up range from 0 to 43 years, with the average follow up being 11.5 years. Participants’ average BMI was 25.9 (4.4).

The indications were divided into acute or elective. Indications for acute or emergency surgery were: fulminant colitis, haemorrhage, perforation, toxic megacolon, or obstruction. Indications for elective surgery were: failure of medical therapy, dysplasia, intolerable side effect of medical therapy, intractable chronic disease, familial adenomatous polyposis (FAP) or Lynch syndrome.

Participants were identified and grouped by their disease type. The type of diseases that were included in the study were: ulcerative colitis, Crohn’s disease, indeterminate colitis, familial adenomatous polyposis, FAP or other.

<table>
<thead>
<tr>
<th>Disease Type</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulcerative colitis</td>
<td>67 (79.8)</td>
</tr>
<tr>
<td>Crohn’s disease</td>
<td>8 (9.5)</td>
</tr>
<tr>
<td>Indeterminate colitis</td>
<td>2 (2.4)</td>
</tr>
<tr>
<td>FAP</td>
<td>7 (8.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical Indications</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed medical therapy</td>
<td>55 (65.5)</td>
</tr>
<tr>
<td>Fulminant colitis</td>
<td>12 (14.3)</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>6 (7.1)</td>
</tr>
</tbody>
</table>
3.4 Surgical complications

Surgical complications were split into early (<30 days after IPAA surgery), or late (>30 days after IPAA surgery). Early complications that were identified were: haemorrhage requiring transfusion, wound infection, pelvic sepsis, gastrointestinal obstruction and medical complications. Late complications that were identified were: gastrointestinal obstruction, acute pouchitis, chronic pouchitis, incisional hernia, peri-anal disease (including peri-anal fistula, abscess, anal stenosis and strictures), pouch failure and other complications. Data on long term outcomes and complications of participants were determined by assessing medical records from hospitals and general practices.

Table 3.4 – Complications

<table>
<thead>
<tr>
<th>Early complications (≤30 days after RP with IPAA)</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemorrhage requiring transfusion</td>
<td>8 (9.6)</td>
</tr>
<tr>
<td>Wound infection</td>
<td>7 (8.4)</td>
</tr>
<tr>
<td>Pelvic sepsis</td>
<td>7 (8.4)</td>
</tr>
<tr>
<td>Small bowel obstruction</td>
<td>4 (4.8)</td>
</tr>
<tr>
<td>Any early complications</td>
<td>20 (24.1)</td>
</tr>
<tr>
<td>No early complications</td>
<td>63 (75.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Late complications (&gt;30 days after RP with IPAA)</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small bowel obstruction</td>
<td>36 (42.9)</td>
</tr>
<tr>
<td>Pouchitis</td>
<td>49 (58.3)</td>
</tr>
<tr>
<td>Abscess or fistula</td>
<td>26 (31.0)</td>
</tr>
<tr>
<td>Stricture</td>
<td>15 (17.9)</td>
</tr>
<tr>
<td>Pouch failure (all with stoma)</td>
<td>10 (11.9)</td>
</tr>
<tr>
<td>Any late complications</td>
<td>65 (77.4)</td>
</tr>
<tr>
<td>No late complications</td>
<td>19 (22.6)</td>
</tr>
</tbody>
</table>
3.5 Functional outcomes

Participant’s average number of bowel motion (BM) in 24 hours was 7.24 (3.29). The average night time BM was 1.63 (1.34).

Table 3.5 - Average BM frequency

<table>
<thead>
<tr>
<th>Bowel motion frequency</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of BM in 24 hours</td>
<td>7.24 (3.29)</td>
</tr>
<tr>
<td>Average number of BM overnight</td>
<td>1.63 (1.34)</td>
</tr>
</tbody>
</table>

3.6 Quality of life

Participants were asked to answer two questionnaires regarding their quality of life; the Inflammatory Bowel Disease Questionnaire (IBDQ) and Health Form 36 Health Survey (SF36). The higher the score, the higher the level of quality of life was experienced by participants.

3.6.1 IBDQ score univariable analysis

Table 3.6 - IBDQ univariable analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>IBDQ Score Mean (SD)</th>
<th>Univariable analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Difference - Mean (95% CI) or Report estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>81</td>
<td>170.3 (28.3)</td>
<td>N/A</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>35</td>
<td>160.1 (29.7)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Male</td>
<td>46</td>
<td>178.0 (24.7)</td>
<td>-15.8 (-28.7 to -4.6)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>68</td>
<td>172.1 (28.3)</td>
<td>Mean square between groups = 279.180</td>
</tr>
<tr>
<td>(Reference)</td>
<td></td>
<td></td>
<td>F = 0.345</td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>162.5 (15.4)</td>
<td></td>
</tr>
<tr>
<td>NZ Maori</td>
<td>2</td>
<td>157.0 (45.3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>160.3 (36.7)</td>
<td>0.63</td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
<td>--------------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 or younger</td>
<td>39</td>
<td>170.4 (29.1)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Older than 50</td>
<td>42</td>
<td>170.1 (27.8)</td>
<td>0.3 (-12.1 to 13.0)</td>
</tr>
<tr>
<td><strong>Years since surgery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 12</td>
<td>38</td>
<td>173.6 (27.6)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>12 or more</td>
<td>42</td>
<td>168.2 (29.2)</td>
<td>5.4 (-17.6 to 7.4)</td>
</tr>
<tr>
<td><strong>Age at surgery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger than 40</td>
<td>37</td>
<td>173.9 (26.6)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Older than 40</td>
<td>44</td>
<td>167.2 (29.5)</td>
<td>-9.0 (-20.0 to 4.9)</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;Secondary</td>
<td>6</td>
<td>166.2 (30.0)</td>
<td>Mean square between groups = 0.818</td>
</tr>
<tr>
<td>(Reference)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>40</td>
<td>170.7 (28.7)</td>
<td>260.429</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F = 0.310</td>
</tr>
<tr>
<td>Tertiary</td>
<td>26</td>
<td>170.0 (29.5)</td>
<td>0.66</td>
</tr>
<tr>
<td>Trades</td>
<td>5</td>
<td>182.8 (30.1)</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>57</td>
<td>175.0 (23.2)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Not employed</td>
<td>23</td>
<td>159.2 (36.6)</td>
<td>-15.2 (-29.9 to -2.7)</td>
</tr>
<tr>
<td><strong>Position at work</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>61</td>
<td>178.3 (23.3)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>Yes</td>
<td>14</td>
<td>139.3 (31.0)</td>
<td>-39.0 (-53.2 to -25.0)</td>
</tr>
<tr>
<td><strong>Days of leave taken</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤100 days</td>
<td>73</td>
<td>173.9 (25.7)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;100 days</td>
<td>7</td>
<td>138.0 (36.1)</td>
<td>-35.9 (-56.7 to -14.7)</td>
</tr>
<tr>
<td><strong>Disease groups</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crohn’s disease</td>
<td>8</td>
<td>152.4 (28.0)</td>
<td>Mean square between groups = 0.561</td>
</tr>
<tr>
<td>(Reference)</td>
<td></td>
<td></td>
<td>599.404</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F = 0.751</td>
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<tr>
<td>Ulcerative colitis</td>
<td>64</td>
<td>171.9 (25.6)</td>
<td>0.04*</td>
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<tr>
<td>Indeterminate colitis</td>
<td>2</td>
<td>157.0 (45.3)</td>
<td>0.85</td>
</tr>
<tr>
<td>Condition</td>
<td>N value</td>
<td>Mean (SD)</td>
<td>p value</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>FAP</td>
<td>6</td>
<td>177.0 (47.4)</td>
<td>0.25</td>
</tr>
<tr>
<td>Lynch syndrome</td>
<td>1</td>
<td>193.0</td>
<td></td>
</tr>
<tr>
<td>Not Crohn’s disease</td>
<td>73</td>
<td>172.2 (27.8)</td>
<td>0.053</td>
</tr>
<tr>
<td>Indications</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Failed medical therapy (Reference)</td>
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<td>166.2 (27.4)</td>
<td>0.346</td>
</tr>
<tr>
<td>Fulminant colitis/Acute colitis</td>
<td>12</td>
<td>179.9 (22.3)</td>
<td>0.12</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>6</td>
<td>174.3 (23.0)</td>
<td>0.76</td>
</tr>
<tr>
<td>FAP prophylaxis</td>
<td>6</td>
<td>177.0 (47.4)</td>
<td>0.42</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>200.5 (4.9)</td>
<td>0.09</td>
</tr>
<tr>
<td>Early complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No early complications (Reference)</td>
<td>64</td>
<td>174.0 (26.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Haemorrhage</td>
<td>7</td>
<td>167.2 (16.7)</td>
<td>0.84</td>
</tr>
<tr>
<td>Small bowel obstruction</td>
<td>4</td>
<td>128.0 (45.3)</td>
<td>0.01*</td>
</tr>
<tr>
<td>Wound infection</td>
<td>7</td>
<td>164.7 (28.7)</td>
<td>0.66</td>
</tr>
<tr>
<td>Pelvic sepsis</td>
<td>6</td>
<td>146.2 (10.1)</td>
<td>0.01*</td>
</tr>
<tr>
<td>Any early complications</td>
<td>17</td>
<td>156.0 (32.2)</td>
<td>0.03*</td>
</tr>
<tr>
<td>Late complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No late complications (Reference)</td>
<td>21</td>
<td>177.2 (27.2)</td>
<td>N/A</td>
</tr>
<tr>
<td>Small bowel obstruction</td>
<td>33</td>
<td>162.2 (31.6)</td>
<td>0.10</td>
</tr>
<tr>
<td>Pouchitis</td>
<td>46</td>
<td>169.9 (27.3)</td>
<td>0.31</td>
</tr>
<tr>
<td>Abscess or fistula</td>
<td>22</td>
<td>163.4 (29.0)</td>
<td>0.10</td>
</tr>
<tr>
<td>Stricture</td>
<td>13</td>
<td>151.7 (38.7)</td>
<td>0.03*</td>
</tr>
<tr>
<td>Pouch failure (all with stoma)</td>
<td>10</td>
<td>158.1 (30.2)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Mean square between groups = 884.162
F = 1.136
Any late complications 60 167.8 (28.4) 0.19

**Average TOTAL Costs**
in NZD (year 2013)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>32</td>
<td>184.1 (23.9)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>48</td>
<td>161.9 (27.9)</td>
<td>-22.2 (-32.2 to -8.3) 0.001*</td>
</tr>
</tbody>
</table>

**Average Direct Costs in NZD (year 2013)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>53</td>
<td>173.4 (27.6)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>27</td>
<td>165.6 (29.7)</td>
<td>-7.8 (-7.6 to 17.3) 0.25</td>
</tr>
</tbody>
</table>

**Average Indirect Costs in NZD (year 2013)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>40</td>
<td>182.1 (24.5)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>40</td>
<td>159.4 (27.7)</td>
<td>-22.7 (-32.6 to -9.3) 0.001*</td>
</tr>
</tbody>
</table>

* = p value less than 0.05

Eighty-one participants completed the IBDQ, which is scored from 70 to 224. The average IBDQ score for this study was 170.3, with the standard deviation of 28.3. Females had a significantly lower IBDQ score than males in this study, as did participants whose position at work was affected by their bowel condition, and those who had to take more than 100 days off work in the past 12 months. Participants with Crohn’s disease had a significantly lower score than participants with ulcerative colitis. Participants who had small bowel obstruction(s) or pelvic sepsis(es) scored significantly lower in the IBDQ than those without any early complications. In terms of late complications, those who developed stricture(s) as a late complication scored lower than participants who did not have any late complications. Those who had an average total costs and average indirect costs greater than NZD$300, scored significantly lower in the IBDQ score compared to those who had an average total costs and average indirect costs less than NZD$300, respectively.

3.6.2 SF36 score univariable analysis

SF36 is broken down into several components and the scores range from zero to one hundred, the mean and standard deviation of each component is as below.
Table 3.7 - SF36 components

<table>
<thead>
<tr>
<th>SF36 components</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical functioning</td>
<td>83.7 (21.4)</td>
</tr>
<tr>
<td>Social functioning</td>
<td>77.6 (27.6)</td>
</tr>
<tr>
<td>Vitality</td>
<td>49.8 (26.3)</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>74.2 (22.5)</td>
</tr>
<tr>
<td>Emotional well being</td>
<td>77.4 (16.9)</td>
</tr>
<tr>
<td>General health</td>
<td>59.6 (26.3)</td>
</tr>
<tr>
<td>Role limited by physical health</td>
<td>68.3 (41.4)</td>
</tr>
<tr>
<td>Role limited by emotional health</td>
<td>77.5 (36.7)</td>
</tr>
<tr>
<td>Physical health</td>
<td>71.5 (23.4)</td>
</tr>
<tr>
<td>Mental health</td>
<td>70.6 (22.0)</td>
</tr>
</tbody>
</table>

Some of these components can be accumulated into an average to represent physical health and mental health. Univariable analysis of these two accumulated variables are as below:

3.6.2.1 SF36 score physical health

Table 3.8 - SF36PH univariable analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>SF36PH Score Mean (SD)</th>
<th>Univariable analysis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difference - Mean (95% CI) or Report estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>86</td>
<td>71.5 (23.4)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>63.2 (23.9)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>78.0 (30.0)</td>
<td>14.9 (5.2 to 24.5)</td>
<td>0.003*</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European (Reference)</td>
<td>71</td>
<td>71.3 (24.1)</td>
<td>Mean square between groups = 419.415</td>
<td>0.519</td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>73.5 (13.0)</td>
<td>F = 0.761</td>
<td></td>
</tr>
<tr>
<td>NZ Maori</td>
<td>3</td>
<td>54.6 (23.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>78.8 (21.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 50 or younger
40 71.9 (22.8) (Reference)

### Older than 50
44 71.0 (24.6) 0.9 (-0.9 to 11.3) 0.864

#### Years since surgery

<table>
<thead>
<tr>
<th>Less than 12</th>
<th>41 76.0 (20.4) (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 or more</td>
<td>43 67.1 (25.8) 8.9 (-1.2 to 19.1) 0.083</td>
</tr>
</tbody>
</table>

#### Age at surgery

<table>
<thead>
<tr>
<th>Less than 41</th>
<th>39 74.3 (20.9) (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41 or more</td>
<td>45 69.0 (25.7) 5.3 (-5.0 to 15.6) 0.310</td>
</tr>
</tbody>
</table>

#### Level of education

<table>
<thead>
<tr>
<th>&lt;Secondary</th>
<th>6 76.4 (13.8) Mean square between groups = 0.522</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary</td>
<td>43 73.6 (24.3) 424.305</td>
</tr>
<tr>
<td>Tertiary</td>
<td>27 67.4 (24.6) F = 0.756</td>
</tr>
<tr>
<td>Trades</td>
<td>5 81.9 (20.9)</td>
</tr>
</tbody>
</table>

#### Employment status

<table>
<thead>
<tr>
<th>Employed</th>
<th>59 77.3 (19.0) (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not employed</td>
<td>25 58.3 (28.0) -19.0 (-29.5 to 8.6) 0.001*</td>
</tr>
</tbody>
</table>

#### Position at work

<table>
<thead>
<tr>
<th>No</th>
<th>64 78.0 (19.5) (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>16 48.6 (24.2) -29.4 (-40.8 to -18.0) 0.000*</td>
</tr>
</tbody>
</table>

#### Days of leave taken

<table>
<thead>
<tr>
<th>≤100 days</th>
<th>76 74.4 (21.6) (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;100 days</td>
<td>7 40.3 (25.3) -34.1 (-51.3 to -16.9) 0.000*</td>
</tr>
</tbody>
</table>

#### Disease groups

<table>
<thead>
<tr>
<th>Ulcerative colitis</th>
<th>67 72.9 (22.3) Mean square between groups = 0.471</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crohn’s disease</td>
<td>9 60.1 (23.7) 491.454</td>
</tr>
<tr>
<td>Indeterminate colitis</td>
<td>2 56.3 (39.8) F = 0.895</td>
</tr>
<tr>
<td>FAP</td>
<td>6 75.2 (31.9)</td>
</tr>
<tr>
<td>Others</td>
<td>2 80.0 (21.7)</td>
</tr>
</tbody>
</table>

#### Indications

<table>
<thead>
<tr>
<th>Failed medical therapy</th>
<th>56 69.6 (23.9) Mean square between groups = 0.912</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fulminant colitis/Acute colitis</td>
<td>13 73.3 (18.5) 141.061</td>
</tr>
</tbody>
</table>

F = 0.245
Dysplasia | 7 | 72.1 (28.2)  
FAP prophylaxis | 6 | 75.2 (31.9)  
Other | 2 | 82.8 (5.7)  

**Early complications**

| No early complications | 65 | 72.8 (22.8) (Reference) |  
| Haemorrhage | 9 | 69.0 (17.1) -2.5 (-19.0 to 14.0) 0.761  
| GI obstruction | 7 | 60.4 (32.7) -11.8 (-30.1 to 6.5) 0.202  
| Wound infection | 7 | 65.2 (28.1) -6.6 (-25.0 to 11.9) 0.481  
| Pelvic sepsis | 4 | 48.3 (14.5) -24.1 (-47.5 to -0.7) 0.044*  
| Any early complications | 20 | 66.0 (25.1) -6.9 (-18.7 to 5.0) 0.254  

**Late complications**

| No late complications | 21 | 80.2 (18.5) (Reference) |  
| GI obstruction | 36 | 64.7 (25.2) -11.7 (-21.6 to -1.8) 0.021*  
| Pouchitis | 48 | 70.9 (23.9) -1.2 (-11.4 to 8.9) 0.810  
| Peri-anal disease | 46 | 66.6 (24.9) -10.4 (-20.3 to -0.6) 0.038*  
| Pouch failure | 12 | 55.5 (23.5) -18.5 (-32.5 to -4.5) 0.010*  
| Any late complications | 65 | 68.6 (24.2) -11.6 (-23.0 to -0.1) 0.048*  

**Average TOTAL Costs in NZD (year 2013)**

| <$300 | 34 | 80.8 (17.6) (Reference) |  
| =$300 | 49 | 65.1 (25.4) -15.7 (-25.8 to 5.7) 0.002*  

**Average Direct Costs in NZD (year 2013)**

| <$300 | 41 | 69.4 (25.4) (Reference) |  
| =$300 | 43 | 73.4 (21.9) 4.0 (-6.3 to 14.3) 0.438  

**Average Indirect Costs in NZD (year 2013)**

| <$300 | 42 | 78.9 (19.4) (Reference) |  
| =$300 | 41 | 64.0 (25.6) -14.9 (-24.8 to 5.0) 0.004*  

**QoL**

| IBDQ | 81 | N/A 0.7 (0.6 to 0.8) 0.000*  
| SF36MH | 86 | N/A 0.8 (0.7 to 1.0) 0.000*  

Eighty-six participants completed the SF36PH questionnaire, which is scored from 0 to 100. The average SF36PH score for this study was 71.5, with the standard deviation of 23.4. Females had a lower SF36PH average score than males, as did participants who were unemployed, had their position at work affected by their bowel condition, and those who had to take more than 100 days off work in the past 12 months. In terms of complications, participants who had pelvic sepsis(es), GI obstruction(s), peri-anal disease, pouch failure, and any late complications scored significantly lower in the SF36PH than those who did not have any late complications. Participants who had total costs and indirect costs greater than NZD$300 per year scored lower in SF36PH than participants who had costs that were less than NZD$300. SF36PH score had a linear relationship with the SF36MH, IBDQ, and the IBD-DI.

### 3.6.2.2 SF36 score mental health

**Table 3.9 - SF36MH univariable analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>SF36MH Mean (SD)</th>
<th>Univariable analysis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difference - Mean (95% CI) or Report estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>86</td>
<td>70.6 (22.0)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>66.4 (28.1)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>74.0 (20.7)</td>
<td>7.6 (-1.8 to 17.0)</td>
<td>0.113</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European (Reference)</td>
<td>71</td>
<td>70.8 (22.9)</td>
<td>Mean square between groups = 208.566</td>
<td>0.736</td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>62.3 (11.0)</td>
<td>F = 0.424</td>
<td></td>
</tr>
<tr>
<td>NZ Maori</td>
<td>3</td>
<td>66.3 (25.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>76.3 (18.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 or younger (Reference)</td>
<td>40</td>
<td>72.1 (20.9)</td>
<td>(Reference)</td>
<td></td>
</tr>
</tbody>
</table>
### Older than 50
- **44** 69.3 (23.4) -2.8 (-12.5 to 6.9) 0.567

### Years since surgery
- **Less than 12** 41 73.2 (18.7) (Reference)
- **12 or more** 43 68.2 (25.0) -5.0 (-14.6 to 4.6) 0.303

### Age at surgery
- **Less than 41** 39 73.2 (20.7) (Reference)
- **41 or more** 45 68.4 (23.3) -4.8 (-14.4 to 4.9) 0.327

### Level of education
- <Secondary 6 80.2 (11.2) Mean square between groups 0.698
- Secondary 43 71.4 (22.2) = 231.480
- Tertiary 27 69.4 (22.9) F = 0.479
- Trades 5 76.4 (23.7)

### Employment status
- Employed 59 74.9 (17.5) (Reference)
- Not employed 25 62.3 (27.8) -12.6 (-22.6 to -2.6) 0.014*

### Position at work
- No 64 77.4 (17.4) (Reference)
- Yes 16 46.9 (21.7) -30.5 (-40.7 to -20.4) 0.000*

### Days of leave taken
- ≤100 days 76 73.2 (20.3) (Reference)
- >100 days 7 49.5 (27.2) -23.7 (-40.1 to -7.3) 0.005*

### Disease groups
- Ulcerative colitis 27 72.2 (19.9) Mean square between groups 0.224
- Crohn’s disease 9 57.2 (25.0) = 685.528
- Indeterminate colitis 2 55.5 (25.4) F = 1.452
- FAP 6 73.5 (35.6)
- Others 2 85.5 (10.6)

### Indications
- Failed medical therapy 56 68.0 (20.8) Mean square between groups 0.656
  = 302.036
Fulminant colitis/Acute colitis 13 75.5 (19.6)  F = 0.611
Dysplasia 7 73.0 (26.5)
FAP prophylaxis 6 73.5 (35.6)
Other 2 85.5 (10.7)

**Early complications**

<table>
<thead>
<tr>
<th>Early complications</th>
<th>No early complications</th>
<th>Haemorrhage</th>
<th>GI obstruction</th>
<th>Wound infection</th>
<th>Pelvic sepsis</th>
<th>Any early complications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>71.7 (20.3) (Reference)</td>
<td>59.8 (25.0)</td>
<td>67.3 (32.2)</td>
<td>70.5 (21.9)</td>
<td>48.4 (6.6)</td>
<td>65.7 (26.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-11.7 (-27.0 to 3.5)</td>
<td>-3.2 (-20.5 to 14.0)</td>
<td>0.2 (-17.1 to 17.6)</td>
<td>-23.0 (-44.9 to -1.1)</td>
<td>-6.1 (-17.2 to 5.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Late complications**

<table>
<thead>
<tr>
<th>Late complications</th>
<th>No late complications</th>
<th>Gl obstruction</th>
<th>Pouchitis</th>
<th>Peri-anal disease</th>
<th>Pouch failure</th>
<th>Any late complications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21</td>
<td>36</td>
<td>48</td>
<td>46</td>
<td>12</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>77.0 (19.4) (Reference)</td>
<td>63.9 (24.4)</td>
<td>70.9 (21.2)</td>
<td>66.4 (23.2)</td>
<td>62.5 (22.5)</td>
<td>68.5 (22.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-11.5 (-20.8 to -2.2)</td>
<td>0.6 (-8.9 to 10.2)</td>
<td>-9.1 (-18.4 to 0.2)</td>
<td>-9.4 (-22.9 to 4.1)</td>
<td>-8.4 (-19.3 to 2.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Average TOTAL Costs in NZD (year 2013)**

<table>
<thead>
<tr>
<th>Average TOTAL Costs in NZD (year 2013)</th>
<th>&lt;$300</th>
<th>&gt;$300</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>34</td>
<td>49</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>80.3 (16.5) (Reference)</td>
<td>64.9 (22.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Total Direct Costs in NZD (year 2013)</th>
<th>&lt;$300</th>
<th>&gt;$300</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>41</td>
<td>67.9 (24.7) (Reference)</td>
</tr>
</tbody>
</table>
Average Indirect Costs in NZD (year 2013)

<table>
<thead>
<tr>
<th>Category</th>
<th>$300</th>
<th>43</th>
<th>73.3 (19.3)</th>
<th>5.4 (-4.2 to 15.0)</th>
<th>0.267</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>43</td>
<td>78.8 (17.8)</td>
<td>(Reference)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;$300</td>
<td>41</td>
<td>63.4 (22.8)</td>
<td>-15.5 (-24.4 to -6.6)</td>
<td>0.001*</td>
<td></td>
</tr>
</tbody>
</table>

QoL

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
<th>Standard Deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBDQ</td>
<td>0.6</td>
<td>0.5 to 0.7</td>
<td>0.000*</td>
</tr>
<tr>
<td>SF36PH</td>
<td>0.7</td>
<td>0.6 to 0.9</td>
<td>0.000*</td>
</tr>
<tr>
<td>IBD Disability</td>
<td>1.6</td>
<td>1.3 to 1.9</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Index

* = p value less than 0.05

Eighty-six participants completed the SF36MH questionnaire, which is scored from 0 to 100. The average SF36MH score for this study was 70.6, with the standard deviation of 22.0. Participants who were unemployed, had their position at work affected, or took more than 100 days of leave had a significantly lower SF36MH score. Those who had pelvic sepsis(es) and GI obstruction(s) scored lower than those who did not have any early and late complications. Participants who had total costs and indirect costs greater than NZD$300 per year, scored lower in SF36MH than participants who had costs that were less than NZD$300. SF36MH score had a linear relationship with the SF36PH, IBDQ, and IBD-DI.

### 3.7 Disability

The World Health Organisation defines disability as “an impairment or problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in life situations”. It is a more objective measure than quality of life, which is more subjective.
Inflammatory Bowel Disease Disability Index (IBD-DI)

Participants were asked to answer the IBD-DI, which is a questionnaire developed to specifically score patients’ physical disability. At the time of this study, this questionnaire has not yet been validated for self-reporting. Therefore, this questionnaire was carried out via either a face-to-face interview or phone interview.

The IBD-DI score ranges from -80 to +22; the more negative the score, the worse the level of disability that was experienced by the participant.

Table 3.10 - IBD-DI univariable analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>IBD-DI Mean (SD)</th>
<th>Univariable analysis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difference - Mean (95% CI)</td>
<td>or Report estimate (95% CI)</td>
</tr>
<tr>
<td>All participants</td>
<td>84</td>
<td>-1.0 (9.9)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>-3.0 (10.3)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>0.6 (9.5)</td>
<td>3.6 (-0.2 to 8.3)</td>
<td>0.09</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European (Reference)</td>
<td>70</td>
<td>-0.7 (10.0)</td>
<td>Mean square between groups = 21.802</td>
<td>F = 0.218</td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>-2.4 (7.8)</td>
<td></td>
<td>0.72</td>
</tr>
<tr>
<td>NZ Maori</td>
<td>2</td>
<td>-7.0 (19.8)</td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>-1.0 (9.7)</td>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 or younger (Reference)</td>
<td>40</td>
<td>-0.3 (9.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older than 50</td>
<td>44</td>
<td>-1.7 (10.1)</td>
<td>-1.38 (-5.6 to 3.0)</td>
<td>0.53</td>
</tr>
<tr>
<td>Years since surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 12 (Reference)</td>
<td>39</td>
<td>-0.6 (9.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 or more</td>
<td>45</td>
<td>-1.4 (10.1)</td>
<td>-0.76 (-5.0 to 3.6)</td>
<td>0.73</td>
</tr>
<tr>
<td>Age at surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Less than 41 40 1.3 (8.9) (Reference)
41 or more 44 -3.1 (10.5) -4.44 (-8.1 to -0.3) 0.04*

**Level of education**

<Secondary 6 -4.0 (11.5) Mean square between groups =
(Reference)

Secondary 39 -1.1 (10.7) 80.094
Tertiary 27 -1.5 (9.7) F = 0.765
Trades 5 5.0 (9.3) 0.54

**Employment status**

Employed 57 0.0 (8.8) (Reference)
Not employed 23 -4.0 (12.5) -4.0 (-9.3 to 0.4) 0.11

**Position at work**

No 62 1.2 (8.7) (Reference)
Yes 14 -12.2 (9.6) -11.0 (-18.6 to -8.5) 0.01*

**Days of leave taken**

≤100 days 74 -0.2 (9.7) (Reference)
>100 days 7 -10.1 (9.8) -9.9 (-17.5 to -2.2) 0.012*

**Disease groups**

Crohn’s disease 8 -8.3 (11.9) Mean square between groups =
(Reference)

Ulcerative colitis 67 -0.5 (8.7) 180.410
Indeterminate colitis 2 -9.5 (16.3) F = 1.935
FAP 7 4.9 (13.6) 0.03*
Not Crohn’s disease 76 -0.2 (9.5) 0.90

**Indications**

Failed medical therapy (Reference) 55 -3.3 (9.7) Mean square between groups =

Fulminant colitis/Acute colitis 12 1.6 (7.3) 217.404

F = 2.379

0.11
Dysplasia | 6 | 1.7 (9.7) | 0.24
FAP prophylaxis | 7 | 4.9 (13.6) | 0.05*
Other | 2 | 8.5 (0.7) | 0.09

**Early complications**

| No early complications (Reference) | 63 | -0.4 (9.4) | N/A | N/A
| Haemorrhage | 8 | 1.5 (7.1) | 0.57
| Small bowel obstruction | 4 | -14.5 (19.4) | 0.24
| Wound infection | 7 | -3.4 (11.4) | 0.44
| Pelvic sepsis | 7 | -7.3 (8.0) | 0.07
| Any early complications | 20 | -3.4 (11.4) | 0.25

**Late complications**

| No late complications (Reference) | 19 | 0.1 (11.1) | N/A | N/A
| Small bowel obstruction | 36 | -2.6 (9.9) | 0.36
| Pouchitis | 49 | -0.3 (9.5) | 0.88
| Abscess or fistula | 26 | -3.3 (9.4) | 0.27
| Stricture | 15 | -6.1 (13.3) | 0.15
| Pouch failure (all with stoma) | 10 | -2.6 (9.0) | 0.51
| Any late complications | 65 | -1.3 (9.6) | 0.59

**Average TOTAL**

**Costs in NZD (year 2013)**

| <$300 | 32 | 2.5 (8.2) | (Reference)
| >$300 | 49 | -3.4 (10.5) | -5.9(-9.3 to -0.6) | 0.01*
Average Direct Costs in NZD (year 2013)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>57</td>
<td>-0.8 (9.4)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>27</td>
<td>-1.3 (11.2)</td>
<td>-0.5 (-5.6 to 4.7)</td>
</tr>
</tbody>
</table>

Average Indirect Costs in NZD (year 2013)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$300</td>
<td>40</td>
<td>2.5 (9.1)</td>
<td>(Reference)</td>
</tr>
<tr>
<td>&gt;$300</td>
<td>41</td>
<td>-4.5 (9.9)</td>
<td>-7.0 (-10.3 to -1.9)</td>
</tr>
</tbody>
</table>

* = p value less than 0.05

Eighty-four participants completed the IBD-DI questionnaire. The average IBD disability score for this study was -1.0, with the standard deviation of 9.9. Participants who were older than 41 at the time of surgery had a lower score than those who were younger than 41.

Participants whose position at work was affected by their bowel condition or took more than 100 days of leave in the past 12 months, had a significantly lower IBD-DI score. Participants who had ulcerative colitis and those who did not have Crohn’s disease had a higher average score. In terms of surgical indications, participants who had an IPAA because they had FAP, for malignancy prophylaxis, had a higher average score than participants whose indication for surgery was failed medical therapy. Participants who had an average total costs or indirect costs greater than NZD$300, had a lower IBD-DI score than those with the average total costs and indirect costs less than NZD$300.

3.8 Correlation between IBDQ and IBD-DI

There was a significantly positive correlation between the IBDQ and the IBD-DI, with r = 0.84 and p value <0.01.
Figure 3.2 - Scatterplot between IBDQ and IBD-DI

3.9 Comparison with Sydney cohort

The IBD-DI and IBDQ results for UC patients in this study was compared to a cohort of 41 medically treated UC patients from a Sydney study by Leong et al. The Sydney study used the same two questionnaires, and was being carried out simultaneously. The raw de-identified data were provided by the Sydney study investigators for a direct comparison. The Sydney study had the following median scores for IBD-DI: -5 for UC and +10 for controls; they found a score of +2.5 or more distinguished controls from disease groups.

Table 3.11 - Comparison of Canterbury cohort versus Sydney cohort

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Canterbury cohort</th>
<th>Sydney cohort</th>
<th>t(df)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBD-DI</td>
<td>-0.49</td>
<td>-6.39</td>
<td>t[53.63] = 2.10</td>
<td>0.04</td>
</tr>
<tr>
<td>IBDQ</td>
<td>172.9</td>
<td>159.4</td>
<td>t[56.78] = 1.75</td>
<td>0.09</td>
</tr>
</tbody>
</table>

The mean IBD-DI score was -0.49 for IPAA patients in Canterbury, compared with -6.39 for medically treated UC patients in Sydney, with the p-value of 0.04, which is statistically significant. These results show that IPAA patients in Canterbury experiences less disability
than medically treated UC patients in Sydney. The average IBDQ score was 172.9 for IPAA patients in Canterbury, compared with 159.4 for medically treated UC patients in Sydney, with the p-value of 0.09, which shows the difference in quality of life is not statistically significant between the two groups.

### 3.10 Work disability and education

**Table 3.12 - Participant work disability and education**

<table>
<thead>
<tr>
<th>Participant characteristics and work disability</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of education obtained</strong></td>
<td></td>
</tr>
<tr>
<td>Did not complete Secondary School</td>
<td>6 (7)</td>
</tr>
<tr>
<td>Completed Secondary School as their highest level of education</td>
<td>43 (49)</td>
</tr>
<tr>
<td>Completed Tertiary Education or trades/apprenticeship</td>
<td>32 (36)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>4 (5)</td>
</tr>
<tr>
<td>Did not complete</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Education affected by bowel condition/IPAA</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (10)</td>
</tr>
<tr>
<td>No</td>
<td>75 (85)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Did not complete</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
</tr>
<tr>
<td>Currently employed</td>
<td>59 (67)</td>
</tr>
<tr>
<td>Previously employed</td>
<td>22 (25)</td>
</tr>
<tr>
<td>Never been employed</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Did not complete</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Position at work affected by bowel condition/IPAA</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16 (18)</td>
</tr>
<tr>
<td>No</td>
<td>64 (73)</td>
</tr>
<tr>
<td>Declined to answer</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Did not complete</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Work productivity affected by bowel condition/IPAA</strong></td>
<td></td>
</tr>
</tbody>
</table>
Not at all 37 (42)  
Slightly 21 (24)  
Moderately 7 (8)  
Quite a bit 9 (10)  
Extremely 6 (7)  
Declined to answer 5 (6)  
Did not complete 3 (3)  

**Number of days of leave taken in the last 12 months** 21.7 (62.3)

**Type of leave taken**
- Sick leave 11 (12.5)  
- Annual leave 1 (1)  
- Unpaid leave 11 (12.5)  
- Combination of leave 11 (12.5)  
- Did not require leave 51 (58)  
- Did not complete 3 (3)  

**Job lost as a result of bowel condition/IPAA**
- Yes 5 (6)  
- No 80 (91)  
- Did not complete 3 (3)  

---

**Education** – 49% of participants completed secondary education, 31% completed tertiary education, and 7% completed trade apprenticeship as their highest level of education obtained. 85% stated that their level of education was not affected by their bowel condition, and 10% believed that it was affected by their bowel condition.

**Employment** – 67% of participants were currently employed, 25% were previously employed, and 3% of participants had never been employed.

**Position at work** – 73% of participants believed that their position at work was not affected by their IPAA, and 18% believed that their position at work was affected by their IPAA.
**Work productivity** - Participants were asked if their work productivity was affected by their IPAA: 42% said that their work productivity was not at all affected, 24% said that it was slightly affected, 8% said it was moderately affected, 10% said it was affected quite a bit, and 7% said it was extremely affected.

![Bar chart showing work productivity affected by bowel condition/IPAA](image)

**Leave taken** – The majority of participants only required 0-5 days of leave over the last 12 months. In contrast, a few participants lost their job as a result of their bowel condition/IPAA, and therefore took the maximum of 255 days of leave off work.

58% of participants had not taken any leave in the last 12 months due to their IPAA/bowel condition. For those who required leave as a result of their IPAA: 12.5% took sick leave, 1% took annual leave, 12.5% took unpaid leave, and 12.5% took a mixture of leave that was available.

**Job loss** – 6% of participants lost their jobs after IPAA surgery, as they were forced to take a prolonged amount of time off work in order to recover. Some needed to take six months off work, some could only work part time intermittently, and one particular participant found it was impossible to continue his line of work and had to resign from his job.
3.11 Direct costs

Direct costs included the costs of surgical procedures including and not limited to: IPAA surgery, other surgical procedures associated with IPAA, and day procedures; costs of inpatient admission which includes: emergency department visits, laboratory tests, radiography, and pharmaceuticals; as well as costs of outpatient contact which includes: outpatient clinic visits, general practitioner visits, prescriptive medications, district nurse visits, and social worker visits. The data of annual direct costs were available from 2006/07 financial year to 2012/13 financial year.

Table 3.13 - Direct cost univariable analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Average direct costs (NZD) per year Mean (SD)</th>
<th>Univariable analysis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Difference (NZD) - Mean (95% CI) or Report estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>86</td>
<td>1514.43 (2728.09)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>1239.74 (2468.08)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>1731.89 (2924.91)</td>
<td>492.15 (-688.02 to 1672.32)</td>
<td>0.409</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>72</td>
<td>1560.90 (2891.09)</td>
<td>Mean square between groups = 0.894</td>
<td></td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>1011.60 (910.06)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ Maori</td>
<td>2</td>
<td>483.67 (455.98)</td>
<td>1531196.54</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>1669.64 (2310.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 or younger</td>
<td>42</td>
<td>1953.56 (3240.39)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Older than 50</td>
<td>44</td>
<td>1095.27 (2081.34)</td>
<td>-858.29 (-2020.74 to 304.16)</td>
<td>0.146</td>
</tr>
<tr>
<td>Years since surgery</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Less than 12</td>
<td>41</td>
<td>2398.01 (3355.17)</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>12 or more</td>
<td>45</td>
<td>709.40 (1659.34)</td>
<td>-1688.61 (-2808.42 to -568.80)</td>
<td>0.004*</td>
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<td>Age at surgery</td>
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<tr>
<td></td>
<td>≤100 days</td>
<td>&gt;100 days</td>
<td>(Reference)</td>
<td></td>
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<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Less than 41</td>
<td>41</td>
<td>1869.15 (3350.19)</td>
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<tr>
<td>41 or more</td>
<td>45</td>
<td>1191.24 (1987.45)</td>
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<tr>
<td></td>
<td></td>
<td>-677.91 (-1846.92 to 941.10)</td>
<td>0.252</td>
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</table>

**Level of education**

<table>
<thead>
<tr>
<th>Level</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Secondary</td>
<td>6</td>
<td>2329.54 (3613.93)</td>
<td>0.631</td>
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<tr>
<td>Secondary</td>
<td>43</td>
<td>1612.20 (2421.15)</td>
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<tr>
<td>Tertiary</td>
<td>27</td>
<td>1589.94 (3380.75)</td>
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<tr>
<td>Trades</td>
<td>5</td>
<td>144.47 (213.63)</td>
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</table>

**Employment status**

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>59</td>
<td>1332.96 (2114.79)</td>
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</tr>
<tr>
<td>Not employed</td>
<td>25</td>
<td>1968.95 (3879.28)</td>
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</table>

**Position at work**

<table>
<thead>
<tr>
<th>At work</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>64</td>
<td>1393.67 (2678.98)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16</td>
<td>2234.62 (3299.45)</td>
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</tbody>
</table>

**Days of leave taken**

<table>
<thead>
<tr>
<th>Days</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100 days</td>
<td>76</td>
<td>1422.22 (2629.90)</td>
<td></td>
</tr>
<tr>
<td>&gt;100 days</td>
<td>7</td>
<td>2764.74 (4004.80)</td>
<td></td>
</tr>
</tbody>
</table>

**Disease groups**

<table>
<thead>
<tr>
<th>Disease</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulcerative colitis</td>
<td>67</td>
<td>1260.99 (2541.53)</td>
<td></td>
</tr>
<tr>
<td>Crohn’s disease</td>
<td>8</td>
<td>2471.98 (3455.76)</td>
<td></td>
</tr>
<tr>
<td>Indeterminate colitis</td>
<td>2</td>
<td>384.06 (377.83)</td>
<td></td>
</tr>
<tr>
<td>FAP</td>
<td>7</td>
<td>2589.64 (3633.74)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>1888.46 (2189.96)</td>
<td></td>
</tr>
</tbody>
</table>

**Indications**

<table>
<thead>
<tr>
<th>Indication</th>
<th>N</th>
<th>Mean (SD)</th>
<th>(Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed medical therapy</td>
<td>57</td>
<td>1281.07 (2614.62)</td>
<td></td>
</tr>
<tr>
<td>Fulminant colitis/Acute colitis</td>
<td>13</td>
<td>906.99 (2164.99)</td>
<td></td>
</tr>
<tr>
<td>Dysplasia</td>
<td>7</td>
<td>2318.57 (2314.54)</td>
<td></td>
</tr>
<tr>
<td>FAP prophylaxis</td>
<td>7</td>
<td>2589.64 (3633.74)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>5433.23 (5608.43)</td>
<td></td>
</tr>
</tbody>
</table>

**Early complications**
No early complications
Haemorrhage  9   2317.18 (2748.73)   914.78 (-987.87 to 2817.44)   0.342
GI obstruction  7   792.05 (1102.12)  -766.66 (-2901.96 to 1368.63)
Wound infection  8   1049.80 (1626.60) -492.51 (-2505.71 to 1520.70)
Pelvic sepsis  5   2207.90 (2309.80)  754.22 (-1743.47 to 3251.91)
Any early complications  22   1294.54 (1993.65) -271.02 (-1609.98 to 1067.94)

Late complications
No late complications  21   963.04 (1356.46) (Reference)
GI obstruction  37   1796.93 (3453.03)  538.48 (-623.20 to 1700.16)   0.359
Pouchitis  50   1582.09 (2923.74)   225.18 (-937.22 to 1387.58)   0.701
Peri-anal disease  48   2110.11 (3405.82)  1375.56 (256.43 to 2494.69)   0.017*
Pouch failure  12   1827.54 (2781.73)   396.79 (-1280.27 to 2073.86)
Any late complications  67   1648.41 (2994.04)  685.37 (-658.57 to 2029.31)   0.314

Average TOTAL
Costs in NZD (year 2013)
<$300  34   748.79 (1901.49) (Reference)
>$300  49   2081.29 (3134.34)  1332.50 (133.03 to 2531.97)   0.030*

Average Indirect
Costs in NZD (year 2013)
<$300  42   791.56 (1752.15) (Reference)
>$300  41   2297.47 (3367.47)  1505.91 (337.55 to 2674.27)   0.012*

QoL
Participants who had surgery more than 12 years ago, had significantly lower direct costs than those who had surgery less than 12 years ago. Participants who had perianal disease as a late complication had higher direct costs compared to participants who did not have perianal disease. Those who had total costs and indirect costs greater than NZD$300 in the last 12 months, were associated with having significantly higher direct costs.

### 3.12 Indirect costs

Indirect costs of the past 12 months included: work or school absenteeism, loss of work productivity, use of alternative or complementary health resources, travel, carers, tutors and additional phone or internet requirements.

Indirect costs that were incurred through work absenteeism as a result of illness were calculated by the human capital method as described by Drummond et al (125). In this method, participants were asked the number of days they had off work as either unpaid or annual leave related to IPAA, which were then transferred into hours off work and multiplied by their gross hourly wage. For participants who were unemployed, their indirect costs were discussed descriptively as monetary values.

Table 3.14 - Indirect costs

<table>
<thead>
<tr>
<th>Indirect costs</th>
<th>Mean (NZD) (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of indirect cost lost as a result of work absenteeism</td>
<td>3409.79 (9611.03)</td>
<td>0</td>
<td>50000.00</td>
</tr>
<tr>
<td>Cost of non-prescription medication in the last 12 months</td>
<td>63.01 (229.28)</td>
<td>0</td>
<td>1200.00</td>
</tr>
</tbody>
</table>
## Table 3.15 - Indirect costs univariable analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Average indirect costs (NZD) over last 12 months</th>
<th>Univariable analysis</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Difference (NZD) - Mean (95% CI) or Report estimate (95% CI)</td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>85</td>
<td>3825.38 (9930.00)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>5414.23</td>
<td>(Reference)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>(11531.02)</td>
<td>-2886.76 (-7093.76 to 1320.24)</td>
<td>0.176</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>70</td>
<td>4474.74 (10629.25)</td>
<td>Mean square between groups = 57215791.088</td>
<td>0.621</td>
</tr>
<tr>
<td>Other European</td>
<td>5</td>
<td>998.40 (1272.89)</td>
<td>F = 0.594</td>
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</tr>
<tr>
<td>NZ Maori</td>
<td>3</td>
<td>800.00 (624.50)</td>
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<td></td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>558.29 (707.69)</td>
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<td><strong>Age</strong></td>
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</tr>
<tr>
<td>50 or younger</td>
<td>39</td>
<td>5179.08</td>
<td>(Reference)</td>
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<tr>
<td>Older than 50</td>
<td>44</td>
<td>(11215.21)</td>
<td>-2416.63 (-6720.00 to 1886.75)</td>
<td>0.267</td>
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<tr>
<td></td>
<td></td>
<td>2762.45 (8427.70)</td>
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<tr>
<td><strong>Years since surgery</strong></td>
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<tr>
<td>Less than 12</td>
<td>41</td>
<td>5336.85 (11200.73)</td>
<td>(Reference)</td>
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<tr>
<td>12 or more</td>
<td>42</td>
<td>2493.35 (8217.39)</td>
<td>-2843.50 (-7126.46 to 1439.46)</td>
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<td>2493.35 (8217.39)</td>
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<td><strong>Age at surgery</strong></td>
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<td>Category</td>
<td>Counts</td>
<td>Mean (SD)</td>
<td>95% CI (Lower Upper)</td>
<td>Significance</td>
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<tr>
<td><strong>Level of education</strong></td>
<td></td>
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<td></td>
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<tr>
<td>&lt;Secondary</td>
<td>6</td>
<td>601.67 (1251.90)</td>
<td>Mean square between groups = 54870039.347</td>
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<td>Tertiary</td>
<td>27</td>
<td>4299.63 (10544.55)</td>
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<td>Trades</td>
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<td>209.20 (320.29)</td>
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<tr>
<td><strong>Employment status</strong></td>
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<td></td>
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<tr>
<td>Employed</td>
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<td>(Reference)</td>
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<td>Not employed</td>
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<td>3443.38 (-1173.22 to 8059.98)</td>
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<td><strong>Position at work</strong></td>
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<td>1248.34 (2758.82)</td>
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<tr>
<td>&gt;100 days</td>
<td>7</td>
<td>32665.43 (13273.95)</td>
<td>31417.09 (27893.74 to 34940.43)</td>
<td>0.000*</td>
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<tr>
<td><strong>Disease groups</strong></td>
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<tr>
<td>Ulcerative colitis</td>
<td>66</td>
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<td>0.889</td>
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<td>Crohn's disease</td>
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<td>Indeterminate colitis</td>
<td>2</td>
<td>730.00 (806.10)</td>
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<tr>
<td>FAP</td>
<td>6</td>
<td>7274.33 (13848.32)</td>
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<tr>
<td>Others</td>
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<td>6380.00 (7608.47)</td>
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<td><strong>Indications</strong></td>
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<td>95% CI</td>
<td>Prob Value</td>
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<td>------------</td>
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<td>Failed medical therapy</td>
<td>55</td>
<td>3131.75 (8868.04)</td>
<td>63333278.769</td>
<td>0.635</td>
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<td>Fulminant colitis/Acute colitis</td>
<td>13</td>
<td>6886.62 (14099.57)</td>
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<td>Dysplasia</td>
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<tr>
<td>FAP prophylaxis</td>
<td>6</td>
<td>7274.33 (13848.32)</td>
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<td></td>
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<tr>
<td>Other</td>
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<td>682.50 (731.86)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Early complications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No early complications</td>
<td>65</td>
<td>3434.58 (9108.58)</td>
<td></td>
<td>0.928</td>
</tr>
<tr>
<td>Haemorrhage</td>
<td>8</td>
<td>3562.00 (10108.94)</td>
<td>-333.21 (-7619.35 to 6952.93)</td>
<td>0.846</td>
</tr>
<tr>
<td>GI obstruction</td>
<td>7</td>
<td>3166.86 (4478.88)</td>
<td>-759.95 (-8497.00 to 6977.11)</td>
<td>0.141</td>
</tr>
<tr>
<td>Wound infection</td>
<td>7</td>
<td>9089.14 (18702.01)</td>
<td>5700.73 (-1936.12 to 13337.58)</td>
<td>0.000*</td>
</tr>
<tr>
<td>Pelvic sepsis</td>
<td>4</td>
<td>21277.00 (20438.96)</td>
<td>18284.20 (9078.61 to 27489.79)</td>
<td>0.461</td>
</tr>
<tr>
<td>Any early complications</td>
<td>19</td>
<td>5330.74 (12018.86)</td>
<td>1896.16 (-3199.40 to 6991.71)</td>
<td>0.088</td>
</tr>
<tr>
<td><strong>Late complications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No late complications</td>
<td>21</td>
<td>1574.95 (3403.12)</td>
<td></td>
<td>0.280</td>
</tr>
<tr>
<td>GI obstruction</td>
<td>35</td>
<td>5976.62 (13236.88)</td>
<td>3669.62 (-552.52 to 7891.76)</td>
<td>0.088</td>
</tr>
<tr>
<td>Pouchitis</td>
<td>48</td>
<td>2809.48 (7609.08)</td>
<td>-2316.93 (-6552.74 to 1918.88)</td>
<td>0.107</td>
</tr>
<tr>
<td>Peri-anal disease</td>
<td>45</td>
<td>5426.40 (11952.34)</td>
<td>3417.80 (-753.36 to 7588.95)</td>
<td>0.000*</td>
</tr>
</tbody>
</table>
Participants’ indirect costs were significantly higher if their position was affected at work, or if they took more than 100 days off work in the past year due to their bowel condition. Participants who had pelvic sepsis(es) as an early complication, had higher indirect costs than those who did not have any early complications. Those who had total costs greater than NZD$300, were associated with higher indirect costs. Indirect costs in the past year had a negative linear relationship with all the questionnaires that were carried out in this study.
3.13 Total costs

Total average cost is the average of the participants’ average direct costs and average indirect costs over the past 12 months.

Table 3.16 – Total Average costs over 12 months

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Average total costs (NZD) over last 12 months - Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All participants</td>
<td>85</td>
<td>4790.26 (11328.56)</td>
</tr>
</tbody>
</table>

The combined total average costs over the past 12 months for the 85 participants were NZD$4,790.26, with the standard deviation of NZD$11,328.56.
Chapter 4. Discussion

The Canterbury IPAA study is a population based cohort study of ileal pouch patients, with long term follow up of complications, functional outcomes, quality of life, disability and costs. This study provided the much needed New Zealand data on IPAA, which enabled comparisons to be made with international data. Findings on each of these outcomes and how they compared with international data is discussed below.

4.1 Complications

Surgical complications are often split into early and late complications. In the Canterbury IPAA cohort, 21% had an early complication. Of those who had an early complication, 8.6% had haemorrhage requiring transfusion, 8.6% had a wound infection, 7.4% had pelvic sepsis, and 4.9% had small bowel obstruction. The majority (79.0%) of the study participants did not have any early complications.

The early complication rate observed in the Canterbury IPAA populations compared favourably to a 2017 Canadian study involving 758 IPAA patients. In this Canadian study, the rate of wound infection was 14.3%, pelvic sepsis 17.8%, and small bowel obstruction 14.3%; the early complication rate observed in this study was much higher than the Canterbury study (42). In a 2016 systematic review, the average early complication rate was 21%, pelvic sepsis 3%, and small bowel obstruction 8% (2). The Canterbury early complication rate was comparable to this systematic review, except for the slightly higher rate of pelvic sepsis. Overall, Canterbury IPAA early complication rate is comparable to international data, and featured more favourably in certain domains.

The late complication rate observed in the Canterbury IPAA study was 74.1%, with the following breakdown: pouch failure 12.7%, strictures 16.0%, abscess or fistula 27.2%, small bowel obstruction 40.7%, pouchitis 58.2%. The late complication rate in the Canterbury IPAA study was much higher than what was reported in the international data. A large systematic review showed overall late complication rate ranged between 17%-55% (2). The same systematic review had the following average late complication rate: pouch failure 5%, fistula
6%, small bowel obstruction 17%, pouchitis 29%. The Canterbury IPAA study had much higher rates in each of these late complications compared to this systematic review. Another study reported late complication rates of strictures to be 7.3%, and fistulas 3.4% (42), which were both lower than rates seen in the Canterbury IPAA study. Overall, The Canterbury IPAA study had a far higher late complication rate than international current literature.

There are many reasons that could explain the difference of complication rates found between international studies. Firstly, studies often have different definitions of major complications. This could lead to a large difference between complication rates. Secondly, the methods of data collection and analysis vary widely between international studies, and this would affect the complication rate.

One of the reasons that could attribute to the higher late complication rate of the Canterbury IPAA study, is that data on long term outcomes and complications of participants were determined by assessing not only the hospital records, but also records from general practices. The most common IPAA complication is pouchitis; when patients have a flare of pouchitis, they are likely to present to their GP first. Pouchitis often settles with a course of antibiotics, which is often prescribed by the GP, thus these patients would not need to present to the hospital system. The majority of international studies did not include data from general practice. Therefore, the true rate of pouchitis and other late complications might be significantly underestimated in international data.

Another possible explanation which may add to the higher complication rate is the long follow up period and cumulative effect of late complications. One of the participants in the Canterbury study had his IPAA made in the 1980’s, which meant he had the retrospective follow up of approximately 35 years. Through international research, it is known that the risk of developing pouchitis increases over a lifetime, with 40% patients reporting at least one episode over 10 years of follow up, to 70% of patients reporting at least one episode over 20 years of follow up (45). The cumulative effect was evident in another study, which showed the pouch failure rate to be 4%, 6%, and 6% after 5, 10, and 20 years respectively (45).

Therefore, both the cumulative effect as well as more complete data collection which included GP data, might explain the higher late complication rates seen in the Canterbury
IPAA study. In conclusion, there is a need for large international studies with long follow up periods, standardised international complication definitions, as well as inclusion of GP data in data collection, for a more accurate indication and comparison of complication rates.

4.2 Functional outcomes

In the Canterbury IPAA study, participants’ average number of bowel motion in 24 hours was 7.24, and night time bowel motion was 1.63. This 24-hour bowel motion frequency is on the high end of the spectrum when compared to international data, with large systematic reviews reporting average stool frequency to be between 5-7 in 24 hours.

This result of slightly higher bowel motion frequency could be explained by the long follow up period of the Canterbury study. It was observed that there is an increase of daytime and night time defaecation frequency, as well as nocturnal leakage and urgency (2, 43, 45, 47-49) with the passage of time. When the New Zealand data was compared to studies with long follow up periods, the bowel motion frequency per 24 hours is found to be comparable to international data.

4.3 Quality of life

Quality of life is an important outcome measure due to the young age of diagnosis of UC. The patients’ quality of life over their lifetime, including their productive years, is a vital consideration when making treatment decisions.

In the Canterbury IPAA study, quality of life was measured by two different questionnaires: SF36 and IBDQ. The SF36 was split into several components; the results of these components from the Canterbury IPAA were comparable to international studies (4, 5, 8, 84, 95). Some of these studies compared its results to those of the general healthy population, and the conclusions were mixed – some found no difference in the SF36 score between IPAA group and the general population, whilst others found the general population had a higher SF36 score than the IPAA group. In contrast, there were studies which had higher SF36 scores when compared with the Canterbury IPAA study (8, 83, 90, 98). However, one of these studies was solely on FAP patients with an IPAA. FAP patients have a completely different
disease pathogenesis and symptom profile, in that they would be at a much lower risk of developing certain late complications, such as pouchitis. Therefore, one could expect the QoL of FAP patients to be higher than UC patients with an IPAA.

When the IBDQ score of the Canterbury study was compared with international data, it appeared that most studies used the short version of the IBDQ score to evaluate QoL in the IPAA population. Therefore, the scores were not directly comparable. One small study did utilise the full IBDQ for its patient cohort, and when compared with the IBDQ score of the Canterbury IPAA study, this study had a lower IBDQ score. However, due to its small study size, the difference in the IBDQ score may not be of statistical significance.

When it came to comparing quality of life of patients with an IPAA to those on medical therapy, research was certainly found to be lacking. The Canterbury IPAA study wanted to help bridge this gap by adding to the current research data available, and did so by comparing its IBDQ score to a cohort of medically treated UC patients in Sydney. The result of this comparison, was that there was no statistically significant difference of the IBDQ score between the Canterbury IPAA group and the Sydney medically treated group. Two international studies which compared IPAA with medical treatment, had the same result conclusion as the Canterbury IPAA study (5, 98). Despite the importance in comparing scores of the IPAA group with the medical treatment group, this can be a very difficult task; due to the fact that the most common reason for elective IPAA surgery is disease resistant to medical therapy (25, 29, 53, 126). This fact alone indicates that the surgical group is likely to have higher disease severity compared to the medical treatment group. Therefore, comparison between the two groups can be likened to comparing apples with oranges. What is needed in future research to enable removal of any bias, is to measure the quality of life prior to surgery, and compare this to after surgery of the same patient cohort. This would give a true indication of whether there is a difference between the two groups.

The Canterbury IPAA study found that across the three questionnaires, certain risk factors were found to increase the risk of a lower quality of life. These factors were: female, unemployment, position affected at work, taken >100 days of sick leave, Crohn’s disease, GI obstruction, pelvic sepsis, strictures, peri-anal disease, pouch failure, any late complications, average total cost greater than NZD$300, average indirect cost greater than NZD$300. This
result was echoed by international studies, which also found that pelvic sepsis, poor pouch function, medical co-morbidities and psychiatric illness increase the likelihood of a lower quality of life (4, 50, 93). However, there was no international research on whether gender, work disability, and costs were risk factors for a lower quality of life. Future research is needed in this area, in order to isolate risk factors which leads to a lower quality of life. This information would no doubt influence treatment decisions for patients.

One of the shortcomings of the Canterbury IPAA study, is that the IBDQ and SF36 scores were not compared to scores of the normal population. This points to a need for future research to find the average IBDQ and SF36 scores in the healthy New Zealand population, to enable comparisons to be made to the Canterbury IPAA population, and therefore, comparisons to international data.

It must be noted, that one of the problems encountered in the literature review was that the majority of studies used different methods to assess QoL. This made it very difficult to compare results directly. Two systematic reviews on the quality of life of IPAA had the same conclusion (86, 97). Future research in this area should focus on having an international standard of QoL measurement, to enable useful direct comparisons.

4.4 Disability

Disability is an objective measure of the effects of disease, which many experts believe are becoming an increasingly important endpoint alongside quality of life, which is a subjective measure of the effects of disease. Peyrin-Biroulet et al developed the world’s first disability measurement tool that is specific to inflammatory bowel disease – the Inflammatory Bowel Disease Disability Index (100). The IBD-DI score ranges from -80 to +22; the more negative the score, the higher the level of disability. The IBD-DI was validated in 2014, concluding that IBD-DI was a valid tool for measuring disability, and was able to differentiate CD and UC from controls (medians -7, -4, +10; p value 0.001) with a score of >3.5 identifying controls with 94% sensitivity and 83% specificity (104). One shortcoming of the IBD-DI is that it must be implemented via interview and has not yet been validated for self-report. However, a current study in the University of Otago which is working on validating the IBD-DI for self-report, and this will allow its more widespread use as an important outcome measure.
The IBD-DI addresses many of the functional issues faced by IPAA patients, including frequency of bowel motions, presence of blood in stools, interference with sleeping, abdominal pain and body image. These factors give it face validity as an appropriate tool to assess disability in IPAA patients in addition to IBD patients who have not undergone colectomy. The IBDQ and IBD-DI have a number of similar constructs and hence the strong but imperfect correlation. This imperfect correlation and the varying associations found in the present study suggest the two scores are unique but overlapping.

The advantage of an objective measure such as the IBD-DI, is that it provides specific information regarding the presence and frequency of multiple functional outcomes. The disadvantage of an objective measure, is that it may not capture how these functional outcomes affect patients at a personal level. The advantage of a subjective measure, is that it captures how the patient feels about their physical function and how it affects them personally. The disadvantage is of a subjective measure, is that the results are dependent on the specific study population, and may vary widely. For the same complication or functional outcome, patients may feel and be affected very differently.

This study was the first to apply the IBD-DI to a well-characterised population-based cohort of restorative proctocolectomy with IPAA patients with long term follow up. Due to the recent development and validation of the IBD-DI, at the initiation of the Canterbury IPAA study in 2013, there were no other studies which had used the IBD-DI in patients with an IPAA. Between 2013 and the conclusion of this thesis at the end of 2017, two new studies had used IBD-DI to evaluate disability in IBD and IPAA patients.

The first study which used the IBD-DI was an Australian study which validated the use of the IBD-DI. Results from this study found the median score to be -7 and -4 for CD and UC patients respectively; both of these scores were lower than the average IBD-DI score of -1 from the Canterbury IPAA study (104). The second study was a Belgium study which included 59 IPAA patients. It had a much higher average IBD-DI score of 17.9 (8.9-28.6) than the average score of -1.0 in the Canterbury IPAA study (90). Since the IBD-DI had the maximal score of +22, with the score of >3.5 identifying as controls/healthy population without IBD, it brings up the question of how this study obtained the median score of 17.9. Therefore, this
comparison is unlikely to be valid due to uncertainty of whether the IBD-DI was scored correctly in this Belgium study.

The IBD-DI results for UC patients who had an IPAA in the Canterbury IPAA study was compared to a cohort of 41 UC patients from a Sydney study (104), which was being carried out simultaneously. The results were that the IBD-DI score of the UC patients in the Canterbury IPAA study was higher (-0.49) than the average mean score from the Sydney cohort of medically treated UC patients (-6.39) with the p value of 0.04 (104). Results suggest that IPAA patients may have lower levels of disability than their medically treated counterparts. However, this comparison involves two very different groups of patients, as they were not matched for any important characteristics such as age, gender, length of time of medical treatment, and disease severity. Because one of the main indications for elective surgery is failed medical therapy, one could argue that IPAA patients may have had worse disease severity than patients’ whose disease is able to be controlled by medical therapy. Therefore, this conclusion cannot be generalised without further research from matched, large, multi-centre studies.

Certain risk factors for higher level of disability (lower IBD-DI score) were identified in the Canterbury IPAA study: participants older than 41 at the time of surgery, position at work affected by bowel condition, took >100 days of leave, patients with CD, average total cost >NZD$300 and indirect cost >NZD$300. On the other hand, those patients who had an IPAA for the indication of FAP or malignancy prophylaxis, had a lower level of disability (higher IBD-DI score) than those who proceeded for IPAA for failed medical therapy. Of the few international studies on this topic, they did not find any disease-specific variables which had a statistically significant effect on the level of disability (5, 90).

Disability can also include work disability, affecting work productivity, position at work, work absenteeism/sick leave, and loss of work. International studies point towards higher level of work disability in patients with IBD, compared to other disease groups and the general population (16, 101, 105-107, 109, 110). Due to the young age of onset of IBD, the increased level of work disability has a significant effect on this population. In addition, some studies point towards certain factors which increases the risk of work disability. One study found that 17% of UC patients were chronically disabled and age >40 increases the risk of higher
level of work disability (18). Another study found that patients with CD has a higher rate of unemployment, sick leave and disability than UC patients (105).

In the Canterbury IPAA study, 18% believe their position at work was affected by their bowel condition, 49% state that their work productivity was affected by their bowel condition, average number of days of leave was 21.7 days, and 6% of participants lost their jobs after IPAA surgery, as they were forced to take a prolonged amount of time off work in order to recover. There were limited international studies on the topic of IPAA and work disability for comparison of results. One study of 64 IPAA patients found that 5% received disability pensions and 9% had reduced workloads (46). The percentage of those who had lost their jobs as a result of work disability was comparable between this historic study and the Canterbury IPAA study. Another study compared absenteeism, presenteeism and work productivity of IPAA group versus medical treatment group, and found there was no significant differences between the two groups (5).

In conclusion, there are very few studies on the topic of IPAA and disability, and work disability. Disability as an objective measure of outcome adds important information regarding physical function that a subjective measure does not provide. However, it is also important to ascertain the subjective measure to provide information on the personal impact it has on patients. More research is required in order for comparisons to be made to the Canterbury IPAA study results.

4.5 Costs

Cost and cost-effectiveness of IBD treatments is an important outcome measure due to the early age of onset of disease, which makes for a long period of lifetime costs and large economic societal burden. In Europe, an estimated 2.5-3 million people are affected by IBD, with a direct healthcare cost of 4.6-5.6 billion Euros per year (101). The costs of treatments of IBD has increased since the introduction of biologics (98, 117, 127-129). Therefore, it is important to collect information and to compare the costs and cost-effectiveness of different treatment options, in particular, medical versus surgical treatment options.
In the Canterbury IPAA study, the average total cost in 12 months was NZD$4,790.26, with the standard deviation (SD) of NZD$11,328.56. This was further broken down into the average direct cost of NZD$930.42 (SD NZD$3,144.87) and average indirect cost of the past 12 months of NZD$3,825.38 (SD NZD$9,930.00). Indirect costs included costs resulting from work absenteeism and job loss; the highest indirect costs in this study was NZD$50,500.00. When compared with international studies, the direct costs were much lower than what was reported in various studies (80, 98, 116, 119). It has been shown in certain studies that after the high initial costs of the three-stage surgery, the costs reduce dramatically over time, which is associated with long term economic benefits (116).

There are several large international studies which compared cost and cost-effectiveness of surgery to medical therapy, and the majority of these studies concluded that surgery was more cost-effective, particularly in the long run (80, 98, 111, 116, 117, 119, 129). A Markov model by Park et al showed that the lifetime costs of standard medical care was higher compared to early colectomy with IPAA, as well as more QALY gained for IPAA group (80). Another study found that IPAA had lower costs, and did not increase risk of disability in patients with severe UC, and concluded that “the value of prolonged medical therapy in this select group of patients is questionable” (111). However, it must be noted that this was a small study, with only 20 patients in each of the surgical and medical group.

Certain risk factors were identified in the Canterbury IPAA study with higher costs: pelvic sepsis, perianal disease, taken >100 days off work in the past year due to their bowel condition. The study also found that higher indirect costs were associated with having higher direct costs, and vice versa. Other studies concurred with these results, particularly that of complications such as pelvic sepsis and pouchitis increased the risk of higher costs (116, 119, 130, 131).

For indirect costs, the Canterbury IPAA study showed the average indirect costs were comparable to international data. The average indirect costs per year (from work absenteeism) ranged from CAD$868 to €6821 in different studies (16, 110, 120). However, it must be noted that due to the lack of standardised definition, inclusion of what indirect costs entails, and method of data collection, a direct comparison between international research is rather difficult. This conclusion was echoed in a systematic review of 14 papers...
on IPAA and indirect costs based on absenteeism, presenteeism and loss of leisure (110). Despite the difficulty in measuring indirect costs, it is a cost that should not be underestimated. In the Canterbury IPAA study, average indirect costs accounted for 79.9% of average total costs. This percentage was much higher than what was reported in international studies, which showed indirect costs to be roughly one-third of all costs (110, 121).

The Canterbury IPAA study may have a higher proportion of indirect costs due to the extensive method of data collection, which included asking participants to fill out an indirect cost questionnaire, including costs such as work or school absenteeism, loss of work productivity, costs of alternative or complementary treatments, travel costs, carers, tutors, and phone and internet requirements. Other studies focused on costs associated with work absenteeism, and did not include other components as above.

Another reason for the high indirect costs could be the fact that indirect costs that were incurred through work absenteeism as a result of illness, were calculated by the human capital method as described by Drummond et al (125). In this method, for those few participants who lost their jobs as a result of their bowel condition, it would calculate the 12 months’ worth of lost income. The highest recorded indirect cost was NZD$50,500; this figure would significantly increase the average indirect cost across the study. Therefore, the average may not be an accurate reflection of the true average indirect cost for participants. Indirect costs are an important issue that requires further research, in particular, a requirement for a standardised definition and method of measuring indirect costs to be used internationally.

In conclusion, there are limited international studies on the direct and indirect costs associated with IPAA. The comparisons between these few studies were made difficult by the lack of standardised method of data collection and analysis. It is apparent that more research is needed in this area, in particular development of an international standardised method of evaluating indirect costs.
4.6 Study limitations

There were a number of limitations for this study. Many of the eligible people were unable to be contacted. Out of the 136 IPAAAs performed in Christchurch since 1984, 29 (21.3%) were uncontactable. Nevertheless, the response rate among contactable and eligible people was high (88.5%). The final number of participants who completed all the questionnaires in this population study was 80. This is a small study number, which is a reflection of the small size of this region and country in comparison to large cities in Europe or USA. This was a single centre study, which would not be as powerful as multi-centre trials.

4.7 Conclusion

Current literature reveals insufficient research on IPAA and disability, and direct and indirect costs. There remain unanswered questions when it comes to comparing results of IPAA with medical treatment for various outcomes, such as quality of life and disability. The Canterbury IPAA study provided novel findings from population cohort data on complications, functional outcomes, quality of life, disability, direct and indirect costs. This study was the first to use the IBD-DI in an IPAA population, and showed excellent correlation between the IBDQ and the IBD-DI. The information gathered from this study enabled comparisons to be made to international studies, which showed similarities in the level of quality of life and disability. The study found that with comprehensive, long term follow up, the late complication rate was higher than what was reported in other studies, which likely underestimated the true rate of late complications. Lower QoL and disability were found in those who had their position affected at work and those who had more than 100 days off work in the last year. Lower QoL and disability scores were associated with perioperative complications and higher indirect and total costs (p <0.01). This study was the first to use the IBD-DI to compare medically treated UC patients with those who had an IPAA, and found that patients with an IPAA had less disability than medically treated UC patients (p = 0.04). Ultimately, all of the specific and novel information from this study will be important for patients, clinicians and health funders to make informed decisions on UC treatments.
4.8 Funding

This study received financial support from the Canterbury Bowel and Liver Trust.

4.9 Conflict of interest

There are no conflicts of interest to declare.
References


81. University M. Inflammatory Bowel Disease Questionnaire

https://milo.mcmaster.ca/questionnaires/questionnaires1989


122. Canterbury Region [Website].


Appendix

Short Form 36 Questionnaire
SF-36™ Health Survey

Instructions for completing the questionnaire: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by filling in the bubble that best represents your response.

Patient Name:  

SSN#:  Date:  

Person helping to complete this form:  

1. In general, would you say your health is:
   - Excellent
   - Very good
   - Good
   - Fair
   - Poor

2. Compared to one year ago, how would you rate your health in general now?
   - Much better now than a year ago
   - Somewhat better now than a year ago
   - About the same as one year ago
   - Somewhat worse now than one year ago
   - Much worse now than one year ago

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?
   a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
   b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
   c. Lifting or carrying groceries.
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
   d. Climbing several flights of stairs.
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
   e. Climbing one flight of stairs.
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
   f. Bending, kneeling or stooping.
      - Yes, limited a lot.
      - Yes, limited a little.
      - No, not limited at all.
g. Walking more than one mile.
   - Yes, limited a lot.
   - Yes, limited a little.
   - No, not limited at all.

h. Walking several blocks.
   - Yes, limited a lot.
   - Yes, limited a little.
   - No, not limited at all.

i. Walking one block.
   - Yes, limited a lot.
   - Yes, limited a little.
   - No, not limited at all.

j. Bathing or dressing yourself.
   - Yes, limited a lot.
   - Yes, limited a little.
   - No, not limited at all.

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
   a. Cut down the amount of time you spent on work or other activities?
      - Yes
      - No
   b. Accomplished less than you would like?
      - Yes
      - No
   c. Were limited in the kind of work or other activities
      - Yes
      - No
   d. Had difficulty performing the work or other activities (for example, it took extra time)
      - Yes
      - No

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?
   a. Cut down the amount of time you spent on work or other activities?
      - Yes
      - No
   b. Accomplished less than you would like
      - Yes
      - No
   c. Didn’t do work or other activities as carefully as usual
      - Yes
      - No

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
   - Not at all
   - Slightly
   - Moderately
   - Quite a bit
   - Extremely

7. How much bodily pain have you had during the past 4 weeks?
   - Not at all
   - Slightly
   - Moderately
   - Quite a bit
   - Extremely
8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

- Not at all
- Slightly
- Moderately
- Quite a bit
- Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks:

a. did you feel full of pep?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

b. have you been a very nervous person?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

c. have you felt so down in the dumps nothing could cheer you up?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

d. have you felt calm and peaceful?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

e. did you have a lot of energy?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

f. have you felt downhearted and blue?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time
g. did you feel worn out?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

h. have you been a happy person?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

i. did you feel tired?
   - All of the time
   - Most of the time
   - A good bit of the time
   - Some of the time
   - A little of the time
   - None of the time

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?
   - All of the time
   - Most of the time
   - Some of the time
   - A little of the time
   - None of the time

11. How TRUE or FALSE is each of the following statements for you?

   a. I seem to get sick a little easier than other people
      - Definitely true
      - Mostly true
      - Don't know
      - Mostly false
      - Definitely false

   b. I am as healthy as anybody I know
      - Definitely true
      - Mostly true
      - Don't know
      - Mostly false
      - Definitely false

   c. I expect my health to get worse
      - Definitely true
      - Mostly true
      - Don't know
      - Mostly false
      - Definitely false

   d. My health is excellent
      - Definitely true
      - Mostly true
      - Don't know
      - Mostly false
      - Definitely false
The Inflammatory Bowel Disease Questionnaire

The following questions ask about your bowel problem and how it affected your life over the last two weeks. Please tick one answer for each of the questions. If you are unsure about how to answer any question, just give the best answer you can. Do not spend too much time answering, as your first thoughts are likely to be the most accurate.

1. On how many days over the last two weeks have you had loose or runny bowel movements?
   1.1. none
   1.2. on one or two days only
   1.3. on three to seven days
   1.4. on eight to fourteen days (ie more than every other day)

2. On how many days over the last two weeks have you felt tired?
   2.1. none
   2.2. on one or two days only
   2.3. on three to seven days
   2.4. on eight to fourteen days (ie more than every other day)

3. In the last two weeks have you felt frustrated?
   3.1. No, not at all
   3.2. Yes, some of the time
   3.3. Yes, most of the time
   3.4. Yes, all of the time

4. In the last two weeks, has your bowel condition prevented you from carrying out your work or other normal activities?
   4.1. No, not at all
   4.2. Yes, for one or two days
   4.3. Yes, for three to seven days
   4.4. Yes, for eight to fourteen days (ie more than every other day)
5. On how many days over the last two weeks have you opened your bowels more than three times a day?
   5.1. none
   5.2. on one or two days only
   5.3. on three to seven days
   5.4. on eight to fourteen days (ie more than every other day)

6. On how many days over the last two weeks have you felt full of energy?
   6.1. none
   6.2. on one to two days only
   6.3. on three to seven days
   6.4. on eight to fourteen days (ie more than every other day)

7. In the last two weeks have you been worried about being admitted to hospital because of your bowel problem?
   7.1. No, not at all
   7.2. Yes, some of the time
   7.3. Yes, most of the time
   7.4. Yes, all of the time

8. In the last two weeks did your bowel condition prevent you from going out socially?
   8.1. No, not at all
   8.2. Yes, some of the time
   8.3. Yes, most of the time
   8.4. Yes, all the time
   8.5. does not apply to me

9. On how many days over the last two weeks have your bowels opened accidentally?
   9.1. none
   9.2. on one or two days only
   9.3. on three to seven days
   9.4. on eight to fourteen days (ie more than every other day)
10. On how many days over the last two weeks have you felt generally unwell?
   10.1. none
   10.2. on one or two days only
   10.3. on three to seven days
   10.4. on eight to fourteen days (ie more than every other day)

11. In the last two weeks have you felt the need to keep close to a toilet?
   11.1. No, not at all
   11.2. Yes, some of the time
   11.3. Yes, most of the time
   11.4. Yes, all of the time

12. In the last two weeks, has your bowel condition affected your leisure or sports activities?
   12.1. No, not at all
   12.2. Yes, some of the time
   12.3. Yes, most of the time
   12.4. Yes, all of the time
   12.5. does not apply to me

13. On how many days over the last two weeks have you felt pain in your abdomen?
   13.1. none
   13.2. on one or two days only
   13.3. on three to seven days
   13.4. on eight to fourteen days (ie more than every other day)

14. On how many nights over the last two weeks have you been unable to sleep well (days if you are a shift worker)?
   14.1. none
   14.2. on one or two nights only
   14.3. on three to seven nights
   14.4. on eight to fourteen nights (ie more than every other night)
15. In the last two weeks have you felt depressed?
   15.1. No, not at all
   15.2. Yes, some of the time
   15.3. Yes, most of the time
   15.4. Yes, all of the time

16. In the last two weeks have you had to avoid attending events where there was no toilet close at hand?
   16.1. No, not at all
   16.2. Yes, some of the time
   16.3. Yes, most of the time
   16.4. Yes, all of the time

17. On how many days over the last two weeks, have you had a problem with large amounts of wind?
   17.1. none
   17.2. on one or two days only
   17.3. on three to seven days
   17.4. on eight to fourteen days (ie more than every other day)

18. On how many days over the last two weeks have you felt off your food?
   18.1. none
   18.2. on one or two days only
   18.3. on three to seven days
   18.4. on eight to fourteen days (ie more than every other day)

19. Many patients with bowel problems have worries about their illness. How often during the last two weeks have you felt worried?
   19.1. No, not at all
   19.2. Yes, some of the time
   19.3. Yes, most of the time
   19.4. Yes, all of the time
20. On how many days over the last two weeks has your abdomen felt bloated?
   20.1. none
   20.2. on one or two days only
   20.3. on three to seven days
   20.4. on eight to fourteen days (ie more than every other day)

21. In the last two weeks have you felt relaxed?
   21.1. No, not at all
   21.2. Yes, some of the time
   21.3. Yes, most of the time
   21.4. Yes, all of the time

22. On how many days over the last two weeks have you noticed blood with your bowel movements?
   22.1. none
   22.2. on one or two days only
   22.3. on three to seven days
   22.4. on eight to fourteen days (ie more than every other day)

23. In the last two weeks have you been embarrassed by your bowel problem?
   23.1. No, not at all
   23.2. Yes, some of the time
   23.3. Yes, most of the time
   23.4. Yes, all of the time

24. On how many days over the last two weeks have you wanted to go back to the toilet immediately after you thought you had emptied your bowels?
   24.1. none
   24.2. on one or two days only
   24.3. on three to seven days
   24.4. on eight to fourteen days (ie more than every other day)

25. In the last two weeks have you felt upset?
25.1. No, not at all
25.2. Yes, some of the time
25.3. Yes, most of the time
25.4. Yes, all of the time

26. On how many days over the last two weeks have you had to rush to the toilet?
26.1. none
26.2. on one or two days only
26.3. on three to seven days
26.4. on eight to fourteen days (ie more than every other day)

27. In the last two weeks have you felt angry as a result of your bowel problem?
27.1. No, not at all
27.2. Yes, some of the time
27.3. Yes, most of the time
27.4. Yes, all of the time

28. In the last two weeks, has your sex life been affected by your bowel problem?
28.1. No, not at all
28.2. Yes, some of the time
28.3. Yes, most of the time
28.4. Yes, all of the time
28.5. does not apply to me

29. On how many days over the last two weeks have you felt sick?
29.1. none
29.2. on one or two days only
29.3. on three to seven days
29.4. on eight to fourteen days (ie more than every other day)

30. In the last two weeks have you felt irritable?
30.1. No, not at all
30.2. Yes, some of the time
30.3. Yes, most of the time
30.4. Yes, all of the time

31. In the last two weeks have you felt lack of sympathy from others?
31.1. No, not at all
31.2. Yes, some of the time
31.3. Yes, most of the time
31.4. Yes, all of the time

32. In the last two weeks have you felt happy?
32.1. No, not at all
32.2. Yes, some of the time
32.3. Yes, most of the time
32.4. Yes, all of the time
Inflammatory Bowel Disease Disability Index
### PLEASE READ ALOUD THIS INSTRUCTIONS TO THE PATIENT

The first question is about the overall health of the patient, including both physical and mental health.

**ANSWERS:** 1 = Very good; 2 = Good; 3 = Moderate; 4 = Bad; 5 = Very bad

<table>
<thead>
<tr>
<th>Overall Health</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
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<tbody>
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</tbody>
</table>

1. In general, how would you rate your health today?

### PLEASE READ ALOUD THESE INSTRUCTIONS TO THE PATIENT

Now I would like to review different functions of your body and activities of daily life. When answering these questions, I would like you to think about the last week, taking both good and bad days into account. When I ask about difficulty / problem, I would like you to consider how much difficulty / problem you have had, on an average, in the past week, while doing the activity in the way that you usually do it. By difficulty I mean that you require increased effort, that you have discomfort or pain, or that the activity is slower or that there are other changes in the way you do the activity. Please answer this question taking into account any assistance you have available.

(Read and show scale to respondent).

**ANSWERS:** 1 = None; 2 = Mild; 3 = Moderate; 4 = Severe; 5 = Extreme

<table>
<thead>
<tr>
<th>Sleep and Energy</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall in the last week, how much of a problem did you have with sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning? (b134)</td>
<td></td>
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<tr>
<td>In the last week, how much of a problem did you have due to not feeling rested and refreshed during the day (e.g. feeling tired, not having energy)? (b130)</td>
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</table>

**Affect**

4. Overall in the last week, how much of a problem did you have with feeling sad, low or depressed? (b152)

5. Overall in the last week, how much of a problem did you have with worry or anxiety? (b152)

**Body Image**

6. Overall in the last week, how much of a problem did you have with the way your body or body parts looked? (b1801)

**Pain**

7. Overall in the last week, how much of stomach or abdomen aches or pains did you have? (b28012)

**ANSWERS:** 1 = None; 2 = Mild; 3 = Moderate; 4 = Severe or cannot do

<table>
<thead>
<tr>
<th>Regulating defecation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall in the last week, how much difficulty did you have coordinating and managing defecation including choosing and getting to an appropriate place for defecation and cleaning oneself after defecation? (d5301)</td>
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</table>

**Looking after one’s health**

9. Overall in the last week, how much difficulty did you have looking after your health, including maintaining a balanced diet? (d570)

**Interpersonal Activities**

10. Overall in the last week, how much difficulty did you have with personal relationships? (d7)

11. Overall in the last week, how much difficulty did you have with participation in the community? (d920)

**Work and Education**

12. Overall in the last week, how much difficulty did you have with work or household activities? (d840-d859)

13. Overall in the last week, how much difficulty did you have with school or studying activities? (d810-d899)

(b25) Number of liquid or very soft stools in the last week

(b515) Body mass index (BMI):

(b340) Do you feel that you have lost weight in the last week?

(s770) Is arthritis or arthralgia present?

Please rate the extent to which the following aspects of the patient’s environment positively or negatively influenced disease activity, body functions, and activities of daily life, which you have reviewed with the patient.

**ANSWERS:** NA = Not applicable; 1 = No positive effect; 2 = Mild positive effect; 3 = Moderate positive effect; 4 = Severe positive effect; 5 = Extreme positive effect

<table>
<thead>
<tr>
<th>NA</th>
<th>1</th>
<th>2</th>
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</table>

+14. Overall in the last week, did the medication the patient take alleviate her/his problems and difficulties? (e1100)

+15. Overall in the last week, did the food the patient take alleviate her/his problems and difficulties? (e1101)

+16. Overall in the last week, did the patient’s family alleviate her/his problems and difficulties? (e310)

+17. Overall in the last week, did health professionals alleviate the patient’s problems and difficulties? (e355)

**ANSWERS:** NA = Not applicable; 1 = No negative effect; 2 = Mild negative effect; 3 = Moderate negative effect; 4 = Severe negative effect; 5 = Extreme negative effect

<table>
<thead>
<tr>
<th>NA</th>
<th>1</th>
<th>2</th>
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</table>

-14. Overall in the last week, did the medication the patient take worsen her/his problems and difficulties? (e1100)

-15. Overall in the last week, did the food the patient take worsen her/his problems and difficulties? (e1101)

-16. Overall in the last week, did the patient’s family worsen her/his problems and difficulties? (e310)

-17. Overall in the last week, did health professionals worsen the patient’s problems and difficulties? (e355)

**ANSWERS:** 1 = No; 2 = Yes

<table>
<thead>
<tr>
<th>Social security and health services, systems and policies</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Does the patient benefit from the support he or she needs from the social security system? (e570)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Does the patient receive the health care he or she needs? (e580)</td>
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</tbody>
</table>
Indirect cost Questionnaire

Instructions for this questionnaire: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by selecting the answer that best represents your response.

What is your Study ID? (This was given to you in an email or a letter; if you have lost your study ID please email Alex at leeyu266@student.otago.ac.nz)

1. What is the highest level of education you have obtained?
   1. Secondary education
   2. Tertiary education
   3. Decline to answer
   4. Other __________________________

2. Do you feel your level of education obtained was affected by your ileal pouch?
   1. Yes
   2. No
   3. Decline to answer

3. Are you currently employed?
   1. Yes
   2. No
   3. Decline to answer

4. Were you previously employed?
   1. Yes
   2. No
3. Decline to answer

Note: If you are not currently employed, but were previously employed, please answer the following questions in relation to your previous work.

5. How many hours do you work in a typical work day? (If you do not wish to answer this question, enter Decline to answer)

6. What is your hourly wage? (If you do not wish to answer this question, enter Decline to answer)

7. Have you had to have time off work in the last 12 months due to your ileal pouch?
   1. Yes
   2. No
   3. Decline to answer

7a. How many days have you had off work in the last 12 months due to your pouch? (If you do not wish to answer this question, enter Decline to answer)
7b. These days were taken off work as:
   1. Unpaid leave
   2. Annual leave
   3. Sick leave
   4. Decline to answer
   5. Other

8. Do you think having a pouch has affected your position at work? (Such as pay rise, receiving bonuses)
   1. Yes
   2. No
   3. Decline to answer

9. Has your ileal pouch affected your work productivity?
   1. Not at all
   2. Slightly
   3. Moderately
   4. Quite a bit
   5. Extremely
   6. Decline to answer

10. Have you used non-prescription medication for your pouch in the last 12 months?
    1. Yes
    2. No
    3. Decline to answer

10a. What was the cost of your non-prescription medication over the last 12 months? (If you do not wish to answer this question, enter Decline to answer)
11. Have you used any alternative health resources in the last 12 months? (ie. acupuncture, chiropractor)
   1. Yes
   2. No
   3. Decline to answer

11a. What was the cost of your alternative health therapy over the last 12 months? (If you do not wish to answer this question, enter Decline to answer)

12. Can you think of any other costs that have arisen due to your ileal pouch? For example: travel, carer, tutor, cleaner, additional phone or internet requirements.
   1. Yes
   2. No
   3. Decline to answer

12a. What was the item(s)/resource(s) that added to the cost of your ileal pouch? (If you do not wish to answer this question, enter Decline to answer)
12b. What was the cost of this item(s)/resource(s) over the last 12 months? (If you do not wish to answer this question, enter Decline to answer)