# Appraisal of the impact of Bariatric surgery on Health Related Quality of life and Work Productivity in Morbidly Obese Patients

By

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## Summary

**Background:** In the last decades, morbid obesity has emerged as an increasingly prevalent chronic metabolic disorder affecting populations located in both developed and emerging countries. This condition leads to major public health issues and is associated with significant medical, quality of life and economic burdens. Obesity therefore represents a major health epidemic challenge facing health care professionals and governments over the next decades. Obesity may be associated to many different causes, its cornerstone being weight gain due to a lack of positive energy balance. A reliable approach to determine if a person has an excessive amount of adipose tissue is to calculate the ratio of their weight in kilogram divided by their height in meters square. This weight-for-height ratio is referred to as the body mass index (BMI). Many serious health conditions have been reported to be concomitant to this condition, including coronary heart disease, hypertension, stroke, type 2 diabetes, musculoskeletal disorders and cancer. Obesity is associated with increased morbidity, disability and premature mortality. Obesity is actually projected to rapidly become the leading cause of preventable death in Canada and the United States second only to tobacco abuse related deaths. According to 2013 data from Statistics Canada, approximately one in five adults age 18 and older meet the criteria for obesity, based on self-reported body mass index. Information provided by the public health agency of Canada estimate the yearly economic burden of obesity to be on the rise reaching as high as $7.1

billion in 2011. A substantial fraction of the Canadian health care expenditure is currently being divested to the treatment and management of obesity and its related comorbidities.

Given the impact of obesity on health status and its related economic burden, it is reasonable to anticipate that weight loss in obese patients will be associated with health and economic benefits. Therefore, the identification of effective weight loss interventions becomes a critical objective when attempting to mitigate the growing impact of obesity related costs on the Canadian health care expenditures. Treatment for obesity usually begins with a trial of lifestyle changes, also known as behaviour modification, which typically combines diet, exercise, and behavioural changes. When the behavioural approach is insufficient to reach an optimal target weight and metabolic control, a pharmaceutical agent may be recommended. However, pharmaceutical interventions and life style modification are often ineffective in the management of morbid obesity. Bariatric surgery is considered when all other treatment has failed and since the first intervention performed in the 1960s, it has considerably grown in popularity as an effective treatment option for the management of obesity. In fact, Bariatric surgery has emerged as a treatment of choice for this patient population. Significant reductions in mean percent excess weight loss and BMI percent change are observed as a consequence of Bariatric surgery. In addition, studies have also reported associated significant risk reductions for the development of morbid obesity related comorbid conditions. Obesity is a risk factor for a myriad of morbidities, such as type 2 diabetes mellitus and cardiovascular disorders. This condition is also associated with psychological

disorders, such as depression, and social discrimination. Several studies have established that obese individuals experience significant impairments in quality of life as a result of their condition. Health related quality of life (HRQoL) represents a particularly important and relevant outcome when assessing the overall impact of chronic conditions such as obesity. The data published as of date reports a significant correlation between excess weight loss and improvement in weight specific and physical aspects of HRQoL. However, trends toward decreases in HRQoL associated with weight regain between the first and sixth year post surgery have also been reported. The evidence relating to change in HRQoL in obese patients following Bariatric surgery for weight loss is currently either of relatively low quality or mainly focussed on evaluating the short-term impact of the intervention on HRQoL. Often overlooked but equally important is the relationship between obesity and its outcome on work productivity. Ample evidence underlining the correlation between obesity, increased work limitation and productivity loss may be found in the literature. However, few studies have measured the impact of Bariatric surgery on work productivity. Nevertheless, the limited evidence published thus far has found Bariatric surgery to have a favourable impact on work productivity over the short term, following the intervention. The need for further evaluation of HRQoL and productivity loss outcomes over longer time horizons, following Bariatric surgery, has actually been identified as key areas of focus in this field of research, given the chronic nature of the disease and its considerable economic burden. Long-term outcomes data related to HRQoL and productivity loss following Bariatric surgery remains scarce in the Canadian setting.

**Objective:** To describe the impact of Bariatric surgery on HRQoL and work productivity in patients with morbid obesity. **Methodology:** A cross-sectional survey design conducted from August 2013 to October 30th 2013. The survey measured health related quality of life and work productivity outcomes, using the SF-36, the EQ-5D and the WLQ, for morbidly obese patients sampled from a population of patients being treated at the McGill University Health Centre (MUHC). **Results:** We observed Improvements in HRQoL and WLQ outcomes over the follow-up time period following Bariatric surgery and that, for all outcome measures. **Conclusion:** Following Bariatric surgery, patients may experience less disability related to bodily pain and mental health issues and the perception of their health related quality of life state was reported to be significantly better than before the surgery. Per our findings, the initial positive impact of Bariatric surgery on HRQoL appeared to be sustained over time. Increases in physical disability, work limitations and decreases in patients' perception of their health status may be consequential to increments in BMI units and years of follow-up since the surgical intervention. Our findings further corroborated trends towards decreases in the occurrence of chronic comorbidities following Bariatric surgery.

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# Literature review

## Introduction

Obesity is an increasingly prevalent metabolic disorder affecting populations located in both developed and emerging countries [1-3]. Based on projections from the WHO, by 2015, an estimated 700 million adults will be clinically obese [4]. This condition leads to major public health issues and is associated with significant medical, quality of life and economic burdens [5, 6] . The personal and societal health and economic burden of this preventable disease pose a serious threat to societies across the globe. Obesity therefore represents a major health epidemic challenge facing doctors and governments over the next decades [7]. This chronic, lifelong, multifactorial, and genetically-related disease is defined as an excessive amount of adipose tissue that may impair health [8].

A reliable approach to determine if a person has, an excessive amount of adipose tissue is to calculate the ratio of their weight in kilogram divided by their height in meters square [9]. Coined in the early 70s, this weight-for-height ratio is referred to as the body mass index (BMI) and is commonly used to classify underweight, overweight and obesity in adults [10, 11]. According to the World Health Organization (WHO) classification, a BMI ranging between 18.5 and 25 $kg/m^2$ describes individuals with a normal weight; a BMI between 25 and 30 $kg/m^2$ describes an individual who is overweight while obese individuals are described as those with a BMI ≥ 30 $kg/m^2$ [10, 12-15]. Under this classification, morbidly obese

individuals are described as those who's BMIs is ≥ 40kg/$m^2$ or ≥ 35kg/$m^2$ with at least one comorbidity[12, 13].

BMI is also the most commonly used measure of overall body fat and associated health risks in population-level studies[16]. Although this ratio provides a means to compare the prevalence of the disease across geographies, and accounts for the fact that taller individuals will weigh more since they have more tissues, this measure is not without limitations. BMI is not a perfect measure since it does not directly assess levels of body fat or its distribution throughout the body [17-21]. Muscle and bone being denser than adipose tissue, an athlete or a muscular person may have a high BMI, unrelated to an excess in adipose tissue [22]. However, since most people are not athletes, BMI remains a very reliable measurement to gauge body fat levels [23-25]. In addition, BMI had been shown to be strongly correlated with the gold-standard methods for measuring adipose tissue [26-28].

Obesity is associated with increased morbidity, disability and premature mortality [7, 29-31]. Many serious health conditions have been reported to be concomitant to this condition, including coronary heart disease, hypertension, stroke, type 2 diabetes, musculoskeletal disorders as well as certain types of cancer [32-42]. Obesity is projected to rapidly become on of the leading cause of preventable death in the Unites States second only to tobacco abuse related deaths [43-46].

The incidence of obesity has double in the United States since the 1980s, with one third of the population currently being affected [47]. Although not quite as high as what is observed in the United States, similar dramatic increases in incidence and

prevalence of obesity rates have been observed in Canada over the last decades [48]. In the Canadian population, obesity has increased from 14% in the late 70s to 25% in 2008[48]. According to Statistics Canada data, approximately one in five adults (18% of women and 10% of men) age 18 and older meet the criteria for obesity based on self-reported body mass index [49]. This is an increase from the ratio of 1 out of 16 (6.2%) Canadian adults age 18 and older observed back in 1985 [50]. When taking into account the tendency for men and women to respectively overestimate their height and weight, the current rate of obesity among Canadian adults may be closer to one in four for adults aged between 18 and 79 [51]. The observed increase in prevalence of obesity appears to be greatest for individuals affected by extreme obesity (BMI ≥40). The rate in this particular group has actually tripled within the last 25 years growing from 0.9 to 2.7 between 1978 and 2004[52].

Obesity may be associated to many different causes. The cornerstone of weight gain is mainly due to a lack of positive energy balance [53, 54]. Other causational avenues for obesity may include genetic disposition, an inactive or sedentary lifestyle, hormonal disorders such as an underactive thyroid (hypothyroidism) or Cushing's syndrome, the use medicines such as corticosteroids or antidepressants, smoking cessations, emotional factors (overeating due to stress, anger or boredom) and even lack of sleep [55-74].

## Morbidity and Mortality associate with Obesity

Obesity is recognised to be associated with a multitude of diseases affecting different body systems[75]. In fact, excesses in adipose tissue have been known to cause impairment to almost all organ systems[76]. Intraperitoneal and intra-abdominal or visceral fat as well as subcutaneous abdominal adiposity are known to be major contributors to the development of chronic illnesses such as cardiovascular disorders (i.e., hypertension, congestive heart failure and deep vein thrombosis), type 2 diabetes, obstructive sleep apnea, depression, low back pain, osteoarthritis, gastro esophageal reflux disease (GERD) and cancer [77-86]. Obesity is also known to affect the neurological (i.e., stroke) reproductive (i.e., polycystic ovarian syndrome disorder) urological (i.e., urinary incontinence and erectile dysfunction) and nephrological (i.e., chronic renal failure) systems [87-90]. Moreover, available clinical evidence also suggests a greater risk of premature mortality for morbidly obese individuals when compared to individuals with BMIs in the normal and overweight ranges [30, 91-93].

Mortality related to obesity has been extensively studied. Obesity has been reported in the literature to be related to an estimated 300,000 deaths per year, in the United and States[94]. Obesity has also been suggested to be second only to smoking as a preventable cause of death in the United States [95].

In Canada, the number of obesity related deaths is reported to have doubled over recent years [50]. One Canadian study estimated the proportion of all deaths theoretically attributed to overweight and obesity, to have grown from 5.1% in 1985

to 9.3% in 2000 [96]. A twelve year follow-up National Population Health survey study involving 11,326 participants reported obese individuals as having significantly increased risks of all-cause mortality, even after controlling for sociodemographic factors and health behaviours [97]. Obesity can therefore have deleterious effect on life expectancy, which underlings the seriousness of the health issue. Failure to address this growing epidemic could result in a wearing down of the pattern of steady gains in health observed since the beginning of the 20$^{th}$ century [98-101].

## Economic impact of Obesity

A study performed in 1997 estimated the cost of obesity in Canada to represent 2.4% of the total health care expenditure or $1.8 billion [6]. Two types of costs are associated with obesity namely direct and indirect costs. Direct costs are those directly resulting from the delivery of outpatient and inpatient health services used to treat the medical condition (i.e., surgery, hospitalization, medical consultations in outpatient clinics and drug therapy) [102]. Indirect costs are defined as those forgone as a consequence of the illness and they mainly encompass expenditures related to loss productivity, wages and workers' compensation [103]. Lost productivity refers to when individuals must temporarily (absenteeism) or permanently (disability or premature mortality) leave work for health reasons [104].

The 1997 estimates were subsequently updated in a 2010 publication where using 2006 data, the total reported direct obesity related costs has risen to 2.6% of the total Canadian health care expenditures or $3.9 billion [105]. The 2006 estimates

also provided information on indirect costs related to obesity in Canada. These indirect costs were calculated based on contributions an individual would have made to the economy in the absence of health related afflictions. Per the 2006 cost of illness study, estimates of $3.2 billion were reported for obesity related indirect costs [105].

It is important to underline that comparing the magnitude of change observed between obesity related costs reported in 1997 and 2006 bares several limitations. First, the definitions and data sources used for obesity between the two time points were different. Back in 1997, obesity was defined as a BMI of ≥ 27. This definition was updated to BMI ≥ 30 in 2000. Therefore, the different definitions lead to a greater number of prevalent obesity cases being reported in the 1997 study when compared to the study conducted in 2006. Second, the former study relied on self-reported BMI data to quantify the prevalence of obesity; in the latter, obesity prevalence was determined using direct BMI measurements. In addition, the 2006 study included new evidence on additional obesity associated comorbidities [105]. The economic burden estimates reported in the 2006 study are presently referred to as the most recent and comprehensive estimates of the economic burden of obesity in Canadian adults at the population-level. That said when factoring assumptions such as the population growth, the aging population as well as the increasing cost of medical care, the 2006 estimates are likely to have significantly increased [106]. Information provided by the public health agency of Canada estimate the yearly economic burden of obesity to remain on the rise reaching as high as $7.1 billion[107].

The most recent Canadian cost of illness study was conducted in the province of Ontario, by Tarride et al. The author linked population survey data to three administrative databases to identify costs associated with hospitalization, same day procedures and physician visits [108]. The authors compared expected costs among people who are underweight, normal weight, and overweight with the costs observed in obese subjects, to arrive at a relative increase in per BMI spending related to obesity. They reported that hospitalization and physician costs were respectively 40% and 22% higher amid obese and overweight adults when compared to normal-weight adults [108].

A substantial fraction of the Canadian health care expenditure is currently being divested to the treatment and management of obesity and its related comorbidities [6, 109, 110]. Given the impact of obesity on health status and its related economic burden, it is reasonable to anticipate that weight loss in obese patients will be associated with health and economic benefits. Therefore, the identification of effective weight loss interventions becomes an objective of paramount importance when attempting to mitigate the alarmingly growing impact of obesity related costs on Canadian health care expenditures.

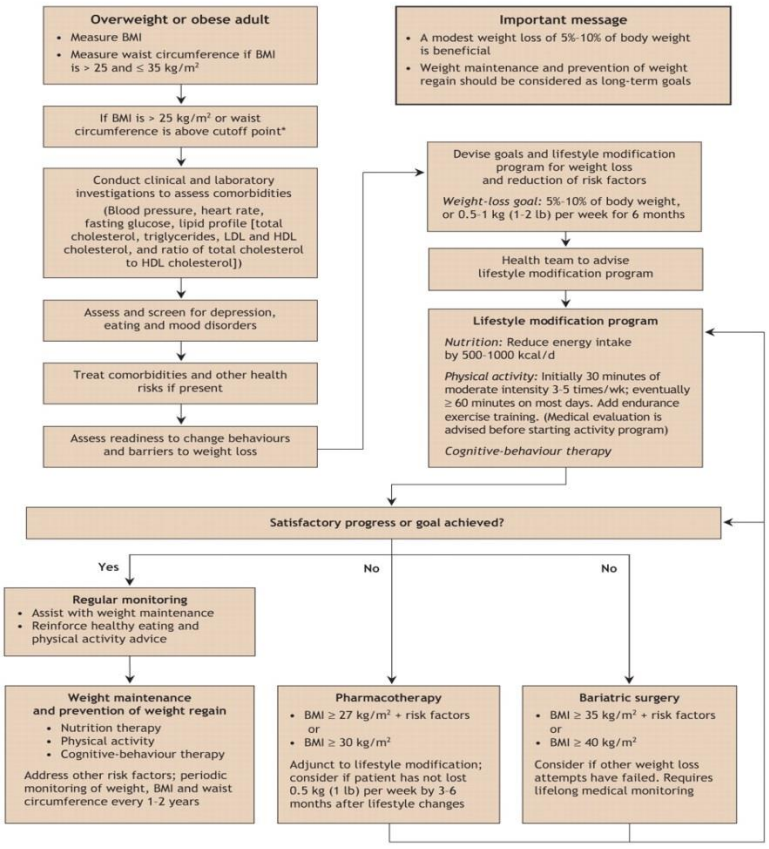
## Obesity Treatments

Obesity is considered as chronic disease caused by complex interactions between genetic, environmental and lifestyle factors [111]. The prevalence of obesity has been on the rise for decades and evidence is consistent with the fact that obesity increases the risk of mortality and morbidity and reduces quality of life [112-125].

These health-related complications consequently lead to a significant net economic impact on society as a whole. Sound measures aiming towards prevention and adequate management of this chronic disease are therefore especially important.

Canadian practice guidelines for the management and prevention of obesity were released back in 2006. For the purpose of providing management and prevention guidance for obesity at the individual and population levels, these guidelines aimed at identifying knowledge and care gaps and to broadcast information to a broader range of health care providers as well as inform future research seeking to improve current standards of care[12, 126]. Figure 1 details the suggested management algorithm proposed under these guidelines.

**Figure 1: Algorithm for the Assessment and Stepwise Management of Overweight or Obese adults [126]**




Treatment for obesity usually begins with a trial of lifestyle changes, also known as behaviour modifications, which typically involves diet, exercise, and behavioural changes. Lifestyle changes may be conducted individually or in-group setting [127-130].

When the behavioural approach is not sufficient to achieve optimal weight targets and metabolic control, a pharmacologic treatment may be recommended [131-135]. Weight loss medication or anti-obesity drugs are usually prescribed to patients as an adjunct to their weight loss treatment regimen [136-140] . Over the years however, most of the approved weight loss medications have been withdrawn from

the Canadian market due to serious adverse events[141]. The only weight loss pharmacological therapy approved in Canada for long-term treatment of obesity is orlistat (Xenical®) [142-145] .

Losing weight is extremely difficult for most obese individuals, and maintaining the weight loss over the long-term is ever more challenging [146, 147]. Lifestyle and behavioural modifications (i.e., diet, exercise with or without behavioural therapy) and pharmacotherapy for obesity each reduce weight by approximately 3-5% but are limited with poor long-term effectiveness and sub optimal adherence [148-152]. In their review of long-term outcomes of calorie-restricting diets, Mann et al. found that as many as two thirds of the dieters weighed more than when they had started dieting 2 years earlier[153, 154]. There is also currently no evidence of persistent weight loss reduction resulting from pharmacotherapies following treatment discontinuation [155, 156].

Given the sub optimal long-term outcomes observed following the use of therapeutic interventions such as lifestyle and behavioural modifications as well as pharmacotherapy, obese individuals are increasingly seeking access to Bariatric surgery for weight loss [157, 158].

In comparison to lifestyle and behavioural modification and pharmacotherapy, Bariatric surgery leads to substantial and sustainable weight reduction and has emerged as the treatment of choice for this population [159].

## Pharmacotherapy for Obesity

As a consequence of the limited success associated with behavioural modifications approaches, pharmacotherapies were proposed as an adjunct to dietary and lifestyle changes as a means to sustain weight loss [148, 160, 161]. Medication approved for weight loss usually fall into two broad categories. One class of pharmacotherapy agents decrease food intake by reducing appetite or increasing satiety, and the other class is comprised of medications that decrease nutrient absorption [147].

The first anti-obesity drug can be traced back to the 1800s. Back then, thyroid hormone treatments had become a popular option for the management of obesity in euthyroid individuals, based on their effectiveness for hypothyroidism [162]. Chronologically, the use of thyroid hormones were then followed by amphetamines towards the end of the 1930s, then phentermine in 1959, fenfluramine in 1973, dexfenfluramine in the mid-1990s and sibutramine in 1997 [163]. The efficacy observed with these medications was mostly modest and given their association with serious side effects such as increased cardiovascular risks, overdose and drug abuse, these medications were all withdrawn from the market [141, 164].

The only anti-obesity drug approved, in Canada, for long-term management of obesity is orlistat (Xenical®) [165]. Orlistat received a notice of compliance from Health Canada in May 1999 [166].

Orlistat is currently recommended as an adjunct therapy along with a calorie reduced diet for patients with a BMI ≥ 30kg/m2, as well as those with BMI≥ 27 kg/m2

and a weight related comorbidity [166]. Orlistat is a reversible gastric lipase inhibitor that blocks the breakdown and absorption of 25% (60 mg) to 30% (120 mg) of dietary triglycerides[167]. As an adjunct to lifestyle modification, orlistat 120 mg three times a day resulted in significantly greater weight loss when compared to placebo (10.6 vs 6.2 kg and 5.8 vs 3.0 kg, respectively; $p<0.001$ for both comparison) [168]. Significantly more patients achieved at least a 5% weight loss from baseline with orlistat compared to placebo after one year of follow-up (72.8 vs. 45.1%; $p< 0.001$) [169]. Orlistat has also been shown to significantly reduce new onset diabetes and improve blood pressure, wait circumference and low-density lipoprotein (LDL); however, tolerability issues greatly limit the use of this drug [170]. Orlistat is known to be associated with unpleasant gastrointestinal side effects such as oily stool or spotting and fecal urgency or incontinence [171]. This medication has also been associated with cases of severe liver injury, oxalate nephrolithiasis, and cholelithiasis [166]. Decrease levels of fat-soluble vitamins and interactions with lipophilic medications have also been observed with orlistat [166].

The pharmaceutical industry continues to actively investigating treatment approaches to manage obesity [172].

Recently, the Food and Drug Administration (FDA) approved two new agents as adjuncts to reduced-calorie diets and increased physical activity for weight loss in obese adults with BMI of greater than or equal to 30, or BMI greater than or equal to 27 with at least on weight-related comorbidity condition [173].

Lorcaserin hydrochloride (Belviq®) received an FDA approval on June 27, 2012. Lorcaserin is a novel chemical entity, highly selective for a subtype of serotonin C (5-HT2C) receptor agonist, believed to promote satiety and decreased food consumption. While being highly selective to serotonin 2C receptors, lorcaserin's affinity to other 5-HT receptor subtypes is low. Activation of these other 5-HT receptor subtypes (i.e., 5-HT2B) are thought to be associated with the serious cardiovascular adverse effects previously observed with nonselective agents such as fenfluramine [174]. This specificity is anticipated to contribute to a reduction in the risk of serious adverse complications such as cardiac valvulopathy and pulmonary hypertension.

Averaged results from three separate phase III trials demonstrated that 47% of patients on lorcaserin lost more than 5% body weight from baseline when compared to 25% for the placebo group ($p<0.05$ in all studies). Patients who received lorcaserin 10 mg twice a day (the recommended dose) lost on average 6 kg of body weight from baseline compared to 3kg for the placebo group. Significant reductions in HbA1c were also observed for diabetic patients in the lorcaserin group when compared to placebo (0.9% vs. 0.4%; $p<0.001$) [175]. Safety results for the phase III trials reported lorcaserin to be generally well tolerated and showed no significant increase in valvulopathy versus placebo [176].

Phentermine/topiramate-controlled release (Qsymia®), approved by the FDA on July 17, 2012, combines a noradrenergic appetite suppressant and an antiepileptic which leads to weight loss through an unclear mechanism [177]. Results from two pivotal Phase III trials demonstrated greater mean percent weight loss for

phentermine/topiramate when compared to placebo (low dose 7.8%, high dose 9.8 and 10.9%, placebo 1.2 and 1.6%; <0.0001 for all comparisons vs. placebo). The percentage of patients who achieved at least 5% weight loss varied from 62.1 to 70% with phentermine/topiramate compared to 17.3 to 20.8% with placebo ($p<0.0001$ for all comparisons). Treatment with phentermine/topiramate consistently improved waist circumference, systolic blood pressure, fasting glucose as well as components of lipid profile. However, Teratogenicity (orofacial cleft) and elevated heart rates represent important safety concerns for phentermine/topiramate [178]. Consequently, a risk evaluation and mitigation strategy (REMS) was required for approval of this combination therapy for the management of obesity [179]. While this option appears to be the most effective anti-obesity agent available, its accessibility is currently restricted through the REMS.

Most of the medications currently available for weight loss render modest efficacy for weight loss and have significant side-effect profiles and contraindications that may limit efficacy [136, 180].

### Surgical Intervention

First line treatment management for morbid obesity, such as low calorie diets with or without support organizations, increased physical activity and behavioural modifications are mostly ineffective in treating obesity over the long term due to the intractable nature of the disease, signified by the high relapse rates observed when individual resume old unhealthy behaviours [181-183]. In addition, there are

currently no truly effective pharmaceutical agents to treat obesity and especially morbid obesity [184]. Bariatric surgery is currently considered when other treatments have failed. In 1991, guidelines for surgical therapy of morbid obesity (BMI ≥40 or BMI ≥35 associated with one weight related comorbidity) were published by the National Institutes of Health [185].

Surgical procedures are mainly grouped into three categories: restrictive procedures, mal-absorptive and a combination of mal-absorptive/restrictive procedures [186].

- Restrictive procedures limit the amount of food intake by creating a small pouch at the top of the stomach where food enters from the esophagus with a narrow outlet. As a consequence of this procedure, food emptying becomes delayed and patients experience a sense of satiety which causes them to eat less [158].
- Mal-absorptive procedures alter the digestive tract by bypassing a portion of the small intestine with the ultimate goal of limiting food absorption [187].

Both techniques may be performed as open or laparoscopy surgery [188].

Since the first intervention performed in the 1960s, Bariatric surgery has considerably grown in popularity as a treatment option for obesity [98, 189]. Close to 6000 Bariatric surgeries were performed in Canada between 2012 and 2013, this reported number of interventions is approximately four time greater than what was observed in 2006-2007 [107]. The number of hospitals performing these interventions has also grown from 34 to 46 over this 6 year time period [107].

However, in view of lengthy wait times reported in some Canadian jurisdictions, some patients rely on the private sector or pay out of pocket to have access to surgery [190]. As a result, approximately 1000 surgery were reported to have occurred at private clinics over the course of the 2013 fiscal year [107]. Recently, the majority of Canadians (80%) undergoing Bariatric surgery are described as being middle aged (45 year old on average) females patients [191]. This is reflective of a greater number of women among Canadians with class II (52%) and class III (60%) obesity [107]. According to CIHI, most surgeries took place in Ontario and Quebec; with close to half (48%) of the national total being performed in Ontario. A large number of interventions performed in Quebec and in Ontario are delivered through Bariatric surgery centres of excellence [192]. Per the American Society for Bariatric surgery (ASBS), centres of excellence must fulfill the following criteria: perform a threshold volume of Bariatric surgery per year (>125) with acceptable results, provide long-term follow-up care, and have a multidisciplinary approach for management of morbidly obese patients [193-195]. The centre of excellence concept originates from effort, by the ASBS, to improve the quality of surgical care for Bariatric surgery patients by examining the relationship between the volumes of Bariatric surgeries performed in hospitals and their operative outcomes. Compared with low-volume hospitals, patients who underwent gastric bypass surgery at high-volume hospitals had a shorter length of hospital stay (3.8% versus 5.1 days, $P<0.01$), lower overall complications (10.2% versus 14.5%, $P<0.01$), lower complications of medical care (7.8% versus 10.8% $P<0.01$), and lower costs ($10,292 versus $13,908, $P<0.01$) [196].

Advances in surgical techniques and expertise combined with increased funding and accessibility are identified as potential contributor to the surge in Bariatric surgery volume witnessed in Canada [197].

The surge in the quantity of Bariatric surgery intervention observed in Canada has also been observed in several countries across the globe. The number on interventions performed in Australia has increased from near 500 during the 1999 fiscal year to practically 17 000 during the 2008 fiscal year [198]. Increases have also been reported in the USA, France, Sweden and England [199].

Findings suggested gastric bypass surgery as the current most frequently performed procedure in Canadian hospitals (53%); followed by sleeve gastrectomy (28%) and gastric banding (15%) [107].

Gastric bypass refers to a surgical technique where a small stomach pouch is created to curb food intake, by stapling a portion of the stomach [200]. Then a Y-shaped part of the small intestine is attached to the stomach pouch, allowing food to bypass the duodenum while the bypass extends to the initial portion of the jejunum. The bypasses of the small intestine are formed to decrease the absorption of food nutrients. This technique corresponds to the most common type of gastric bypass surgery performed and is referred to as Roux-en-Y. This procedure can be performed either through open or laparoscopically surgery [201]. This technique results in significant food intake restriction and increased satiety which ultimately leads to weight loss [201].

Sleeve gastrectomy is more recent types of Bariatric surgery generally performed laparoscopically. This irreversible procedure permanently reduces the stomach to approximately 25% of its original size, through the removal of a large portion along its greater curvature, leaving a narrow gastric tube or sleeve. Sleeve gastrectomy is a restrictive procedure; no intestines are removed or bypassed, leaving absorption of nutrients unaffected because of this procedure [202, 203].

Weight loss is achieved through the significant reduction in stomach size, which limits the amount of food that may be consumed in one sitting. As a result, patients feel full very quickly and continue to feel full for several hours, even after the consumption of a small amount of food. As a complement to the stomach size reduction, sleeve gastrectomy may also contribute to reduce the amount of ghrelin, an appetite-stimulating hormone, produced by the stomach [204-206].

Gastric banding is a minimally invasive restrictive surgical approach for weight loss where food intake is limited by a silicon band with an inflatable inner collar placed around the upper stomach [207, 208]. The silicon band is connected to a small port placed in the abdominal wall [207, 208]. This results in creating a small pouch and a narrow passage to the lower stomach. Food emptying from the pouch is delayed by this small passage, which creates a feeling of fullness for the patient. In order to change the size of the passage, the silicon band can be constricted or relaxed over time, by injecting saline through the port [209]. The Lap-Band System is considered as the safest and most common gastric device currently available [210]. Gastric banding surgery is usually performed laparoscopically and may be done as an outpatient procedure [211].

The economic impact of obesity on the healthcare system is stated to be a significant one [212]. When compared with other treatment options, Bariatric surgery has been reported to be a cost effective treatment option for obesity [213]. In fact, economic data from a Canadian retrospective study concluded that Bariatric surgery produced effective weight loss and decreases long-term direct health care costs for a variety of obesity related disorders and was cost saving after 3.5 years [214].

When factoring components such as: preoperative assessments and care, the surgery procedure itself, and the postoperative and follow-care, the total cost of Bariatric surgery may range between $14,000 and $24,000 Canadian dollars [215].

Until now, individuals with class III obesity (BMI of 40 or greater) or Class II (BMI of 35 or greater) with co-morbid medical conditions, who have prior unsuccessful weight loss attempts, are considered for surgical treatment of obesity. These guidelines are aligned with recommendation used in other countries [216]. Recently, given positive results observed in studies involving gastric banding surgery, some experts have recently suggested lowering the minimum BMI for eligibility to Bariatric surgery from 35 $kg/m^2$ to 30 $kg/m^2$ (class I obesity) with at least one co-morbid medical condition.

Expanding the guidelines to potentially include those with lower BMIs will most likely result in significantly more individuals being eligible for surgery in Canada [107]. Between 2007 and 2012, approximately 3.1 million Canadians aged between 18

and 79 could be classified under the class I obesity criteria; out of this group, three out of five were reported to have one or more co-morbidities [107].

### Obesity Surgery Weight Loss Outcomes

Obesity is a complex disease where traditional treatments such as behaviour modifications along with low calorie diets and increased physical activity as well as pharmacological therapy have rendered limited success. Individuals who have Bariatric surgery lose on average 25% of their excess body weight within the first 12 months following their surgical interventions [217]. Bariatric surgery is currently the most effective treatment for obesity with the greatest chances for improvement and even resolution of obesity-associated complications [218-220]. In addition, Bariatric surgery for morbid obesity has been linked with overall decreased mortality [221].

Findings from a meta-analysis surveying all articles published on Bariatric surgery between 1990 and 2003 indicated that a substantial majority of patients with hyperlipidemia, hypertension, and obstructive sleep apnea experienced improvement or complete resolution of these comorbidities following Bariatric surgery [158].

In addition, research conducted by Elder & Wolfe concluded that Bariatric surgery led to a reduction in the incidence of important chronic conditions including cardiovascular disease, diabetes, degenerative joint disease, lower extremity venous stasis and obstructive sleep apnea [222].

In terms of Canadian data, Christou et al conducted an observational study using a single practice in Quebec, where morbidity and mortality data for a cohort of 1035 morbidly obese patients, having undergone Bariatric surgery at the McGill University Health Center between 1986 and 2002, were compared to that of non-surgically treated matched controls. These two cohorts were followed for a maximum of five years. Significant reductions in mean percent excess weight loss (% EWL) (61.1%, $p<0.001$) and BMI percent change (34.6%, $P<0.001$) were reported in favour of the Bariatric surgery cohort [223, 224]. In addition, this study also reported significant risk reductions for developing cardiovascular diseases, infections, cancer as well as endocrine, psychiatric and mental disorders for Bariatric surgery patients when compared to controls [223, 224]. Finally, mortality rates reported over the 5 years were shown to be markedly lower in the Bariatric surgery cohort compared to the controls (0.68% versus 6.17%; RR 0.11, 95% CI 0.04-0.27) [223-225].

Obese patients have an increased prevalence of cardiovascular and type 2 diabetes risk factors, which have been shown to improve following Bariatric surgery [112, 117, 226].

The clinical benefit of excess weight loss as a major risk-reduction contributing factor for myocardial infarction, stroke and cardiovascular events has been highlighted in several observational studies [227-229]. Pooled data extrapolated from 4 observational studies, involving a total of 17, 262 patients who underwent Bariatric surgery and 26,726 nonsurgical controls (follow up period ranging from 2 years to 14.7 years), found that Bariatric surgery was associated with significantly reduced risk of composite cardiovascular adverse events (OR 0.54 95% CI 0.41-

0.70, $I^2$=58%) as well as with significant reduction in specific endpoints of myocardial infarction (OR 0.46 95% CI 0.30-0.69, $I^2$=79%) and stroke (OR 0.49 95% CI 0.32-0.75, $I^2$=59%) [230].

Essentially, the efficacy of Bariatric surgery for the improvement and even the normalization of glucose levels in obese patients with type 2 diabetes have been confirmed by several observational studies and one randomized controlled trial [231, 232]. Results from observational and randomized controlled trials have revealed that when it comes to type 2 diabetes, Bariatric surgery was associate with better glucose control and more recurrent remissions (defined as blood glucose <110 mg/dL) when compared to usual care including customary lifestyle and pharmacological treatment for obesity and diabetes [233].

Consequently to this evidence, some clinical investigators have even advocated the use of Bariatric surgery as an early therapeutic intervention for patients with type 2 diabetes who do not meet standard criteria for Bariatric surgery [234].

In fact, the International Diabetes Federation (IDF) issued a position statement, during the 2nd World Congress on Interventional Therapies for Type 2 Diabetes in 2011, indicating that Bariatric surgery should be considered earlier in the treatment of eligible patients as a means to help decrease potential serious complications [235].

This position statement was championed by 20 leading experts in diabetes and Bariatric surgery, known for having issued a series of recommendations on the use

of weight-loss surgery as a cost-effective option for severely obese people with type 2 diabetes.

This statement underlines the growing evidence supporting the substantial health benefit from Bariatric surgery, under certain circumstances, namely for the management of obese people with type 2 diabetes (for glucose control and other obesity-related comorbidities).

To date, no large scale randomized controlled clinical trials have examined the impact of surgery on morbidity or mortality[236]. Resounding data are however available from high quality observational studies such as the Swedish Obesity Study (SOS) [237]. The SOS is a prospective, cohort study of 2010 patients having undergone Bariatric surgery and 2037 non-surgical matched controls. This study was initiated in 1987 and is now nearing the 30-year follow-up mark. Reported mean changes in body weight collected following 2, 10, 15 and 20 years were -23%, -17%, -16% and -18% for the surgery group and 0%, 1%, -1% and -1% in the control group respectively. Bariatric surgery was also associated with a long-term reduction in overall mortality [adjusted hazard ratio (HR) = 0.71, 95% confidence interval (CI) 0.54-0.92; P=0.01], a decreased incidences of diabetes (adjusted HR=0.17, P<0.001], myocardial infarction (adjusted HR=0.71; P=0.02), stroke (adjusted HR=0.66; P=0.008) and cancer (women: adjusted HR=0.58; P=0.0008; men: n.s.] [238].

A recent review, which included 22 trials and 1798 participants, concluded that greater improvement in weight loss outcomes and weight-associated comorbidities,

are observed following surgical intervention for obesity when compared to non-surgical therapeutic options. This greater benefit was observed regardless of the type of surgical intervention used [239].

### Roux-en-Y Gastric Bypass Outcomes

First described by Mason in 1969 Roux-en-Y gastric bypass (RYGB) is currently the most commonly performed Bariatric surgical procedure in North America [240]. Several studies have shown significant and sustained weight loss in severely obese individuals following RYGB [241]. Most early studies have reported excess body weight loss between 60 to 70% following this procedure [242]. For instance, results from a study conducted back in 1998 reported mean loss of excess body weight at 15 months following RYGB to be slightly higher than 60% [243]. Consequently, this procedure was identified by many surgeons to be the "gold standard" for most patients with clinically severe obesity [244]. More recently, results from a retrospective survey published in 2010 reported that at 40-months post-surgery, 52.7% of patients achieved successful weight loss, defined as weight loss greater than 50% excess body weight [245]. Another retrospective observational study published in 2013 reported similar weight loss results; namely a 63.4% excess weight loss at 12 months after RYGB [246].

Numerous studies have also reported significant improvement in weight related comorbidities following Bariatric surgery [158], resolution of comorbidities have however been reported to be greater after RYGB [247]. Results of a recent systematic review assessing long term outcomes following Bariatric surgery,

reported a mean sample-size weighted percentage of excess weight loss of 65.7% along with remission rates for type 2 diabetes, hypertension and hyperlipidemia, following gastric bypass surgery [248].

In this study, remission rates for type 2 diabetes, defined as glycated hemoglobin <6.5% without medication, was reported as 66.7%. For hypertension, remission rates defined as blood pressure <140/90 mm Hg without medication was reported as 38.2%. Finally, the remission rates for hyperlipidemia (cholesterol <200 mg/dL, high-density lipoprotein > 40mg/dL, low-density lipoprotein <160 mg/dL and triglycerides < 200 mg/dL) was reported at 60.4%.

## Laparoscopic Sleeve Gastrectomy Outcomes

Laparoscopic sleeve gastrectomy (LSG) is a relatively new, treatment option available for the surgical management of morbid obesity[249]. Although new, the body of evidence available for this procedure highlight it as being an effective option for the management of morbid obesity.

In a review including several randomized controlled trials, short and medium-term follow-up weight loss outcomes related to LGS were shown to be equivalent or superior to RYGB and laparoscopic adjustable gastric banding (LAGB) [250-252].

Findings from several prospective matched cohort and case control studies have demonstrated equivalent or superior weight loss and improved obesity related comorbidity outcomes (i.e. diabetes remission rates, improvements in inflammatory markers and cardiovascular risks) following LGS when compared to RYGB and LAGB [253-255].

A recent retrospective review of the initial ten patients who underwent LSG reported an average excess body weight loss and BMI of 51% and 23 kg/m2, respectively, after a follow time period of one year [256].

More recently, a study reported the 5-year average percent excess weight loss for patients having undergone LSG as 86% [257]. This long-term study also reported complete or near complete resolution of co-morbidities in most patients following this procedure. The reported co-morbidities included type 2 diabetes (100% resolved), hypertension (95% resolved), hyperlipidemia (100%) and obstructive sleep apnea (100% resolved). Gastro-esophageal reflux being the only exception, in this occurrence, resolution was achieved in only 53% of patients.

### Laparoscopic Adjustable Gastric Banding Outcomes

Although reported to be less effective than other procedures such as RYGB and LGS, Laparoscopic adjustable Gastric banding (LAGB) is still considered to be a safe and effective surgical option for the management of severe obesity [258]. In addition, this option may be associated with lower complication rates than other Bariatric procedures.

An early study reported a 42.1% excess weight reduction at 24 months following LAGB [259].

This procedure has been shown by O'Brien and Dixon to result in approximately 56% excess weight loss at 5 years [260]. These findings are aligned with published LAGB pooled data where the 5-year excess weight loss is reported as 55% [261, 262].

A study examining the 10-year outcome of LAGB of 200 patients found that two thirds of patients reached excess body weight loss greater that 50% at some point after the operation [263].

Improvement and resolution of obesity related comorbidities outcomes such as type 2 diabetes, hypertension and hyperlipidemia, following LAGB, have also been reported in the published literature [264].

Weber et al reported a drop in prevalence of diabetes and hypertension from 44% to 18% and 60% to 18% respectively, following gastric banding surgery [265].

Brancatisano et al conducted a prospective study, assessing improvement of obesity related comorbidity outcomes, for 838 morbidly obese who underwent LAGB using the Swedish Adjustable Gastric band between 2001 and 2007 [266]. Reported resolution and/or improvement of obesity related comorbidities, after a median follow-up of 13 months, were as follows: type 2 diabetes mellitus, 79%; metabolic syndrome, 78%; hypertension, 67%; dyslipidemia, 66%; gastroesophageal reflux, 66%; asthma, 57%; arthritis/joint pain, 70%; polycystic ovarian syndrome, 48%; and depression, 57%.

In a recent review, the remission rate for type 2 diabetes, defined as glycated hemoglobin <6.5% without medication, was reported as 28.6%. Remission rates for hypertension (blood pressure <140/90 mm Hg without medication) was reported as 17.4% and the remission rates for hyperlipidemia (cholesterol <200 mg/dL, high-density lipoprotein >40 mg/dL, low-density lipoprotein <160 mg/dL and triglycerides <200 mg/dL) was reported at 22.7% [248].

## Health Related Quality of Life

Obesity is a risk factor for a myriad of morbidities, such as type 2 diabetes mellitus and cardiovascular disorders [83, 112, 226, 267]. This condition is also associated with psychological disorders, such as depression, and social discrimination [70, 79, 80, 268, 269]. Several studies have established that obese individuals experience significant impairments in quality of life because of their obesity, with greater impairments associated with greater degrees of obesity [270-279]. When quality of life is measured in the context of health and disease, it is referred to as Health-related quality of life (HRQoL) [280].

HRQoL represent a particularly important and relevant outcome when assessing the overall impact of chronic conditions such as obesity [281]. By definition, it signifies a multi-dimensional concept that includes domains related to physical, mental, emotional, and social functioning. HRQoL is therefore the functional effect of a medical condition and/or its consequent therapy upon a patient. As a concept, HRQoL goes beyond the direct measurement of population health, life expectancy, and causes of death, and focuses on the impact health status has on quality of life [282]. Health related quality of life can therefore be classified into physical and mental components and provides a means to predict future health status and the outcome itself [283]. In essence, measuring HRQoL provides a means to quantify the degree to which a medical condition or its treatment affects the individual's life along with traditional measures (i.e., BMI, survival, and tumour response), this measure allows for a rounded assessment of the burden of disease or illness [284].

Generic measures of HRQoL may be used in a wide range of populations and they assess multiple domains of functioning including mobility, self-care, physical, emotional and social functioning. These generic instruments allow for the comparison of degrees of impairment and suffering associated with different illnesses as well as improvement in functioning resulting from treatment [285]. HRQoL may therefore be used to assess changes in HRQoL over time and compare HRQoL of patients with different conditions or who receive different treatments [286].

As a gold standard, HRQoL is usually self-reported; however, in instances where the patient is too ill or too young, data on patient's HRQoL may be reported by a proxy [287].

### Short Form 36 (SF-36)

The short form 36 health survey questionnaire (SF-36) is currently the most commonly employed, self-administered, generic measure of quality of life [288-290].

The SF-36 is a well-validated questionnaire that measures eight multi-item dimensions of health. These eight dimensions are defined as follows:

- Physical Functioning (PF): 10 items focussed on the assessment of limitations in performance of various physical activities;
- Social Functioning (SF): 2 items focussed on the assessment of limitations in social functioning;
- Role Physical (RP): 4 items focussed on the assessment of limitations in daily activities as a result of physical health;

- Role Emotional (RE): 3 items focussed on the assessment of limitations in daily activities as a result of emotional problems;
- Mental Health (MH): 5 items focussed on assessment of the presence and degree of depression and anxiety;
- Vitality (VT): 4 items focussed on the assessment of energy level;
- Bodily Pain (BP): 2 items focussed on the assessment of pain-related functional limitations;
- General Health (GH): 5 items focussed on the assessment of an individual's perception of his or her overall health.

For each dimension score for the SF-36 are standardized using a scale from 0 (worst possible health state) to 100 (best possible health state). Two standardized summary scores can also be calculated from the SF-36; the physical component summary (PCS) and the mental health component summary (MHC) [291-293].

### EuroQol 5D (EQ-5D)

The EuroQol 5D (EQ-5D) is another widely used, self-administered, generic quality of life instrument which has been extensively validated [294]. The conceptual basis of the EQ-5D is the holistic view of health, which includes the medical definition, as well as the fundamental importance of independent physical, emotional and social functioning. The concept of health in the EQ-5D encompasses both positive aspects (well-being) and negative aspect (illness).

The EQ-5D consists of a 20 centimeter Visual Analog Scale (VAS) and a questionnaire. The VAS records the participant's perception of his or her own

current overall health and can be used to monitor change over time. This questionnaire provides a description of the subject's current health and is divided in 5 domains: mobility, self-care, usual activities, pain, discomfort, anxiety, and depression. Each domains comprises five questions with 3 possible answers (1=no problem, 2=moderate problem, 3=severe problem). The participants are asked to grade their own current level of function in each dimension. A dimension for which there are no problems is specified to be at level 1, while a dimension for which there are extreme problems is specified to be at level 3. Each unique health state is described by the instrument has an associated 5-digit descriptor ranging from 11111 for perfect health to 33333 for the worst possible state of health. As a result, 245 health states are described through this process [295].

### Obesity and HRQoL

A number of authors have reported the relationship between obesity and HRQoL. Most of research findings indicate HRQoL as being commonly inferior for obese individuals when compared to individuals with BMIs in the normal range (between 18.5 kg/m2 and 25 kg/m2) [296]. These findings are also consistent in reporting an association between obesity and lower HRQoL particularly for the physically oriented domains [297]. Effects of obesity on physically oriented domains of HRQoL are positively correlated as they become more pronounced with increases in obesity levels [298, 299]. A study performed by Huang et al, further highlighted this effect to be more apparent in women [300]. Published findings have also made steady reports of the impact of obesity being far more important for the physical domains when compared to the mental domains [279]. These research findings remain

constant across younger populations the elderly, or the general population. Authors have repeatedly hypothesised this effect on the physical domains to be related to mobility problems and pain experiences as a consequence of increased weight gain [301]. A study performed by Lean et al, is in support of this hypothesis since all their evaluated outcomes, namely respiratory insufficiency, low back pain, non-insulin dependent diabetes, cardiovascular risk factors and general physical function were significantly influenced by increased level of BMI [302].

A recent publication detailing results from a study involving 7640 participants further support the finding listed above. The study aiming at assessing the longitudinal association between measures of obesity and HRQoL moreover concluded that increases in BMI were correlated with decreases in physical HRQoL [303].

### Obesity treatment and HRQoL outcomes

The evidence relating to change in HRQoL in obese patients following non-surgical or surgical interventions for weight loss is currently either of relatively low quality or mainly focused on evaluating the impact of short term outcomes on HRQoL [304].

A study conducted between May 1999 and March 2001, involving 155 morbidly obese patients having undergone either laparoscopic or open gastric bypass assessed changes in quality of life (QoL), through the administration of the SF-36 at 1, 3 and 6-months post-surgery. This study reported that regardless of comparable weight loss at the 1 year time point for the both surgical groups; more rapid improvement in QoL was reported for the laparoscopic group [305].

Results originating from a 2007 questionnaire based study have also reported Improvements in QoL following LAGB surgery. In this study sixty-four out of eighty one patients (79%) reported improvements in their QoL within one year of having undergone the surgical procedure [306].

Findings from Sarwer et al, found that following a 38.8% weight loss subsequent to gastric bypass surgery, patients experienced significant improvements in health-related quality of life. These improvements were measured at 92-weeks post-surgery; when significant magnitude of change was observed for most subscales of the SF-36 [307].

Results from a study, conducted at the Bariatric surgery department of the Hadassah University Medical Center, further supports findings associated with improvements in HRQoL for patients who undergo Bariatric surgery. This study highlights that subsequently to a one year follow-up period, and a 34.7% mean weight loss reduction, higher scores than community norm were observed in all SF-36 scales for the Bariatric surgery group [308].

HRQoL evidence following Bariatric surgery as it relates to the type of surgical procedure performed is currently scarce. Such an assessment was conducted by Karlsen et al, where 139 morbidly obese patients where treated with either RYGB or intensive lifestyle-intervention program. Results from this one-year follow-up study identified that although both groups reported HRQoL improvements, weaker responses were observed for the intensive lifestyle-intervention group when compared to RYGB. The author hypothesises the difference in weight loss, in

favour of RYGB, following the two treatments, as a suitable explanation for the greater HRQoL results observed for the RYGB [309].

More recently, evaluation of HRQoL over 4 years using the SF-36 questionnaire exposed important improvements in all domains during the first 3 years post-surgery, for patients who underwent RYGB when compared to controls. The observed HRQoL improvements may not be directly correlated with excess weight loss, given that this study found no significant differences in excess body weight loss between the RYGB and the control groups. At year 4 however, results for domains such as role physical, pain, vitality, social and emotional functioning as well as mental health were similar between the RYGB and the control group. General health and physical functioning were the only domains with a better outcome for the RYGP group after four years [310].

A 5 to 10% reduction in body weight is often stated within guidelines and by experts to be of clinical importance with respect to obesity related outcomes. A two-year Canadian prospective population-based attempted to verify if such is reduction is also associated with clinically important improvements in HRQoL. This research measured HRQoL for a total of 500 patients using the SF-36 and the EQ-5D index; it concluded that weight reductions needed to achieve minimal clinically important differences for most HRQoL instruments are noticeably greater than the endorsed 5 to 10% threshold [311]. In alignment with other published evidence on the matter, weight loss improvements observed for the surgical group consistently led to clinically important improvements in HRQoL over the course of this study's reporting period.

Research assessing the impact of obesity treatments on HRQoL outcomes over longer time periods (i.e., at least five years) are currently quite limited [304].

Amongst the available evidence the Swedish obese subjects (SOS) interventional study, examining trends and effects of weight loss treatments on HRQoL over a 10-year period, currently corresponds to one of the largest and highest quality observational existing in the public domain. A total of 1276 (655 surgical and 621 non-surgical) participants completed 10 years of this study, where HRQoL was measured prior to treatment, at 6 months and at years 1, 2, 3, 4, 6, 8 and 10. Reported results indicate a close correlation between changes in HRQoL, during the 10-year observation period, and the phases of weight loss, regain and stability. Along the same lines, Improvements and deteriorations in HRQoL were associated with the magnitude of weight loss or regain. Peak improvements in the surgical group were observed during the first year of weight loss, while the weight regain phase (mainly between 1 – and 6-year follow-up) was accompanied by a steady drop in HRQoL. At the 10-year follow-up mark, net improvements were noted in all domains of HRQoL when compared to baseline results. Interestingly, findings from this study also suggest a 10% weight loss as being enough to have a positive influence on HRQoL over the long-term [312].

Trends towards decreases in HRQoL associated with weight regain between the first and sixth year post surgery is further supported by results recently issued by Kolotkin et al. The author reported HRQoL as being relatively stable, regardless of the weight regain and small decreases in HRQoL between year two and six post-

surgery. This study reported a significant correlation between excess weight loss and improvements in weight specific and physical aspects of HRQoL [313].

## Obesity and Productivity

Per the Organization for Economic Co-operation and development (OECD), productivity is defined as a ratio of a volume measure of output to a volume measure of input use. More specifically, work productivity is the amount of goods and services that a worker produces in a given amount of time.

Obesity is widely referred to as a chronic disease which adversely impacts work productivity and on-the-job performance [314].

Work limitation rates have been identified as important indicators of “on-the-job” performance. These rates offer convincing evidence about the health status of working individuals [315]. Work limitation may be self-reported using standardized validated tools such as the Work limitation Questionnaire (WLQ) [316]. Through the WLQ workers may provide their perspective of the degree to which health problems interfere with their work activities.

## Work Limitation Questionnaire (WLQ)

The WLQ is a generic validated self-reported instrument that measures the extent to which individuals experience limitations at work and estimates productivity losses. This questionnaire is divided in four scales, each measuring a different dimension of work limitation defined as time management, physical demands, mental-interpersonal and output demands. The time management (TM) scale

contains five questions dealing with difficulties involved with time and scheduling demands. The physical demands (PD) scale contains six items and incorporates a person's ability to perform tasks that involve physical strength, movement, stamina, coordination and flexibility. The nine-item mental-interpersonal scale (MIDS) deals with cognitive work tasks and on-the-job social interactions. The final scale is the output demands (OD) scale, which contains five questions pertaining to diminished work quantity and quality [316-318].

## Obesity and Productivity Loss

Often overlooked but equally important is the relationship between obesity and its outcomes on work productivity. Ample evidence underlining the correlation between obesity, increased work limitations (i.e., limitations in the kind or amount of work one can do, as a consequence of physical, mental or emotional problems [319]) and productivity loss may be found in the literature [320, 321].

Stemming from a reduced participation in the workforce, productivity loss is often a consequence of increased absenteeism or presenteeism [322]. Absenteeism corresponds to a term used to describe being actually absent from work whereas presenteeism is characterized by lower productivity while being at work. BMI has been acknowledged as a potential independent predictor of absenteeism in the work place, with obese employees missing more days of work than their normal-weight counterparts [323]. Findings from a study conducted by Gates et al exposed a threshold effect between BMI and presenteeism established on results, where moderately or extremely obese workers actually experience more significant work

limitations when compared to mildly obese workers. Similarly, Klarenbach et al reported the likely presence of an inversed correlation between obesity severity and the odds of participation in the workforce; with class I, II and III obesity having odds ratios of 0.94 (0.89-0.99), 0.85 (0.77-0.94) and 0.66 (0.57-0.78) respectively [324].

As the prevalence of obesity increases in Canada, so will the percentage of obese individuals in the workforce, ultimately leading to negative labour market outcomes and significant economic consequences. Essentially, indirect costs of obesity related to absenteeism, lower productivity and unemployment cost the Canadian economy $2.63 billion dollars in 2008 [325].

### Obesity Surgery and Work Limitation Outcomes

Few studies have measured the impact of Bariatric surgery on productivity. However, the data published to date has repeatedly found Bariatric surgery to have a favourable impact on work productivity outcomes. An early study published in 1998, involving 69 Bariatric surgery patients, reported an increase in employment rate from 53% before the surgery to 80% after a mean follow-up time of 85.9 months post-surgery [326].

In 2007, results from a study conducted by Hawkins et al. contributed to further supported findings related to improvement in work productivity. This study, observed 59 patients for a median follow-up period of 14 months after the surgical procedure. At the end of the study follow-up period, the proportion of patients who worked increased from 58% to 76%. In addition, the average number of reported hours worked per week increased from 30.1 to 35.8 hours. Furthermore, there was

an 87% decrease in the number of respondents who specified obesity as a factor affecting the time spent on paid or unpaid work. Finally, the post-surgery work or productivity profile observed in this research was highly similar to what is found in the average UK population [327].

A recent publication assessed changes in patients' employment impairment and productivity 12-months post-surgery. This study conducted by Sockalingam et al reported a significant reduction in both endpoints ($p<0.0001$) upon completion of the follow-up period [328].

The collective research conducted to date has highlighted Bariatric surgery as the most effective intervention for the management of obesity and its related comorbidities, regardless of the type of procedure used. Individuals who undergo this procedure have been observed to lose on average between 60 and 75% of excess body weight within 12 months of the surgery. Although scarce, scientific evidence has conveyed the observed excess weight loss to be sustained beyond 10 years. Obesity related comorbidity outcomes, such as type 2 diabetes, hypertension and cardiovascular disorders, have also been found to greatly improve or even resolve, because of excess body weight loss, following the surgical procedure. Moreover, although assessed over short terms, improvements in Health related quality of life and productivity loss outcomes have also been established because of this intervention. Less is however known about the status of these outcomes over the long term for patients who have undergone surgery.

The need for assessments of HRQoL and productivity loss outcomes over longer time horizons, following Bariatric surgery, has actually been identified as a key area of focus in this field of research[304]. Given the chronic nature of obesity and the considerable direct and indirect costs which make up the economic burden of illness, assessing HRQoL and productivity loss over the long term (>10 years) following Bariatric surgery will be very valuable in providing a more comprehensive picture of the net impact of Bariatric surgery, as an effective therapeutic option for obesity management. Long-term outcomes data related to HRQoL and productivity loss following Bariatric surgery remains relatively scarce, especially in the Canadian setting. This research will aim to expend the scientific knowledge base to include long term HRQoL and productivity outcomes data following surgery in the Canadian setting. This contribution may serve to assist Canadian health policy makers in their evaluation of medical interventions for the management of obesity, and as they craft national or provincial health policies around this chronic disease.

## Objectives

The overall study objective was to describe the impact of Bariatric surgery on HRQoL and work productivity, in patients with morbid obesity.

**Objective #1:**

To describe the impact of Bariatric surgery on HRQoL and work productivity.

**Objective #2:**

To assess the relationship between EWL, HRQoL and work productivity in Bariatric surgery patients; and to determine the impact of time, since surgery, on this relationship.

**Objective #3:**

To identify predictive determinants of HRQoL and work productivity outcome measure scores following Bariatric surgery in obese patients.

**Objective #4:**

To determine the impact Bariatric surgery on chronic comorbidities.

# Methodology

## Design

This study utilized a cross-sectional survey design that was conducted from August 2013 to October 30th 2013. The survey measured health related quality of life and work productivity of morbidly obese patients sampled from a population of patients being treated at the McGill University Health Centre (MUHC).

The criteria for participation were as follows:

## Inclusion criteria

1. Male and female patients aged 18 years and older
2. Morbidly obese patients having undergone Bariatric surgery at the Centre for Bariatric Surgery, McGill University Health Centre (MUHC) at any time between January 1992 and July 31, 2013 or;

   morbidly obese patients being treated at the McGill University Health Center for Bariatric surgery and who are identified as being wait-listed for treatment up to July 31, 2013.
3. Ability to provide informed consent.

## Exclusion criterion*:*

1. Inability or unwillingness to complete patient reported questionnaires.

## Procedures

### IRB Approval Process:

The study proposal received IRB approval from the Institutional Review Board Services, on July 2nd 2013.

The referring physician signed the IRB approved study participation invitation. For the purpose of this study, the referring physician was Dr. Nicolas Christou (legal representative authorized to administer the informed consent process). This IRB approved study participation invitation letter also served as the informed consent document. This document provided the patients with information specific to the following:

- Informed consent process
- Study objectives
- Study procedures and duration
- Legal representative's responsibilities
- Study participants' responsibilities
- Ethics review board's responsibilities

Potential participants were advised through the invitation to participate letter that by returning the completed questionnaires, they are providing implicit consent to participate in the study. Participants were requested to return the completed surveys by October 30, 2013.

Health related quality of life and work productivity data were gathered through an anonymous survey. From the first week of August 2013 to the first week of October 2013, using a single envelop, 1944 questionnaires were mailed to patients identified from the MUHC Bariatric surgery database.

The contents of the envelope mailed to participants were as follows:

- IRB approved Letter of invitation to participate (English or French version) (Appendix 3)

- Questionnaires (English or French version) (Appendices 4 to 6)
    - EQ-5D
    - SF-36
    - WLQ
- Reply envelope with paid postage
- Returned questionnaires were checked by the researcher to ensure their completion. Information regarding completed questionnaires was recorded by the researcher using a coding system to identify the patients who had completed the questionnaires. Information such as new forwarding addresses, notification that the participant had died or advice that the patient did not want to take part in the study was also recorded. The envelopes that were returned to sender with no forwarding addresses were followed up where possible using the telephone directory.

In total, 122 respondents completed and returned the questionnaires. The study sample size was therefore composed of 122 patients.

## Sample

Taking into account their surgical status, the 122 patients who returned the completed questionnaires were divided in two groups:

- Post-operative patient population (surgical group): morbidly obese patients having undergone Bariatric surgery at the Centre for Bariatric Surgery, McGill University Health Centre (MUHC) at any time between January 1992 and July 31, 2013
- Pre-operative patient population (non-surgical group): Patients being treated at the McGill University Health Center for Bariatric surgery and who are identified at being wait-listed for treatment up to July 31, 2013.

## Measures

### Health related quality of life (HRQL):

#### Medical Outcome Study Short Form 36-item (SF-36)

HRQL was measured using the SF-36 (version 2.0). The SF-36 is intended to give information on general health and wellbeing, but this instrument also allows for the calculation of aggregate summary scores for the physical component (PCS) and mental component (MCS). This is a widely used survey, deemed meaningful to patients, clinicians, researchers and administrators across the health care system (Ware & Sherbourne, 1992). Published International Quality of Life Assessment (IQOLA) Project SF-36 translations and English-language adaptations are available for royalty-free distribution by the Health Assessment Lab.

The SF-36 encompasses 35 items grouped under eight subscales (physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health), plus one item that measures change in the health status in the last 12 months.

Each item has a Likert-style structure and participants are asked to provide an answer that comes closest to how they have felt during a 4-week recall period.

### EuroQol-5D

The EQ-5D is a standardized instrument for use as a measure of health outcome developed by the EuroQol group (a consortium of investigators in Europe) [329]. The EQ-5D has gained widespread use for several reasons; namely for being a brief cognitively simple questionnaire well adapted for self-completion by participants via postal surveys. The measure is also easy to score and interpret.

The EQ-5D questionnaire is completed in relation to five domains: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. For each domain, there are three levels of response: individuals are asked whether they have no problems, some problems or severe problems. The answers given for the five areas are then transformed to generate a summary score, which indicates the overall utility. In total, there are 245 possible health states (i.e. 3 to the power of 5 plus unconscious and dead), formed through different combinations of the levels. Each state is referred to in terms of a 5-digit code. A single summary score is generated by applying societal preference weights to a health state classifier completed by the patient. The utility score is typically interpreted along a continuum where 1

represents best possible health and 0 represents death, with some health states considered worse than death (<0).

In addition to the self-classifier, the EQ-5D also provides a global rating of current health using a 20 cm visual analog scale (VAS) ranging from 0 (worst imaginable health) to 100 (best imaginable health) along which the respondent rates their current health.

The index-based utility scores can be used to compare burden of disease across different conditions. The ability to convert self-classifier responses into a single preference-based score makes the EQ-5D a practical tool for clinical evaluation. This tool also allows for the potential generation of health profiles by functional class.

### Work Limitation Questionnaire

Productivity loss was assessed through the administration of the work limitation questionnaire. The work limitation questionnaire is a self-administered survey instrument. This survey asks employees to rate their level of difficulty (or ability) to perform 25 specific job demands in the last 2 weeks. Responses to the 25 items are combined into four work limitation scales: Time management; Physical Demands; Mental/Interpersonal and Output Demands. These four scales aim at capturing the multidimensionality of job roles and also reflect an important characteristic of many chronic illnesses, in that they may result in limitations in performing some activities but not others [330].

The Time Management scale consists of five items addressing the difficulty in managing time and scheduling demands. The Physical Demands scale contains six items covering a person's ability to perform job tasks that involve physical strength, stamina, movement, coordination and flexibility. The Mental/Interpersonal Demands scale has nine items that assess cognitive job tasks and on-the-job social interactions. The Output Demands scale has five items concerning reduced work quantity and quality. Each item has a 5-point ordinal response scale and there is an additional category of response for “does not apply to my job” (the sixth point). Scale scores range from 0 (limited none of the time) to 100 (limited all of the time). In addition to the scale score, a total WLQ index score can be calculated and converted into an estimate of productivity loss.

The data collected from the completed work limitations questionnaires were recorded by the researcher and scored as follows:

0 = 0% (none of the time)

1= 25%

2= 50%

4= 100% (all of the time)

“Does not apply” responses are set as missing data.

The individual level score is a mean of the responses for items within the scale. The mean is used instead of a summed scale to take into account the valid option of “does not apply”. If half or more of the responses within a scale are missing, the

case was deleted. The mean of the items is then multiplied by 25 to put it on a scale of 0-100%.

## Data Analysis

The survey data were coded and entered by the researcher into the Statistical Packages for Social Sciences (SPSS) version 22. Illegible responses were coded as missing data.

Descriptive statistics were repeated for the study sample as a whole and for the pre-op and post-op groups. This included the mean, median, standard deviation and 95% confidence interval of the mean for continuous scale variables and frequency distributions for categorical scale variables. Differences between the pre-op and post-op groups with respect to continuous variables were assessed with the Student's t-test for independent samples. Normality of continuous scale variables were assessed with P-P plots and the Kolmogorov-Smirnov test. When significant ($p<0.01$), the Wilcoxon ranked-sum test was used to assess between group differences. Chi square statistic was performed to assess differences for categorical scale variables.

In order to address the first objective, SF-36 scores for the post-op patients were compared to those of the pre-op patients. An area under the curve (AUC) plot was constructed to represent the SF-36 scores at different points in time after surgery or after being wait-listed for surgery.

General linear models, using month of follow-up as a factor and covariates adjusting for baseline patient characteristics, specifically age, comorbidities, relationship status, education, employment status and baseline BMI, were used to produce Least Square Mean (LSM) estimates at each month of follow-up for the two patient

groups. The LSM estimates were then used to create the area under the curve (AUC) for each group. The two AUCs were then compared using Hanley's method [331]. The difference between the SF-36 scores for each patient from that of respective age and gender normal values was used as the outcome variable. Similar analysis methods were used to assess the difference between the EQ-5D and WLQ for each patient group.

For objective 2, the association between excess weight loss (EWL) SF-36, EQ-5D and WLQ scores were first analyzed using simple Pearson correlation coefficients. This analysis was repeated for duration of follow-ups classified in quantiles in order to assess the impact of time on the association between EWL and QOL as well as EWL and work productivity measurements. The independent associations between EWL and changes in HRQoL and work productivity measurements were assessed using General Linear Models where EWL was classified in quantiles and where the independent factor and the following variables were included as covariates: age, duration of follow-up, employment status, education, and relationship status.

For objective 3, a General Linear Model was used to identify independent predictors of HRQOL measures. The predictors included in the model were: age, gender, body mass index (BMI) at the initial visit with the surgeon and at follow-up time post-surgery

For objective 4, odds ratios were used to compare paired odds ratios of the occurrence of comorbidities between the pre-op and post-op groups at baseline and

at the time of follow-up (i.e. at questionnaire completion), given exposure to Bariatric surgery.

# Results

## Descriptive Statistics

Of the 1944 patients (1189 female and 755 male patients) to whom questionnaires were mailed, 122 respondents (110 female patients and 12 male patients) completed and returned the questionnaires. Another 3 returned the questionnaires indicating that they did not wish to participate. In total, 6% of the mailed questionnaires were returned. Notification was received that 20 patients had moved and another 9 were deceased. The remaining patients could not be traced. Most of the respondents completed their questionnaires in October 2013.

As participants were required to specify if they were post-operative (surgery group) or pre-operative (non-surgical group), of the 122 patients who completed the questionnaire, 91 (90 females and 1 male patient) were post-operative patients (post-op) and 31 (20 females and 11 male patients) as pre-operative patients (pre-op).

Table 1 describes the socio-demographic characteristics of the study population, a summary of which is provided below.

## Gender

Most of the respondents were of the female gender (90.2%), leaving approximately 1 out of 10 respondents being male (9.8%).

When dividing the total study population into post-op and pre-op status, the distribution of male versus female participants favoured females in both groups and

was significantly greater in the pre-op study population (for a ratio of 11out of 31or 35.5%) than in the post-op study population (ratio of 1 out of 91 or 1.1%) ($p<0.0001$).

### Age

Questionnaire respondents were aged between 25 and 74 years with the average of the total sample (N=122) being 52 years of age. 59.8% of the total sample was 55 years old or less.

The mean age for the post-op study population (N=91) was 54.40±10.70 and statistically significantly greater than that of the pre-op study population at 45.81±8.76 ($p<0.0001$). Age distributions for the complete sample, post-operative and pre-operative patient population all followed a Gaussian distribution and are illustrated in figures 2 and 3.

### Relationship Status

More than half of the total study participants listed their relationship status as married or living with a partner (53%). Close to one third of them were single (31%), and almost one out of 5 of the total participants (16%) were divorced ($p<0.0001$).

Approximately 60% of the post-op study population (N=91) were married or living with a partner. Close to 1 out of four of them were single and 15% were divorced ($p<0.0001$). Close to one third of the pre-op study population (N=31) were married or living with a partner. More than half of them (52%) were single and almost one-fifth (16%) were divorced ($p<0.0001$).

## Education

The highest level of education (more than 16 years of schooling) was reported to have been attained by close to a quarter (24%) of the total sample. An additional 30% of the total population completed more than 11 but up to 16 years of schooling and almost half (46%) of the total number of participants completed up to 11 years of schooling.

Similar results were observed for the post-op study population and the pre-op. Respectively, 25% and 19% of the post-op and pre-op study population had indicated having completed more than 16 years of schooling (p=0.873). 29% of the post-op and 35% of the pre-op study populations had completed more than 11 but up to 16 years of studies (p=0.764). Finally, close to half of the post-op and pre-op study populations, 46% and 45% respectively indicated having up to 11 years of schooling as their education (p=0.771). The two groups were therefore comparable when it came to their reported levels of education.

## Employment

Out of the 122 participants who completed the questionnaire, close to half (49%) of them held gainful full time employment. Most of the remaining half (48%) were found to be absent from the work force. A small portion (3%) of the total sample was classified under the retired category.

At the time of follow-up (i.e. questionnaire completion), when considering data for individuals assigned to the post-op and pre-op groups, paid employment was held

by a greater percentage of individuals found in the pre-op group (77% vs. 40%) ($p<0.0001$). At the same time, more than half (56%) of the post-op study population and close to one quarter (23%) of the pre-op study population were unemployed ($p<0.0001$). Retirement status was specified by 4% of the pre-op participants and by none of the individual assigned to the pre-op group ($p<0.0001$).

### Weight

Mean ± standard deviation body weight outcomes for the total sample (N=122), the post-op study population (N=91) and the pre-op study population (N=31) were respectively 95.55 ± 29.71, 82.76 ± 12.62 and 133.09 ± 32.70 ($p<0.0001$). When comparing these means issued from self-reported data recorded at the time of questionnaire completion to data extracted from patient records, this represents a 27% and 36% weight loss reduction respectively for the total study sample and the post-op subgroup. A statistically significant 1% weight gain was however, observed for the pre-op sub study population during the study follow-up.

Mean body weight results for both the post-op and pre-op groups were above what is considered an ideal body weight. The average ideal body weight for the entire sample (N=122) was 64.64 ± 5.64. The estimated ideal body weight for the post-op and pre-op groups were respectively 63.34 ± 4.54 and 68.45 ± 6.78. Consequently, in order for the total population as well as the post-op and pre-op sub study population to reach their ideal body weight, a 32%, 23% and 49% weight loss reduction would correspondingly be required.

## BMI

The mean BMIs reported in kg/m$^2$, at the time of questionnaire completion, correspondingly for the complete sample (N=122), the post-op (N=91) and pre-op (N=31) study populations were 35.46 ± 9.75, 31.47 ±5.15 and 47.15±10.67 ($p<0.0001$). A mean statistical difference of 15.68 kg/m$^2$ was observed in favour of the pre-op group.

## Duration of Follow-up

Duration of follow-up for any given participant begins when he or she is first seen by a treating surgeon. Thus, participants included in the total study sample (N=122) had on average 12.18 ± 9.13 years of follow-up at the time of questionnaire completion. Follow-up time for the post-op (N=91) and pre-op (N=31) study populations were assessed respectively as 15.31 ± 9.62 years and 3.00 ± 1.46 years and the difference between groups was deemed statistically significant ($p<0.0001$).

Duration of follow-up was also evaluated for any given participant who underwent a surgical intervention. Therefore, on average the calculated follow-up time post-surgical intervention to when the questionnaires were completed was 12.41 ±9.80 years for the post-op study population.

The most frequent Bariatric surgical techniques observed for the surgical group were isolated gastric bypass laparoscopic and isolated gastric bypass Open.

In Summary, the post and pre-operative groups were comparable when accounting for demographic characteristics such as gender and level of education. The groups did however differ significantly when taking in consideration characteristics such as age, relationship status, employment, weight and BMI. In essence, the post-operative group appeared to be on average older and less employed than the pre-operative group. Comparatively, the pre-operative group had higher weights and BMIs.

## Table 1: Demographics of Questionnaire Respondents

| | Total Sample | Post-op | Pre-op | P value |
|---|---|---|---|---|
| Number of patients studied (N) | 122 | 91 | 31 | |
| Age (y) | | | | |
| - Mean ± SD | 52.21 ± 10.87 | 54.40 ± 10.70 | 45.81 ± 8.76 | P<0.0001 |
| - Median | 52 | 54 | 46 | |
| Gender | | | | |
| - Male | 11 | 1 | 11 | P<0.0001 |
| - Female | 111 | 90 | 20 | P<0.0001 |
| Weight at initial visit with surgeon (kg) | | | | |
| - Mean ± SD | 130.27 ± 25.52 | 129.91 ± 22.78 | 131.33 ± 32.70 | P=0.823 |
| - Median | 127.01 | 127.01 | 125.64 | |
| Weight at questionnaire completion (kg) | | | | |
| - Mean ± SD | 95.55 ± 29.71 | 82.76 ± 12.62 | 133.09 ± 33.58 | P<0.0001 |
| - Median | 86.53 | 82.69 | 130.00 | |
| Height (m) | | | | |
| - Mean ± SD | 1.64 ± 0.08 | 1.62 ± 0.08 | 1.68 ± 0.09 | P=007 |
| - Median | 1.64 | 1.62 | 1.68 | |
| BMI ($kg/m^2$) at initial visit with surgeon | | | | |
| - Mean ± SD | 48.57 ± 8.97 | 49.27 ± 8.35 | 46.55 ± 10.47 | P=0.146 |
| - Median | 46.58 | 48.20 | 45.94 | |
| BMI ($kg/m^2$) at questionnaires completion | | | | |
| - Mean ± SD | 35.46 ± 9.75 | 31.47 ± 5.15 | 47.15 ± 10.67 | P<0.0001 |
| - Median | 32.80 | 31.21 | 46.40 | |
| Duration of follow-up (y) | | | | |
| - Mean ± SD | 12.18 ± 9.13 | 15.31 ± 9.62 | 3.00 ± 1.46 | P<0.0001 |
| - Median | 8.00 | 11.00 | 3.00 | |
| Duration of follow-up post-surgery (y) | | | | |
| - Mean ± SD | n/a | 12.41 ± 9.80 | n/a | n/a |
| - Median | n/a | 10.00 | n/a | |
| Employment status (%) | | | | |
| - Employed | 49% | 40% | 77% | P<0.0001 |
| - Unemployed | 48% | 56% | 23% | P<0.0001 |
| - Retired | 3% | 4% | 0% | P<0.0001 |
| Relationship status (%) | | | | |
| - Married/partnered | 53% | 60% | 32% | P<0.0001 |
| - Single | 31% | 24% | 52% | P<0.0001 |
| - Divorced | 16% | 15% | 16% | P<0.0001 |
| Years of Education (%) | | | | |
| - ≤11 years | 46% | 46% | 45% | P=0.771 |
| - >11 years ≤16 years | 30% | 29% | 35% | P=0.764 |
| - >16 years | 24% | 25% | 19% | P=0.873 |

## Comorbid Health Conditions

Table 2 lists the main comorbid conditions that participants reported as part of the survey. The most frequently reported conditions for the total study population were (in order, from the most frequent) hypertension, sleep apnea, psychological disorders (depression/anxiety), diabetes mellitus, osteoarthritis, hypercholesterolemia, gastroesophageal reflux disease (GERD), gout, stress incontinence, dyslipidemia, gallbladder disease, asthma, thyroid dysfunction, deep vein thrombosis (DVT), stroke, polycystic ovary syndrome (PCOS) and cancer.

The 5 most frequently reported comorbid conditions for the post-op study population were: sleep apnea, hypertension, psychological disorders (depression/anxiety), osteoarthritis and diabetes mellitus. For the pre-op study population, the 5 most frequently reported comorbid conditions were hypertension, psychological disorders (depression/anxiety), sleep apnea, diabetes mellitus and gastro esophageal reflux disease (GERD).

More than one third of the study population suffered from hypertension (37%), sleep apnea (36%) and psychological disorders (35%). A little over a quarter of them suffered from osteoarthritis (28%) and diabetes mellitus (28%). These self-reported findings are representative of comorbidity profiles commonly associated with obesity [332].

A prevalence of comorbidities can be observed, across the board, between the post and pre-op study populations for all conditions except for stroke, gallbladder disease, osteoarthritis, asthma and cancer (stroke (14% vs. 13%), gallbladder

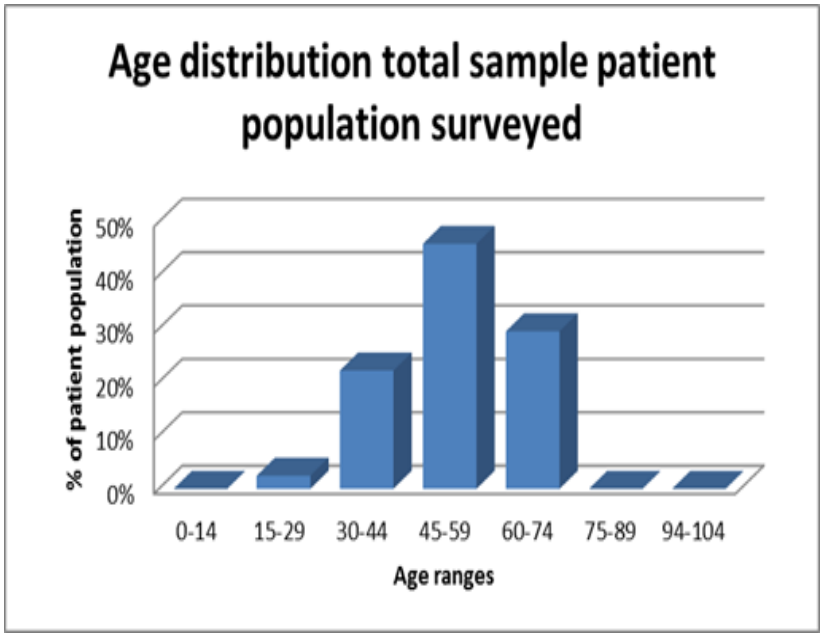
disease (19% vs. 16%), osteoarthritis (29% vs. 26%), asthma (18% vs. 16%) and cancer (8% vs. 7%)).

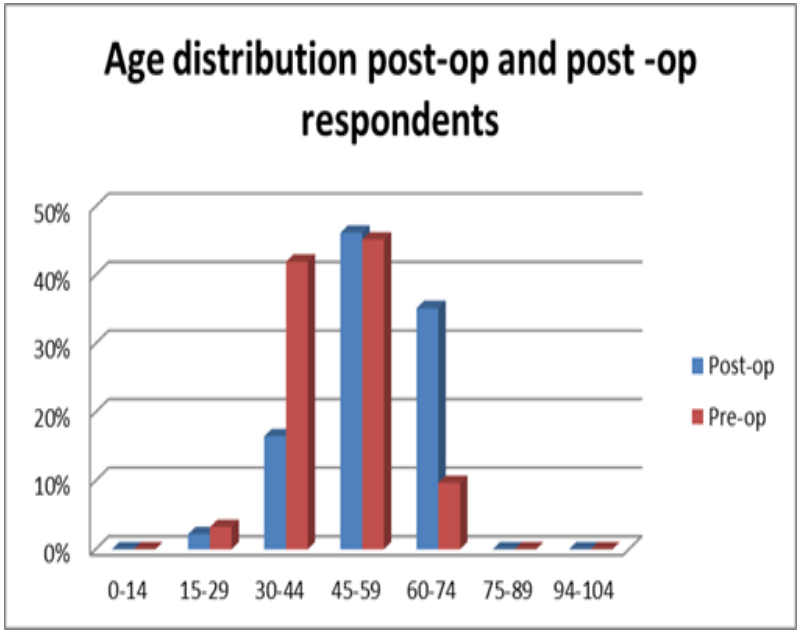
## Table 2: Frequency Distribution of Comorbid Conditions

| Comorbid Conditions (%) | Baseline | | | At Questionnaire completion | | |
|---|---|---|---|---|---|---|
| | Total Sample | Post-op | Pre-op | Total Sample | Post-op | Pre-op |
| | N=122 | N=91 | N=31 | N=122 | N=91 | N=31 |
| Diabetes mellitus | 37% | 35% | 42% | 28% | 25% | 35% |
| Hypertension | 48% | 48% | 48% | 37% | 34% | 45% |
| Hypercholesterolemia | 30% | 30% | 29% | 25% | 24% | 26% |
| Stroke | 16% | 16% | 13% | 14% | 14% | 13% |
| Dyslipidemia | 20% | 19% | 23% | 18% | 16% | 23% |
| DVT[1] | 13% | 12% | 16% | 13% | 12% | 16% |
| Gallbladder disease | 21% | 23% | 16% | 18% | 19% | 16% |
| Osteoarthritis | 28% | 29% | 26% | 28% | 29% | 26% |
| Gout | 22% | 21% | 26% | 20% | 19% | 23% |
| Sleep Apnea | 43% | 43% | 42% | 36% | 35% | 39% |
| GERD[2] | 31% | 29% | 39% | 25% | 24% | 29% |
| Asthma | 19% | 18% | 23% | 17% | 18% | 16% |
| PCOS[3] | 16% | 13% | 23% | 11% | 11% | 13% |
| Stress incontinence | 21% | 22% | 19% | 18% | 18% | 19% |
| Thyroid dysfunction | 17% | 14% | 26% | 13% | 12% | 16% |
| Psychological Disorders (Depression/Anxiety) | 40% | 42% | 35% | 35% | 33% | 42% |
| Cancer | 3% | 4% | 4% | 6% | 8% | 7% |

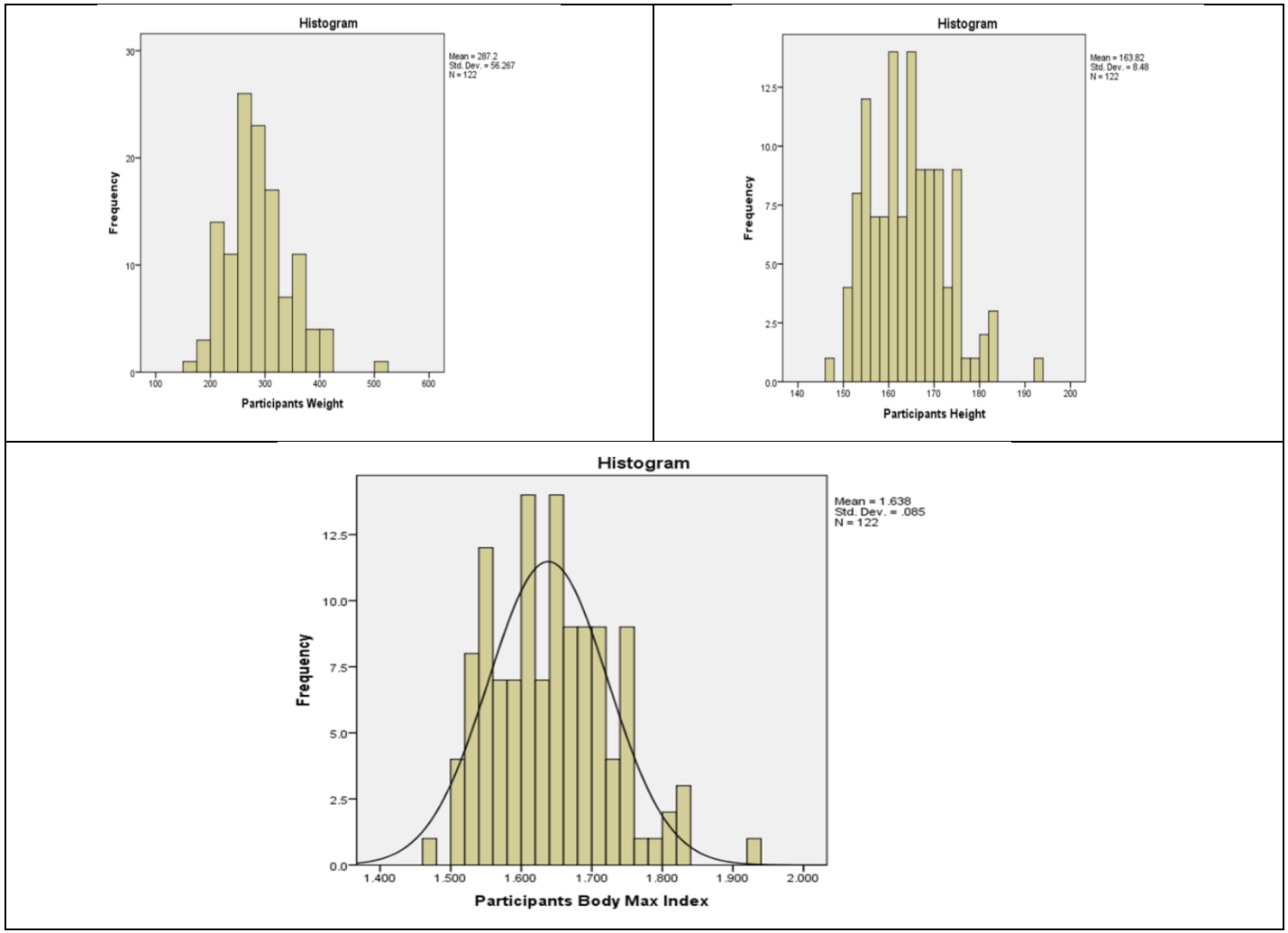
1: DVT = Deep Vein Thrombosis
2: GERD = Gastro esophageal Reflux Disease
3: PCOS = Polycystic Ovary Syndrome

## Figure 2: Age Distributions



## Figure 3: Body Weight, Height and BMI Distributions for Total Sample



# Measures

## Health Related Quality of Life

### SF-36

### Table 3: Means and Standard Deviations for SF-36 Subscale Scores

| | Total Sample | Post-op | Pre-op | P value* | Canadian Norms[333] |
|---|---|---|---|---|---|
| N | 122 | 91 | 31 | | |
| SF-36 PF Scale | | | | | |
| - Mean ± SD | 42.50 ± 11.84 | 44.65 ± 12.74 | 36.20 ± 4.86 | P<0.001 | 88.00 ± 16.90 |
| Median | 43.35 | 50.70 | 36.00 | | |
| SF-36 RP Scale | | | | | |
| - Mean ± SD | 44.90 ± 10.84 | 46.52 ± 11.68 | 40.13 ± 5.73 | P<0.001 | 84.90 ± 31.90 |
| Median | 44.60 | 49.50 | 37.00 | | |
| SF-36 BP Scale | | | | | |
| - Mean ± SD | 43.32 ± 11.94 | 44.50 ± 12.82 | 39.85 ± 8.11 | P=0.021 | 76.20 ± 23.40 |
| - Median | 41.80 | 46.10 | 41.40 | | |
| SF-36 GH Scale | | | | | |
| - Mean ± SD | 43.87 ± 12.00 | 46.18 ± 12.63 | 37.07 ± 6.26 | P<0.001 | 77.30 ± 18.40 |
| - Median | 42.20 | 48.20 | 36.20 | | |
| SF-36 VT Scale | | | | | |
| - Mean ± SD | 47.68 ± 10.92 | 48.69 ± 12.11 | 44.73 ± 5.38 | P=0.015 | 65.50 ± 18.20 |
| - Median | 45.80 | 49.00 | 45.80 | | |
| SF-36 SF Scale | | | | | |
| - Mean ± SD | 43.64 ± 11.74 | 45.62 ± 12.08 | 37.83 ± 8.43 | P<0.001 | 86.40 ± 20.30 |
| - Median | 45.90 | 51.40 | 40.50 | | |
| SF-36 RE Scale | | | | | |
| - Mean ± SD | 43.58 ± 12.41 | 44.99 ± 13.83 | 39.43 ± 4.77 | P=0.001 | 85.60 ± 30.10 |
| - Median | 44.20 | 48.10 | 40.30 | | |
| SF-36 MH Scale | | | | | |
| - Mean ± SD | 43.20 ± 12.31 | 46.30 ± 12.42 | 34.11 ± 5.78 | P<0.001 | 76.80 ± 15.80 |
| - Median | 41.60 | 50.00 | 35.90 | | |
| SF-36 PCS Scale | | | | | |
| - Mean ± SD | 43.20 ± 12.31 | 45.58 ± 11.84 | 39.69 ± 5.32 | P<0.001 | 51.30 ± 9.00 |
| - Median | 44.50 | 49.00 | 37.90 | | |
| SF-36 MCS Scale | | | | | |
| - Mean ± SD | 44.76 ± 11.68 | 46.80 ± 12.65 | 38.78 ± 4.54 | P<0.001 | 51.40 ± 9.20 |
| - Median | 45.75 | 50.00 | 39.30 | | |

*Independent sample t-test significant at the 0.05 level (2-tailed)

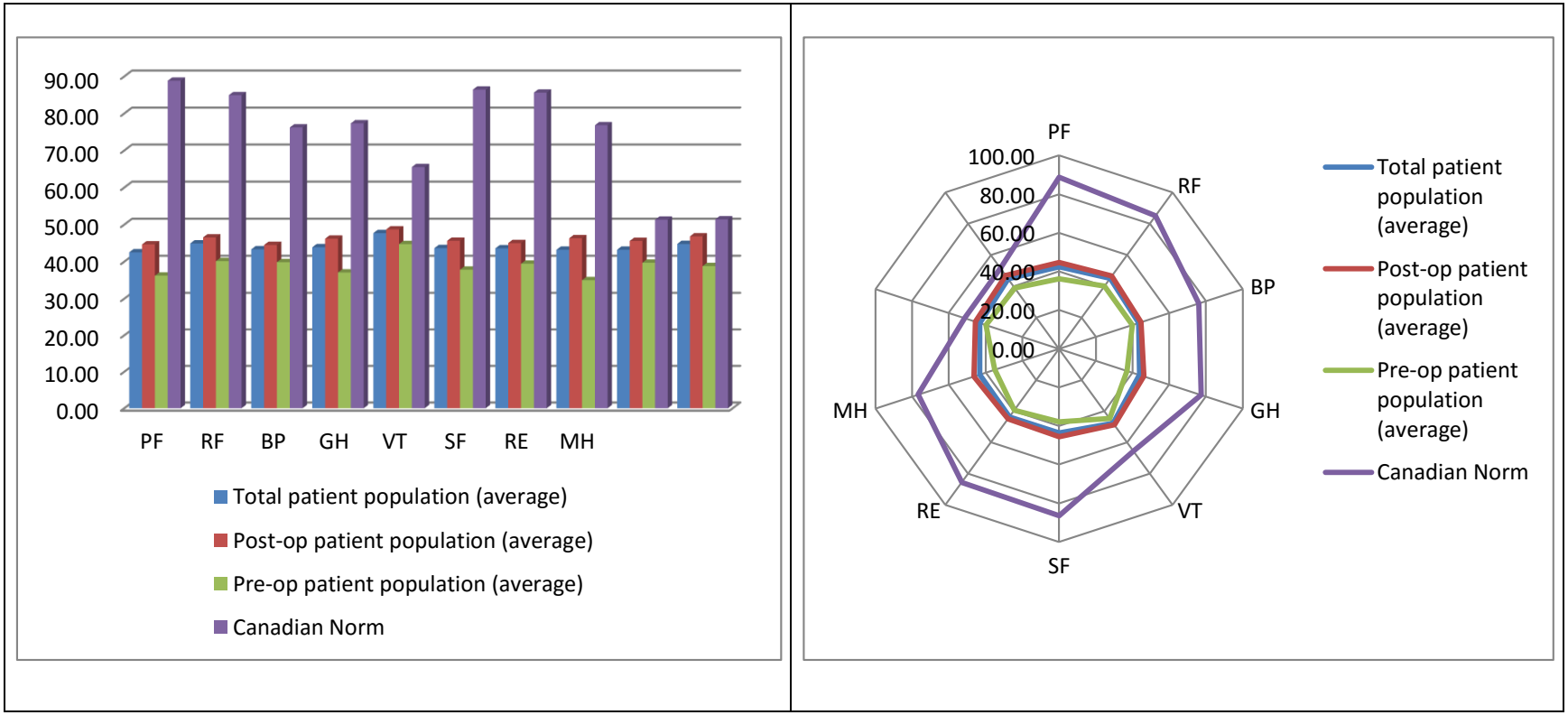
Table 3 lists the SF-36 subscale scores and summary scores for the participants. Figure 4 provides a summary representation of results obtained. The subscale scores for the total study sample ranged from 47.68 (Vitality) to 42.50 (Physical Functioning). In comparison, subscale scores for the post-op and pre-op study groups ranged respectively from 48.69 (Vitality) to 44.50 (Bodily Pain) and from 44.73 (Vitality) to 34.11 (Mental Health). When considering the results obtain for the total sample (N=122), the study participants scored on average 34.26 points (not factoring the component summary scale scores). This average score is lower than what is observed per Canadian norms and that across all subscales of the SF-36 [334]. Differences of 5.72 and 4.60 points are consequently observed for the PCS and MCS scales between results tabulated for the total sample and the Canadian norms. Now when comparing results obtained for the post-op study group to those of the pre-op group, individual in the post-op group scored higher scores averaging 7.26 points (not factoring the component summary scale scores) were observed in favour of the post-op group, namely for all subscales of the SF-36. When focussing on the summary subscales, differences of 5.89 and 8.02 points were respectively observed between the post-op and pre-op groups for the PCS and MCS scales.

Since Mortensen et al. (2000) recommended that differences of 3 points on PCS and MCS be considered clinically important, the differences between scores reported for the total sample and the Canadian norms as well as the post-op and pre-op groups would be considered clinically significant [335].

The score suggests that overall, individuals participating in this survey regarded themselves as having a worst health status them Canadian individuals with the same

mean age. These scores also suggest that individuals having undergone a Bariatric surgery (post-op group) for the management of obesity had a better perception of their health status, when compared to those who had not (pre-op group). In addition, differences between the post-op and pre-op groups were found to be statistically ($p<0.05$, as described in Table 3) and clinically significant.

## Figure 4: SF-36 Summary of Results



## EQ-5D

### Table 4: Mean and Standard Deviation for EQ-5D Utility Index and VAS Scores and Proportions Reported Levels within EQ-5D Dimensions Compared to Population Norms

| | Complete Sample | Post-op | Pre-op | P value | Population norms[336] |
|---|---|---|---|---|---|
| N | 122 | 91 | 31 | n/a | 1517 |
| EQ-5D utility | | | | | |
| - Mean ± SD | 0.78 ± 0.19 | 0.81 ± 0.20 | 0.72 ± 0.13 | P=0.006 | 0.87± 0.10 |
| - Median | 0.81 | 0.83 | 0.77 | | |
| EQ-5D Mobility | | | | | |
| - Mean ± SD | 1.21 ± 0.41 | 1.20 ± 0.40 | 1.26 ± 0.45 | P=0.483 | |
| - Level 1 | 96 (79%) | 73 (80%) | 23 (74%) | | 81.8% |
| - Level 2 | 26 (21%) | 18 (20%) | 8 (26%) | | 17.8% |
| - Level 3 | 0 (0%) | 0 (0%) | 0 (0%) | | 0.4% |
| EQ-5D Self-Care | | | | | |
| - Mean ± SD | 1.11 ± 0.32 | 1.04 ± 0.21 | 1.32 ± 0.48 | P=0.003 | |
| - Level 1 | 108 (89%) | 87 (96%) | 21 (68%) | | 98.5% |
| - Level 2 | 14 (11%) | 4 (4%) | 10 (32%) | | 0.8% |
| - Level 3 | 0 (0%) | 0 (0%) | 0 (0%) | | 0.8% |
| EQ-5D Usual-Activity | | | | | |
| - Mean ± SD | 1.39 ± 0.52 | 1.27 ± 0.50 | 1.71 ± 0.46 | P<0.000 | |
| - Level 1 | 77 (63%) | 68 (75%) | 9 (29%) | | 84.4% |
| - Level 2 | 43 (35%) | 21 (23%) | 22 (71%) | | 13.7% |
| - Level 3 | 2 (2%) | 2 (2%) | 0 (0%) | | 1.9% |
| EQ-5D Pain/Discomfort | | | | | |
| - Mean ± SD | 1.71 ± 0.61 | 1.70 ± 0.66 | 1.74 ± 0.45 | P=0.715 | |
| - Level 1 | 45 (37%) | 37 (41%) | 8 (26%) | | 56.7% |
| - Level 2 | 67 (55%) | 44 (48%) | 23 (74%) | | 40.2% |
| - Level 3 | 10 (8%) | 10 (11%) | 0 (0%) | | 3.1% |
| EQ-5D Anxiety/Depression | | | | | |
| - Mean ± SD | 1.57 ± 0.67 | 1.42 ± 0.62 | 2.00 ± 0.63 | P<0.001 | |
| - Level 1 | 65 (53%) | 59 (65%) | 6 (20%) | | 70.2% |
| - Level 2 | 45 (37%) | 26 (28%) | 19 (61%) | | 29.4% |
| - Level 3 | 12 (10%) | 6 (7%) | 6 (19%) | | 0.4% |
| EQ-5D VAS | | | | | |
| - Mean ± SD | 71.84 ± 17.35 | 75.47 ± 18.38 | 61.19 ± 6.56 | P<0.001 | 80.60 ± 15.30 |
| - Median | 70.00 | 80.00 | 61.00 | | |

## Table 5: EQ-5D Health States Occurrences and Corresponding Unique Utility Weights

| EQ-5D Health states | Utility | Occurrence Complete Sample N=122 | Occurrence Post-op N=91 | Occurrence Pre-op N=31 |
|---|---|---|---|---|
| 11111 | 1.000000 | 30 | 30 | 0 |
| 11112 | 0.843777 | 7 | 6 | 1 |
| 11121 | 0.8271093 | 16 | 16 | 0 |
| 11122 | 0.7997944 | 10 | 7 | 3 |
| 11123 | 0.5165166 | 1 | 1 | 0 |
| 11131 | 0.4628989 | 3 | 3 | 0 |
| 11211 | 0.8602705 | 1 | 1 | 0 |
| 11212 | 0.8329556 | 2 | 0 | 2 |
| 11221 | 0.8162879 | 4 | 2 | 4 |
| 11222 | 0.7675994 | 9 | 4 | 5 |
| 11223 | 0.5056952 | 4 | 1 | 3 |
| 11231 | 0.4627643 | 1 | 1 | 0 |
| 11232 | 0.4354494 | 1 | 1 | 0 |
| 12112 | 0.7973426 | 1 | 0 | 1 |
| 12122 | 0.7319864 | 1 | 0 | 1 |
| 12211 | 0.8138361 | 1 | 0 | 1 |
| 12212 | 0.7651476 | 2 | 0 | 2 |
| 12221 | 0.7484799 | 1 | 0 | 1 |
| 12223 | 0.4378872 | 1 | 0 | 1 |
| 21121 | 0.8100014 | 4 | 3 | 1 |
| 21122 | 0.7613129 | 2 | 1 | 1 |
| 21221 | 0.7778064 | 2 | 1 | 1 |
| 21222 | 0.7077443 | 6 | 4 | 2 |
| 21223 | 0.4672137 | 1 | 1 | 0 |
| 21231 | 0.4456564 | 1 | 1 | 0 |
| 21232 | 0.3969679 | 2 | 2 | 0 |
| 21333 | 0.2135216 | 1 | 1 | 0 |
| 22123 | 0.4316007 | 2 | 1 | 1 |
| 22212 | 0.7052925 | 1 | 0 | 1 |
| 22221 | 0.6886248 | 1 | 1 | 0 |
| 22222 | 0.5971891 | 1 | 1 | 0 |
| 22223 | 0.3780321 | 1 | 0 | 1 |
| 22333 | 0.1670872 | 1 | 1 | 0 |

| | | | |
|---|---|---|---|
| Unique Utility Count | 33 | 24 | 19 |

Based on the participants' questionnaire responses, a total of 34 unique health states were generated from the EQ-5D, for the total sample (N=122). Per Table 5, the most frequently generated health states, observed for the total sample, were as follows: 11111 (utility weight of 1.000000) for a total of 30 occurrences, 11121 (utility weight of 0.8271093) for a total 16 occurrences, 11122 (utility weight of 0.7997944) for a total of 10 occurrences and 11222 (utility weight of 0.7675994) for a total of 9 occurrences. The mean EQ-5D utility for the complete sample was 0.78 with a standard deviation of 0.19. The highest and lowest observed utility values were respectively 1.000000 and 0.1670872. The mean VAS result for the total sample was 71.84 with a standard deviation of 17.35.

24 unique health states were generated, for the post-op study group (N=91). The most frequently generated health states for this particular group were as follows: 11111 (utility weight of 1.000000) for a total of 30 occurrences, 11121 (utility weight of 0.8271093) for a total 16 occurrences, 11122 (utility weight of 0.7997944) for a total of 7 occurrences and 11112 (utility weight of 0.843777) for a total of 6 occurrences. The highest and lowest observed utility values for the post-op group were respectively 1.000000 and 0.1670872. The mean VAS result for the post-op group was 75.47 with a standard deviation of 18.38.

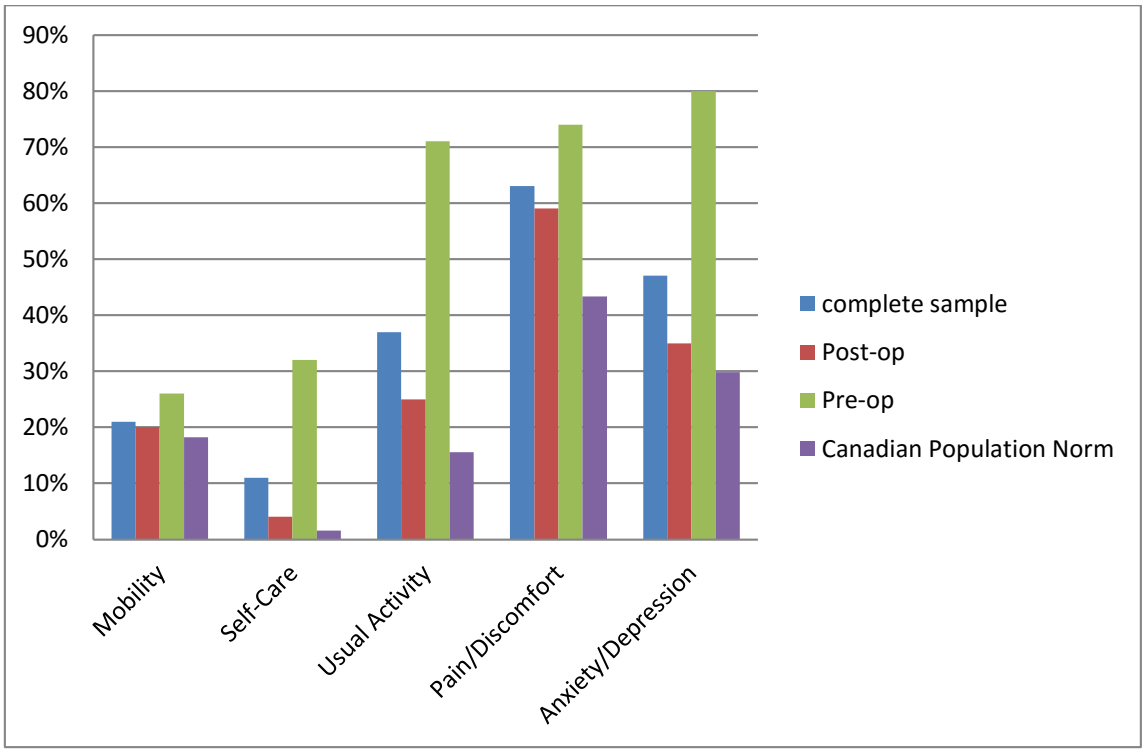
There were 19 health states identified for the pre-op group (N=31). The most frequently generated health states observed in this group were 11222 (utility weight of 0.7675994) for a total of 5 occurrences, 11221 (utility weight of 0.8162879) for a total of 4 occurrences, 11122 (utility weight of 0.7997944) for a total of 3 occurrences and 11223 (utility weight of 0.5056952) for a total of 3 occurrences. The highest and lowest observed utility values

for the pre-op group were consequently 0.843777 and 0.3780321. The mean VAS result for the pre-op group was 61.19 with a standard deviation of 6.56.

When comparing the post-op and pre-op groups for observed EQ-5D results such as EQ-5D utility, mobility, self-care, usual-activity, pain/discomfort, anxiety/depression and VAS (Table 4), statistical significance difference, in favour of the post-op group, is detected between the two groups for all but 2 measures (i.e. mobility and pain/discomfort).

On average, the post-op group scored better for all dimensions of health related quality of life using the EQ-5D when compared to the pre-op group. In addition, lower percentages of problems associated with each dimensions were reported in the post-op group when compared to the pre op group and that across all dimensions of the EQ-5D questionnaire (refer to figure 5 below).

## Figure 5: Percent of Respondents Reporting Problems on Any Dimension of the EQ-5D



## Work Limitation Questionnaire

### Table 6: Mean and Standard Deviation for the Work Limitation Questionnaire (WLQ) Scores

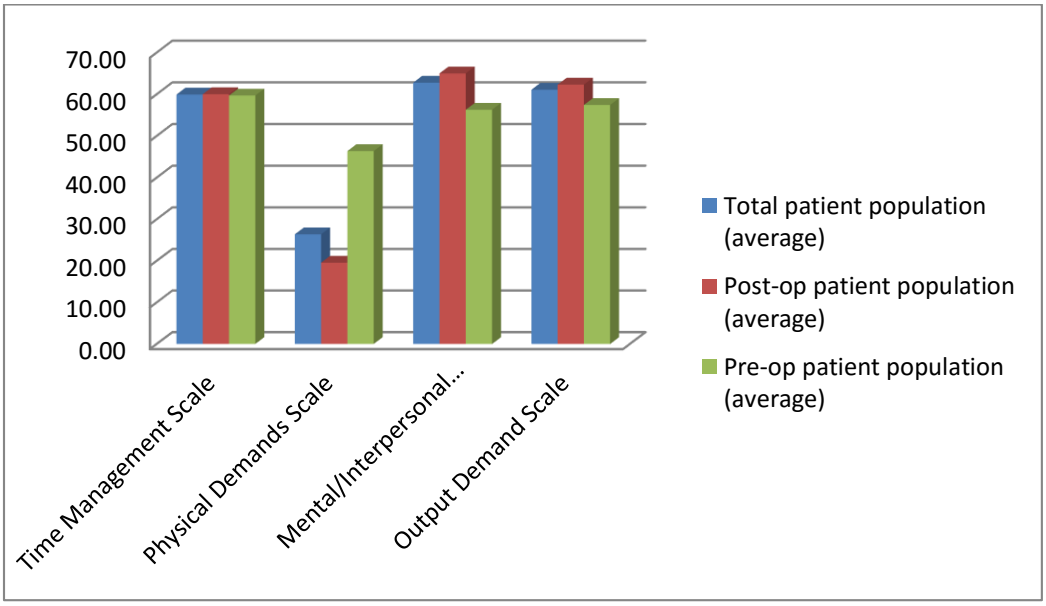
| | Complete Sample | Post-op | Pre-op | *t*-value (df) | P value* |
|---|---|---|---|---|---|
| N | 122 | 91 | 31 | | |
| WLQ TM Scale | | | | | |
| - Mean ± SD | 59.92 ± 34.49 | 60.00 ± 38.96 | 59.68 ± 15.60 | 0.07 (120) | P=0.948 |
| Median | 70.00 | 75.00 | 60.00 | | |
| WLQ PD Scale | | | | | |
| - Mean ± SD | 26.37 ± 25.45 | 19.55 ± 24.09 | 46.37 ± 17.80 | -6.58 (120) | P≤0.000 |
| Median | 25.00 | 4.17 | 50.00 | | |
| WLQ MID Scale | | | | | |
| - Mean ± SD | 62.77 ± 33.82 | 64.99 ± 38.12 | 56.27 ± 13.96 | 1.85 (120) | P=0.067 |
| - Median | 66.67 | 83.33 | 61.11 | | |
| WLQ OD Scale | | | | | |
| - Mean ± SD | 61.07 ± 34.96 | 62.31 ± 39.02 | 57.42 ± 18.52 | 0.93 (120) | P=0.356 |
| - Median | 70.00 | 75.00 | 55.00 | | |

TM= Time Management, PD= Physical Demands, MID= Mental/Interpersonal Demands, OD= Output Demands
*Independent sample t-test significant at the 0.05 level (2-tailed)

Respondents assigned to the post-op group had higher scores for all but one scale of the work limitation questionnaire (i.e. Physical Demand scale). When it comes to the WLQ, higher scores represent greater limitations. Differences of 0.32 (P=0.948), 8.72 (P=0.067) and 4.89 (P=0.356), in favour of the post-op group, were respectively noted for the TM, MID and OD scales of the WLQ. The level of clinical significance for the differences observed between the two groups was however not reached.

A difference of 26.82 (P≤0.000) points was detected between the post-op and the pre-op groups. In keeping with this result, participants from the pre-op group had significantly higher (worse) limitations scores for the PD scales when compared to the post-op group. A summary of results is provided in figure 6.

## Figure 6: WLQ Summary Results:



## Research Questions

### Research Question 1

**Research question #1a:**

Research question 1a assessed the impact of Bariatric surgery on health related quality of life.

Health related quality of life scores were assessed over within less than 3 and more than 34 years of follow-up after Bariatric surgery or after having been wait-listed for this intervention. Univariate analyses for mean HRQoL scores versus follow-up time after surgery or after having been wait-listed for this intervention were performed and presented under Appendix 2. The trapezoidal rule was then uses to approximate the AUCs for the pre and post-op groups. AUC summary statistic was used to perform the longitudinal analysis of patient reported HRQoL scores. The impact of Bariatric surgery intervention on HRQoL was subsequently investigated through comparison of the pre and post. AUC curves using Hanley's method [337].

Although a trend toward significance may be highlighted, after comparison between the pre and post group, no important trend towards statistical differences in AUC were observed for the SF36 PF scale (p=0.066), the SF-36 RP scale (p=0.089), the SF36 GH scale (p=0.060), the SF36 SF scale (p=0.096), the SF-36 MH scale (p=0.064), and the SF36 PCS scale (p=0.066). A statistical significant difference between the non-surgical and surgical groups were detected for the SF36 BP scale (p=0.027), the SF-36 RE scale (p=0.007), the SF36 MCS (p=0.025), and the EQ-5D VAS (p=0.004). These observed statistically significant differences may be translated into a positive improvement in

HRQoL outcomes following Bariatric surgery of approximated at 28% for the SF36 BP, 34% for the SF-36 RE, 24% for the MCS and 41% for the EQ-5D VAS.

### Table 7: HRQoL scales vs. Follow-up Time

| Outcome Scales | AUC (SE)* | | | z statistic | P-value** |
|---|---|---|---|---|---|
| | Pre-op | Post-op | Pairwise comparison | | |
| SF-36_PF$_{scale}$ | 1.000 (0.000) | 0.799 (0.109) | 0.201 (0.109) | 1.840 | 0.066 |
| SF-36_RP$_{scale}$ | 1.000 (0.000) | 0.868 (0.078) | 0.132 (0.078) | 1.703 | 0.089 |
| SF-36_BP$_{scale}$ | 0.625 (0.129) | 0.903 (0.081) | 0.278 (0.126) | 2.210 | 0.027 |
| SF-36_GH$_{scale}$ | 1.000 (0.000) | 0.854 (0.078) | 0.146 (0.077) | 1.880 | 0.060 |
| SF-36_VT$_{scale}$ | 1.000 (0.000) | 0.944 (0.045) | 0.056 (0.045) | 1.238 | 0.216 |
| SF-36_SF$_{scale}$ | 1.000 (0.000) | 0.889 (0.067) | 0.111 (0.067) | 1.664 | 0.096 |
| SF-36_RE$_{scale}$ | 1.000 (0.000) | 0.660 (0.127) | 0.340 (0.127) | 2.678 | 0.007 |
| SF-36_MH$_{scale}$ | 1.000 (0.000) | 0.854 (0.079) | 0.146 (0.079) | 1.853 | 0.064 |
| SF-36_PCS$_{scale}$ | 1.000 (0.000) | 0.799 (0.109) | 0.201 (0.079) | 1.840 | 0.066 |
| SF-36_MCS$_{scale}$ | 1.000 (0.000) | 0.764 (0.105) | 0.236 (0.105) | 2.239 | 0.025 |
| EQ-5D_$_{VAS}$ | 1.000 (0.000) | 0.590 (0.140) | 0.410 (0.140) | 2.919 | 0.004 |

*Hanley & McNeil, 1982
**0.5 significance level

**Research question #1b:**

Research question 1b assessed the impact of Bariatric surgery on work productivity. As to the approach used to address the first research question, work productivity scores were assessed over within less than 3 and more than 34 years of follow-up after Bariatric surgery or after having been wait-listed for this intervention. Univariate analyses for mean WLQ scores versus follow-up time since surgery or after having been wait-listed for this intervention were performed and presented under Appendix 3. The trapezoidal rule was then uses to approximate the AUCs for the pre and post-op groups. AUC summary statistic was used to perform the longitudinal analysis of patient reported WLQ scores. The impact of Bariatric surgery intervention on work productivity was again investigated through comparison of the pre and post. AUC curves using Hanley's method [337].

After comparison between the pre and post group, no significant statistical differences in mean scores were observed for the WLQ PD scale (p=0.353) and the MID scale (p=0.271), with an important trend for the WLQ OD scale (p=0.092). A statistically significant difference was however observed for the WLQ TM scale (p=0.038). This observed statistical significant difference may indicate that when factoring follow-up time, patients in the surgical group fared better with regards to the time management component of the WLQ when compared to the non surgical group.

### Table 8: WLQ Scales vs. Follow-up Time

| Outcome Scales | AUC (SE)* | | | z statistic | P-value** |
|---|---|---|---|---|---|
| | Pre-op | Post-op | Pairwise comparison | | |
| WLQ_TM scale | 0.917 (0.067) | 0.597 (0.139) | 0.319 (0.154) | 2.078 | 0.038 |
| WLQ_PD scale | 0.931 (0.068) | 0.847 (0.091) | 0.083 (0.090) | 0.928 | 0.353 |
| WLQ_MID scale | 0.958 (0.048) | 0.833 (0.108) | 0.125 (0.114) | 1.100 | 0.271 |
| WLQ_OD scale | 1.000 (0.000) | 0.833 (0.108) | 0.153 (0.091) | 1.686 | 0.092 |

*Hanley & McNeil, 1982
**0.5 significance level

### Research Question 2

**Research question #2:**

The second research question aimed at evaluating the relationship between EWL, HRQoL and work productivity in Bariatric surgery patients. Furthermore, this research question attempted to assess the impact of time since surgery on this relationship.

In order to address the second research question, a Pearson product-moment correlation coefficient was first computed to evaluate the relationship between EWL, and for the SF-36, EQ-5D and WLQ scores. As a result of this first step, statistical significant correlation coefficients were identified for the questionnaire subscales identified in Table 22.

### Table 9: Pearson's Correlation Data for HRQoL and WLQ vs. EWL

| | Follow-up time post-surgery | P value | Correlation*** Strength & Direction |
|---|---|---|---|
| - SF-36 PF Scale | r = 0.215* | P=0.017 | Modest Positive |
| - SF-36 GH Scale | r = 0.280** | P=0.002 | Modest Positive |
| - SF-36 SF Scale | r = 0.280** | P=0.002 | Modest Positive |
| - SF-36 MH Scale | r = 0.421 | P=0.000 | Moderate Positive |
| - SF-36 MCS Scale | r = 0.311** | P<0.000 | Moderate Positive |
| EQ-5D index | r = 0.191* | P=0.035 | Modest Positive |
| - EQ-5D VAS | r = 0.279** | P=0.002 | Modest Positive |
| - WLQ PDS | R = -428** | P<0.000 | Moderate Negative |

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Overall, modest to moderate statistically significant positive correlations were identified between EWL and the following scales: SF-36 PF (r=0.215, p=0.017), the SF-36 GH (r=0.280, p=0.002), the SF-36 SF (r=0.280, p=0.002), the SF-36 MH (r=0.421, p=0.000), the SF-36 MCS (r=0.311, p=0.000), the EQ-5D index (r=0.191, p=0.035), the EQ-5D VAS (r=0.279, p=0.002) and the WLQ PDS (r=-0.428, p<0.000).

Using a General Linear model where EWL was classified in quantiles, and where the independent factor, age, duration of follow-up, employment status, education and relationship status were included as covariate; independent associations were assessed between EWL and changes in HRQoL and work productivity measurements.

## Table 10: Mean SF-36, EQ-5D and WLQ scores and Follow-up Time Periods since Surgery (FTPS) vs. %EWL

| | %EWL | | | | |
|---|---|---|---|---|---|
| | **FU (years)** | **≤ 25 %** | **26 to 50%** | **51 to ≤ 75%** | **51 to ≤ 100%** |
| **$SF36_{PFscale}$** | ≤6 | 41.600±14.294 | 51.318±9.501 | 37.000±28.284 | ND |
| | >6 to ≤10 | 54.900±1.715 | 51.831±5.396 | 35.975±21.923 | ND |
| | >10 to ≤20 | 38.100±0.000 | 43.915±12.309 | ND | 52.800±0.000 |
| | >20 | 45.240±10.666 | 38.637±12.459 | 23.400±0.000 | ND |
| **$SF36_{GHscale}$** | ≤6 | 38.300±6.701 | 54.359±7.935 | 41.250±25.244 | ND |
| | >6 to ≤10 | 48.300±15.939 | 49.885±9.157 | 39.950±17.185 | ND |
| | >10 to ≤20 | ND | 44.377±11.890 | 41.000±0.000 | 60.100±0.000 |
| | >20 | 51.980±10.178 | 41.037±13.644 | 40.471±15.947 | ND |
| **$SF36_{SFscale}$** | ≤6 | 38.667±15.704 | 53.934±6.405 | 43.200±19.233 | ND |
| | >6 to ≤10 | 52.725±5.214 | 45.915±12.967 | 45.900±15.415 | 56.800±0.000 |
| | >10 to ≤20 | 24.100±0.000 | 41.723±13.745 | ND | ND |
| | >20 | 51.380±6.654 | 41.685±11.344 | 35.000±0.000 | ND |
| **$SF36_{MHscale}$** | ≤6 | 39.667±20.018 | 49.353±10.516 | 42.950±13.930 | ND |
| | >6 to ≤10 | 49.975±7.632 | 48.931±12.399 | 50.725±17.413 | ND |
| | >10 to ≤20 | 27.500±0.000 | 43.508±17.098 | ND | 50.000±0.000 |
| | >20 | 47.180±8.663 | 44.796±11.254 | 41.600±0.000 | ND |
| **$SF36_{MCSscale}$** | ≤6 | 34.133±24.490 | 52.230±7.217 | 44.500±17.536 | ND |
| | >6 to ≤10 | 51.000±7.860 | 48.315±13.055 | 48.825±18.182 | ND |
| | >10 to ≤20 | 19.400±0.000 | 43.708±15.761 | ND | 54.900±0.000 |
| | >20 | 53.300±4.980 | 44.252±11.301 | 48.400±0.000 | ND |
| **$EQ\text{-}5D_{index}$** | ≤6 | 0.713±0.213 | 0.918±0.213 | 0.723±0.392 | ND |
| | >6 to ≤10 | 0.866±0.269 | 0.839±0.126 | 0.826±0.206 | ND |
| | >10 to ≤20 | 0.397±0.000 | 0.703±0.250 | ND | 1.000±0.000 |
| | >20 | 0.862±0.078 | 0.777±0.195 | 0.689±0.000 | ND |
| **$EQ\text{-}5D_{VAS}$** | ≤6 | 70.000±17.321 | 40.273±14.760 | 46.900±11.044 | ND |
| | >6 to ≤10 | 83.750±11.087 | 87.882±7.991 | 69.500±41.719 | ND |
| | >10 to ≤20 | 45.000±0.000 | 82.692±12.579 | 60.250±24.226 | 95.000±0.000 |
| | >20 | 78.600±12.033 | 70.037±21.554 | 60.000±0.000 | ND |
| **$WLQ_{PD\ scale}$** | ≤6 | 13.889±24.056 | 7.598±11.714 | 16.667±23.570 | ND |
| | >6 to ≤10 | 16.667±21.784 | 12.180±15.633 | 0.000±0.000 | ND |
| | >10 to ≤20 | 50.000±0.000 | 28.846±31.433 | ND | 4.167±0.000 |
| | >20 | 18.333±16.029 | 30.710±27.883 | 0.000±0.000 | ND |

Note: %EWL = percent excess weight loss, ND = No Data

## Table 11: Two-way ANOVA Tables for Mean SF-36 scores and Follow-up Time since Bariatric Surgery vs. % EWL

| Source of Variation | SS | df | MS | f | p-value |
|---|---|---|---|---|---|
| **SF-36$_{PF\ scale}$** | | | | | |
| %EWL | 793.005 | 3 | 264.335 | 2.052 | p= 0.114 |
| %EWL * Follow-up Time Post Surgery | 595.919 | 5 | 117.184 | 0.910 | p= 0.479 |
| Error | 9661.682 | 75 | 128.822 | | |
| Total | 196016.110 | 91 | | | |
| **SF-36$_{GH\ scale}$** | | | | | |
| %EWL | 657.305 | 3 | 219.102 | 1.584 | p= 0.200 |
| %EWL * Follow-up Time Post Surgery | 1364.205 | 5 | 272.841 | 1.972 | p= 0.092 |
| Error | 10 374.342 | 75 | 138.325 | | |
| Total | 208 464.540 | 91 | | | |
| **SF-36$_{SFscale}$** | | | | | |
| %EWL | 678.128 | 3 | 226.043 | 1.724 | p= 0.161 |
| %EWL * Follow-up Time Post Surgery | 1539.232 | 5 | 307.846 | 2.403 | p= 0.045 |
| Error | 9607.958 | 75 | 128.106 | | |
| Total | 202 504.020 | 91 | | | |
| **SF-36$_{MH\ scale}$** | | | | | |
| %EWL | 344.547 | 3 | 114.849 | 0.687 | p= 0.563 |
| %EWL * Follow-up Time Post Surgery | 524.987 | 5 | 104.997 | 0.628 | p= 0.679 |
| Error | 12 541.725 | 75 | 167.223 | | |
| Total | 208 925.070 | 91 | | | |
| **SF-36 $_{MCS\ scale}$** | | | | | |
| %EWL | 839.051 | 3 | 279.684 | 1.146 | p= 0.069 |
| %EWL * Follow-up Time Post Surgery | 1903.186 | 5 | 380.637 | 2.510 | p= 0.037 |
| Error | 11 371.419 | 75 | 151.619 | | |
| Total | 213 724.450 | 91 | | | |

## Table 12: Two-way ANOVA Tables for Mean EQ-5D scores and Follow-up Time since Bariatric Surgery vs. % EWL

| Source of Variation | SS | df | MS | f | p-value |
|---|---|---|---|---|---|
| **EQ-5D$_{index}$** | | | | | |
| %EWL | 0.188 | 3 | 0.063 | 1.776 | p= 0.159 |
| %EWL * Follow-up Time Post Surgery | 0.215 | 5 | 0.043 | 1.214 | p= 0.311 |
| Error | 2.654 | 75 | 0.035 | | |
| Total | 62.673 | 91 | | | |
| **EQ-5D$_{VAS}$** | | | | | |
| %EWL | 2785.894 | 3 | 928.631 | 3.187 | p= 0.290 |
| %EWL * Follow-up Time Post Surgery | 1997.103 | 5 | 399.421 | 1.371 | p= 0.245 |
| Error | 21 856.410 | 75 | 291.419 | | |
| Total | 548 756.000 | 91 | | | |

### Table 13: Two-way ANOVA Tables for Mean WLQ scores and Follow-up Time since Bariatric Surgery vs. % EWL

| Source of Variation | SS | df | MS | f | p-value |
|---|---|---|---|---|---|
| **$WLQ_{PDS}$** | | | | | |
| %EWL | 933.886 | 3 | 356.079 | 1.114 | p= 0.603 |
| %EWL*Follow-up post-Surgery | 2141.639 | 5 | 428.328 | 0.857 | p= 0.514 |
| Error | 37 498.960 | 75 | 319.643 | | |
| Total | 86 996.528 | 91 | | | |

A two-way analysis of variance (ANOVA) was conducted to compare the relationship of %EWL over time for HRQoL and work productivity. These HRQoL and productivity outcome measure scales corresponding to the SF-36 PF, SF-36 GH, SF-36 SF, SF-36 MH, SF-36 MCS, the EQ-5D index and VAS and the WLQ PDS scale. Descriptive statistics for means HRQoL and WLQ scores in function of %EWL classified in quantiles and follow-up time periods post-surgery are presented in Table 23.

The results show no significant associations between %EWL and HRQoL for the following scales of the SF-36: PF (f (3, 75) =2.052, p=0.114), GH (f (3, 75) =1.584, p=0.200), MH (f (3, 75) =0.687, p=0.563) and the MCS (f (3,75) =1.146, p=0.069); the EQ-5D index (f (3,75) =1.1776, p=0.159) and VAS (f (3,75) =3.187, p=0.290) as well as the WLQ PD scale (f (3,75) =1.114, p=0.603).

A statistical significance interactive relationship between %EWL and time was however observed for the SF-36 social functioning scale (p=0.045) and the mental component summary scale (p=0.037) (Table 24).

Per this analysis, a statistically significant relationship could not be identified between %EWL and time post-surgical intervention in relations to outcomes measures scores such

as the SF-36 (PF, GH, MH and MCS), the EQ-5D (index and VAS) and the PD scale of the WLQ. However, a statistically significant interactive relationship appeared to exist between %EWL and time for the Social Functioning and the mental health component summary scales of the SF-36.

## Research Question 3

**Research question 3:**

The third research question focussed on identifying potential predictive determinants of HRQoL and work productivity scores following Bariatric surgery in obese patients.

A stepwise multiple linear regression analysis was used to develop a model for predicting health related quality of life (HRQoL), and work productivity outcome scores from the following characteristics: age, gender, body mass index (BMI) at the initial visit with the surgeon and follow-up time since-surgery. Basic descriptive statistics and regression coefficients are shown in Tables 14, 15 and 16.

Results obtained for the SF-36 highlighted BMI, follow-up time post-surgery and age as significant predictors of the PF mean score. For the EQ-5D, BMI and follow-up time post-surgery were both identified as significant predictors of the VAS mean score. Finally, for the WLQ, BMI and follow-up time post-surgery were identified as significant predictors of the mean score for the PD subscale.

Further to conducting multiple linear regressions to predict mean scores for the following scales of the SF-36: role physical (RP), bodily pain (BP), general health (GH), social functioning (SF), mental health (MH); the EQ-5D utility and the following scales of the WLQ: time management (TM), mental/interpersonal demands (MID) and output demands

(OD), from participant's age, gender, BMI and follow-up time post-surgery, no significant associations were found.

## Table 14: Multiple Regression Analysis for Mean score of the Physical Functioning Scale of the SF-36 Related to Age, Follow-up Time since Bariatric Surgery and Body Mass Index (BMI)

| | b | SE b | Beta | df | f | P value |
|---|---|---|---|---|---|---|
| Step 1: | | | | | | |
| - Constant | 67.503 | 6.547 | | | | |
| - Age | -0.420 | 0.118 | -0.353 | 1 | 12,652 | P<0.001 |
| Step 2: | | | | | | |
| - Constant | 65.740 | 6.414 | | 2 | | |
| - Age | -0.313 | 0.123 | -0.263 | | | P=0.013 |
| - Follow-up Time Post Surgery | -0.326 | 0.134 | -0.251 | | 9.627 | P=0.017 |
| Step 3: | | | | | | |
| - Constant | 82.756 | 9.688 | | 3 | | |
| - Age | -0.307 | 0.120 | -0.258 | | | P=0.012 |
| - Follow-up Time Post Surgery | -0.385 | 0.134 | -0.297 | | | P=0.005 |
| - Body Mass Index (BMI) | -0.338 | 0.147 | -0.221 | | 8.498 | P=0.024 |

$R^2$ = 0.124 for Step 1: $\Delta R^2$=0.056 for Step 2: $\Delta R^2$=0.047 for Step 3 (p<0.001).

## Table 15: Multiple Regression Analysis for Mean score of the Visual Analogue Scale (VAS) of the EQ-5D Related to Follow-up Time since Bariatric-Surgery and Body Mass Index (BMI)

| | b | SE b | Beta | df | f | P value |
|---|---|---|---|---|---|---|
| Step 1: | | | | | | |
| - Constant | 82.579 | 2.986 | | | | |
| - Follow-up Time Post Surgery | -0.573 | 0.189 | -0.305 | 1 | 9,158 | P=0.003 |
| Step 2: | | | | | | |
| - Constant | 107.860 | 11.751 | | 2 | | |
| - Follow-up Time Post Surgery | -0.655 | 0.189 | -0.349 | | | P<0.001 |
| - Body Mass Index (BMI) | -0.492 | 0.222 | -0.224 | | 7.248 | P=0.029 |

$R^2$ = 0.093 for Step 1: $\Delta R^2$=0.048 for Step 2: (p<0.001).

## Table 16: Multiple Regression Analysis for Mean score of the Physical Demands (PD) Scale of the WLQ Related to Follow-up Time since Bariatric-Surgery and Body Mass Index (BMI)

| | b | SE b | Beta | df | f | P value |
|---|---|---|---|---|---|---|
| Step 1: | | | | | | |
| - Constant | 9.554 | 3.882 | | | | |
| - Follow-up Time Post Surgery | 0.806 | 0.246 | 0.328 | 1 | 10,724 | P=0.002 |
| Step 2: | | | | | | |
| - Constant | 34.331 | 12.342 | | 2 | | |
| - Follow-up Time Post Surgery | 1.001 | 0.258 | 0.407 | | | P<0.000 |
| - Body Mass Index (BMI) | 0.500 | 0.237 | -0.222 | | 7.797 | P=0.038 |

$R^2$ = 0.108 for Step 1: $\Delta R^2$=0.043 for Step 2: (p<0.001).

## Research Question 4

**Research question 4:**

The forth objective focusses on the assessment of the impact of Bariatric surgery on obesity related chronic comorbidities.

Per Table 2, in total, 17 unique comorbidities were reported for the study sample namely: diabetes mellitus, hypertension, hypercholesterolemia, stroke, dyslipidemia, DVT, gallbladder disease, osteoarthritis, gout, sleep apnea, GERD, asthma, PCOS, stress incontinence, thyroid dysfunction and psychological disorders such as depression and anxiety.

We performed a crosstab analysis to evaluate and compare occurrences of comorbidities, for the pre and post op groups, at baseline and at follow-up (Tables filed under Appendix 4).

32 and 23 cases of diabetes mellitus were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.624; 95% confidence interval: 0.329 – 1.182; p<0.000). 13 and 11 cases were respectively identified at baseline and at follow-up for the pre-op group (odds ratio: 0.762; 95% confidence interval: 0.273 – 2.122; p=0.602). Odds of experiencing diabetes mellitus from baseline to follow-up were less within the post-op group when compared to the pre-op group. Results reached statistical significance solely for the post-op group (Table 48).

44 and 31 cases of hypertension, were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.552; 95% confidence interval: 0.304 – 1.003; p=0.050). For the pre-op group, 15 and 14 cases were respectively reported at baseline

and at follow-up (odds ratio: 0.878; 95% confidence interval: 0.324 – 2.384; p=0.799). We therefore observed reduced odds of occurrence of hypertension within the post-op group, between baseline and follow-up, when compared to the pre-op group. Results were found to be statistically significant solely for the post-op group (Table 49).

For hypercholesterolemia, 27 and 22 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.756; 95% confidence interval: 0.392 – 1.459; p=0.403). As for the pre-op group, 9 and 8 cases were respectively identified at baseline and at follow-up (odds ratio: 0.850; 95% confidence interval: 0.278 – 2.599; p=0.776). We consequently observed a reduction in the incidence of cases hypercholesterolemia, from baseline to follow-up, within the post-op group when compared to the pre-op group. Results for neither of these groups reached statistical significance (Table 50).

15 and 13 cases of stroke were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.844; 95% confidence interval: 0.377 – 1.893; p=0.681). As for the pre-op group, 4 cases were identified both at baseline and at follow-up (odds ratio: 1.000; 95% confidence interval, 0.226 – 4.415; p=1.000). We observed reduced odds of occurrence of stroke cases, between baseline and follow-up, for the post-op group when compared to the pre-op group. No difference in odds was observed for this event, within the pre-op group, between baseline and follow-up. Statistical significance was not reached in either of the groups (Table 51).

For dyslipidemia, 17 and 15 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.859; 95% confidence interval: 0.400 – 1.845;

p=0.697). As for the pre-op group, 7 cases were identified both at baseline and at follow-up (odds ratio: 1.000; 95% confidence interval: 0.304 – 3.289; p=1.000). Reduced odds of dyslipidemia incidence cases were observed for the post-op group, between baseline and follow-up. No difference in incidence of this event was observed between baseline and follow-up for the pre-op group. Statistical significance was not reached in either of the groups (Table 52).

For DVT, 11 cases were identified both at baseline and at follow-up for the post-op group (odds ratio: 1.000; 95% confidence interval: 0.410 – 2.438; p=1.000). For the pre-op group, 5 cases were identified both at baseline and at follow-up (relative risk, 1.000, 95% confidence interval, 0.258 – 3.871; p=1.000). No difference in odds of occurrence of DVT cases were observed between baseline and follow-up for either of the groups. In addition, statistical significance was not reached for either of the groups (Table 53).

21 and 17 cases of gallbladder disease were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.766, 95% confidence interval; 0.373 – 1.570; p=0.466). 5 cases were identified in the pre-op group, at baseline and at follow-up (odds ratio: 1.000; 95% confidence interval: 0.258 – 3.871; p=1.000). Lower odds of cases of gallbladder disease, were observed from baseline to follow-up, within the post-op group. We observed no difference between baseline and follow-up for the pre-op groups. Statistical significance was not reached in either of the groups (Table 54).

For osteoarthritis, 25 cases were identified both at baseline and at follow-up for the post-op group (odds ratio: 1.000; 95% confidence interval: 0.526 – 1.903; p=1.000). As for the pre-op group, 8 cases were identified both at baseline and at follow-up (odds ratio: 1.000;

95% confidence interval: 0.321 – 3.120; p=1.000). Differences in odds of osteoarthritis cases, between baseline and follow-up, were therefore not observed for either the post-op or pre-op groups. In addition, statistical significance was not reached in either of the groups (Table 55).

For gout, 19 and 15 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.871; 95% confidence interval: 0.419 – 1.807; p=0.709). As for the pre-op group, 8 and 7 cases were respectively identified at baseline and at follow-up (odds ratio: 0.839: 95% confidence interval: 0.262 – 2.687; p=0.767). Reduced odds of incidence of gout, marginally favouring the pre-op group, were observed for both groups between baseline and follow-up. Statistical significance was not reached for either of the groups (Table 56).

For sleep apnea, 39 and 32 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.723; 95% confidence interval: 0.398 – 1.315; p=0.287). As for the pre-op group, 13 and 12 cases were respectively identified at baseline and at follow-up (odds ratio: 0.874; 95% confidence interval: 0.317 – 2.414; p=0.796). Reduced odds of sleep apnea cases, favouring post-op group, were consequently observed within both groups. Statistical significance was not reached in either of the groups (Table 57).

For GERD, 26 and 22 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.797; 95% confidence interval: 0.412 – 1.544; p=0.501). As for the pre-op group, 12 and 9 cases were respectively identified at baseline and at follow-up (odds ratio: 0.648, 95% confidence interval; 0.224 – 1.870; p=0.420). The

observed odds of occurrence of GERD cases were consequently lower within the pre-op group when compared to the results observed within the post-op group. Statistical significance was not reached in either of the groups (Table 58).

For asthma, 16 cases were identified both at baseline and at follow-up for the post-op group (odds ratio: 1.000; 95% confidence interval: 0.466 – 2.145; p=1.000). As for the pre-op group, 7 and 5 cases were respectively identified at baseline and at follow-up (odds ratio: 0.659; 95% confidence interval: 0.184 – 2.359; p=0.520). We observed no difference in the odds of occurrence of asthma cases between baseline and follow-up, within the post-op group. Reduced odds of incidence of asthma cases were observed within the pre-op group. Statistical significance was not reached for either of the groups (Table 59).

For PCOS, 12 and 10 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.813; 95% confidence interval: 0.332 – 1.988; p=0.649). As for the pre-op group, 7 and 4 cases were respectively identified at baseline and at follow-up (odds ratio: 0.508, 95% confidence interval: 0.132 – 1.951; p=0.319). When comparing both groups for differences in odds of occurrence of PCOS between baseline and follow-up, although odds reductions were observed within both groups, a greater reduction resulted within the pre-op group. However, results for neither of the groups were statistically significant. (Table 60).

For stress incontinence, 20 and 6 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.757; 95% confidence interval: 0.364 – 1.576; p=0.457). As for the pre-op group, 6 cases were identified both at baseline and at follow-

up (odds ratio: 1.000; 95% confidence interval: 0.284 – 3.526; p=1.000). We therefore observed lower odds of incidence of stress incontinence cases, between baseline and follow-up, for the post-op group. We observed no differences in odds of stress incontinence, between baseline and follow-up, for the pre-op groups. Statistical significance was not reached for either of the groups (Table 61).

For thyroid dysfunction, 26 and 22 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.825; 95% confidence interval: 0.349 – 1.952; p=0.661). As for the pre-op group, 8 and 5 cases were respectively identified at baseline and at follow-up (odds ratio: 0.553: 95% confidence interval: 0.158 – 1.930; p=0.349). We therefore observed a greater reduction in odds of occurrence of thyroid dysfunction cases within the pre-op group from baseline to follow-up when compared to the post-op group. Statistical significance was not reached in either of the groups (Table 62).

For psychological disorders, 38 and 30 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 0.686; 95% confidence interval: 0.375 – 1.255; p=0.220). As for the pre-op group, 11 and 13 cases were respectively identified at baseline and at follow-up (odds ratio: 1.313; 95% confidence interval: 0.471 – 3.659; p=0.602). Reduced odds of psychological disorders cases were therefore observed for the post-op group, between baseline and follow-up. Within the pre-op group, we observed a 31% increase in odds of occurrence of psychological disorder, between baseline and time of follow-up. Statistical significance was however not reached in either of the groups (Table 63).

Lastly, for cancer, 4 and 5 cases were respectively identified at baseline and at follow-up for the post-op group (odds ratio: 1.265; 95% confidence interval: 0.328 – 4.869; p=0.732). As for the pre-op group, 1 and 2 cases were respectively identified at baseline and at follow-up (odds ratio: 2.069; 95% confidence interval: 0.178 – 24.075; p=0.554). Increased odds of incidence of cancer cases were observed within both the post-op (26.5% increase) and pre-op (200% increase) groups. Statistical significance was however not reached in either of the groups (Table 64).

Odds of occurrence of each of the 17 unique comorbid conditions were compared between the post-op and pre-op groups. Although, no statistical differences were found between the groups for any of the comorbid conditions, trends toward decreases in odds, in favour of the post-op group, were observed for the following comorbid conditions: diabetes mellitus (28% reduction), hypertension (17% reduction), dyslipidemia (23% reduction), DVT (29% reduction), gout (25% reduction), sleep apnea (36% reduction), GERD (31% reduction), asthma (21% reduction), PCOS (43% reduction), stress incontinence (2% reduction) and thyroid dysfunction (5% reduction), psychological disorders (4% reduction) and cancer (14% reduction). We observed no difference in odds of incidence of hypercholesterolemia cases between the groups. Trends towards increased odds of incidence of stroke (30% increase), gallbladder disease (48% increase) and osteoarthritis (15% increase) were also observed for the post-op group when compared to the pre-op group. These results are presented in Table 17.

## **Table 17**: Post-op vs. Pre-op Odds of Occurrence of Comorbid Conditions

| Comorbid Conditions | Baseline | | | | Follow-up | | | | OR post/pre | 95% CI | P-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Post-op N=91 | | Pre-op N=31 | | Post-op N=91 | | Pre-op N=31 | | | | |
| | + | - | + | - | + | - | + | - | | | |
| Diabetes mellitus | 32 | 59 | 13 | 18 | 23 | 68 | 11 | 20 | -28% | [0.321 – 1.636] | 0.437 |
| Hypertension | 44 | 47 | 15 | 16 | 31 | 60 | 14 | 17 | -17% | [0.375 – 1.842] | 0.649 |
| Hypercholesterolemia | 27 | 64 | 9 | 22 | 22 | 69 | 8 | 23 | 0% | [0.411 – 2.435] | 1.000 |
| Stroke | 15 | 76 | 4 | 27 | 13 | 78 | 4 | 27 | +30% | [0.396 – 4.252] | 0.667 |
| Dyslipidemia | 17 | 74 | 7 | 24 | 15 | 76 | 7 | 24 | -23% | [0.284 – 2.070] | 0.600 |
| DVT[1] | 11 | 80 | 5 | 26 | 11 | 80 | 5 | 26 | -29% | [0.227 – 2.249] | 0.566 |
| Gallbladder disease | 21 | 70 | 5 | 26 | 17 | 74 | 5 | 26 | +48% | [0.505 – 4.314] | 0.477 |
| Osteoarthritis | 25 | 66 | 8 | 23 | 26 | 65 | 8 | 23 | +15% | [0.456 – 2.898] | 0.767 |
| Gout | 19 | 72 | 8 | 23 | 15 | 76 | 7 | 24 | -25% | [0.292 – 1.930] | 0.551 |
| Sleep Apnea | 39 | 52 | 13 | 18 | 32 | 59 | 12 | 19 | -36% | [0.277 – 1.496] | 0.306 |
| GERD[2] | 26 | 65 | 12 | 19 | 22 | 69 | 9 | 22 | -31% | [0.300 – 1.593] | 0.386 |
| Asthma | 16 | 75 | 7 | 24 | 16 | 75 | 5 | 26 | -21% | [0.293 – 2.141] | 0.646 |
| PCOS[3] | 12 | 79 | 7 | 24 | 10 | 81 | 4 | 27 | -43% | [0.204 – 1.599] | 0.286 |
| Stress incontinence | 20 | 71 | 6 | 85 | 6 | 85 | 6 | 25 | -2% | [0.355 – 2.707] | 0.970 |
| Thyroid dysfunction | 22 | 79 | 8 | 23 | 22 | 79 | 5 | 26 | -5% | [0.378 – 2.371] | 0.906 |
| Psychological Disorders (anxiety/depression) | 38 | 53 | 11 | 20 | 30 | 61 | 13 | 18 | -4% | [0.428 – 2.149] | 0.918 |
| Cancer | 4 | 87 | 1 | 30 | 5 | 86 | 2 | 29 | -14% | [0.159 – 4.679] | 0.864 |

1: DVT = Deep Vein Thrombosis
2: GERD = Gastro esophageal Reflux Disease
3: PCOS = Polycystic Ovary Syndrome

## Discussion

The current body of evidence depicts Bariatric surgery as the most effective intervention for the management of morbid obesity, irrespectively of the surgical procedure used. Furthermore, improvements in Health related quality of life and productivity loss outcomes have also been established as a consequence of this intervention. Unfortunately, these detected improvements in HRQoL and productivity loss outcomes have mostly been assessed over short follow-up time periods. Less is actually known about the potential impact of Bariatric surgery on these important outcomes over time following the surgical intervention.

This research aimed to contribute to the current body of evidence by assessing the impact of Bariatric surgery on HRQoL and work productivity outcomes over time. To achieve this objective, data for Health related quality of life and work productivity were gathered through a cross-sectional survey conducted between August 2013 and October 30$^{th}$ 2013, in obese individuals sampled from a patient population being treated at the McGill University Health Centre (MUHC). In total, 122 respondents (110 female patients and 12 male patients) completed and returned the questionnaires (i.e. SF-36, EQ-5D and WLQ). For the purpose of our analysis, the respondents were divided into two groups: a post-op or surgical and a pre-op or non-surgical group.

These two groups were then compared to address the following research questions:

1. What is the impact of Bariatric surgery on health related quality of life and work productivity?

2. Is there a relationship between EWL and HRQoL and work productivity in Bariatric surgery patients? Furthermore, what is the impact of time since surgery on this potential relationship?
3. Are there any potential predictive determinants of HRQoL and work productivity scores following Bariatric surgery in obese patients?
4. What is impact of Bariatric surgery on obesity related chronic comorbidities?

In order to address the first research question, HRQoL scores were assessed beyond 34 years of follow-up after Bariatric surgery or after having been wait-listed for this intervention. Univariate analyses for mean HRQoL scores versus follow-up time after surgery or after having been wait-listed for this intervention were performed and using the trapezoidal rule, AUCs were approximated for the pre and post-op groups. AUC summary statistic was then used to perform a longitudinal analysis of patient reported HRQoL and WLQ scores. The impact of Bariatric surgery intervention on HRQoL and work productivity was then investigated through comparison of the AUC curves for the pre and post-op groups.

The findings suggested improvements in HRQoL and WLQ outcomes over time following Bariatric surgery, for all outcome measures. Although not statistically significant, we noted important trends towards significance for the PF, RP, GH, SF, MH and PCS scales of the SF-36. Similar trends were observed for the PD, MID and OD scales of the WLQ. Statistical significant differences were observed for 3 outcomes scales of the SF-36 (BP, RE and MCS), 1 outcome scale of the EQ-5D (VAS) and 1 outcome scale of the WLQ (TM). These statistically significant findings may be translated into positive improvements, following Bariatric surgery, of respectively 28, 34, 24, 41 and 32%, in

Bodily Pain (BP), Role Emotional (RE), Mental Component Summary (MCS), Visual Analogue Scale (VAS) and Time management (TM) scale scores.

The bodily pain (BP) and role emotional (RE) scales of the SF-36 are both unipolar measures, meaning that they define health status in terms of absence of disability. The Mental component score of the SF-36 is corresponds to an aggregated measure of the mental health dimensions underlying the questionnaire. Through the EQ-5D VAS, individuals record scores, which define their current health related quality of life state. The greater the scores for these entire outcome measures, the better the health state or the perception of the health state. Therefore, these results suggested that following Bariatric surgery, patients may experience approximately 28% less disability related to bodily pain, 34% less disability due to mental health issues and a 24% improvement in their overall mental health status. Furthermore, the EQ-5D VAS findings suggested that following Bariatric surgery, patients' perception of their health related quality of life state was 41% better than prior to the surgery. Lastly, findings related to the WLQ TM scale highlighted a 32% reduction in difficulties related to time and scheduling management following Bariatric surgery.

These observed improvements in HRQoL are consistent with findings currently in the public domain; namely with respect to improvements in all domains of HRQoL outcome measures following Bariatric surgery. Furthermore, our findings appear to be supportive of the observed initial positive influence of Bariatric surgery on HRQoL to be maintained over time.

Although scarce, the evidence currently available in the public domain has highlighted less employment impairment and better employment productivity for morbidly obese individuals who have undergone. Our findings identified similarly, trends towards improvements in work productivity, following bariatric surgery. While these work productivity results may be considered mainly as trends, they remain nonetheless quite interesting given their alignment with the scarce evidence currently available in similar settings.

We also aimed to assess the relationship between EWL, HRQoL and work productivity following Bariatric surgery. Our findings did detect the existence of a statistically significant interactive relationship between EWL and time for the Social Functioning and the mental health component summary scales of the SF-36. Therefore, improved outcomes for the social functioning and mental component scales of the SF-36 were associated with increases in the EWL and increases in time since the surgical intervention. Thus following Bariatric surgery, as time following the intervention and the EWL increase, improvements may be observed with regards to disabilities related to social functioning and mental health dimensions.

Previously published data have suggested weight maintenance over time as having a positive influence on HRQoL over the long term. Our findings appear to be in support of this evidence. These results seem to advocate for the importance of additional patient management measures, following Bariatric surgery, that would serve to further promote weight maintenance following the intervention (i.e. patient support program that could assist in ongoing changes in lifestyle and behaviours).

No statistically significant difference was observed between EWL and HRQoL for the following scales of the SF-36: PF, GH, MH and MCS; the EQ-5D index and VAS as well as for the PD scale of the WLQ.

Through our third research question, we attempted to explore predictive determinants of mean HRQoL and work productivity scores measured using the SF-36, the EQ-5D and the WLQ, following Bariatric surgery. A multiple linear regression analysis, used to develop a model for predicting mean HRQoL and work productivity outcome scores from participants' age, gender and body mass index (BMI) data collected at the initial visit with the surgeon and at follow-up time post-surgery, identified 3 significant regression equations.

The HRQoL and work productivity scales with the strongest predicted outcomes mean scores were found to be the physical functioning (PF) scale, for the SF-36, the Visual Analogue Scale (VAS) for the EQ-5D and the physical demands (PD) scale for the WLQ. The multiple linear regression analyses demonstrated that age, gender and body mass index (BMI) at initial visit with the surgeon and at follow-up time post-surgery explain 12.4%, 9.30% and 10.8% of the variation respectively observed for PF scale of the SF-36, the EQ-5D VAS and the PD scale of the WLQ.

Participants' PF mean scores were predictively negatively affected with increases in BMI units, years of age and follow-up time since surgery. The VAS was impacted negatively over time with increments in BMI units and years of follow-up subsequent to the surgical intervention. Age was however not significant to the regression equation. Consistent observations are noted for the physical demands scale of the WLQ. As such, the physical

demands scale is negatively impacted with BMI increments and time following Bariatric surgery interventions.

These findings shown that increases in physical disability, work related physical demands and decrements in patients' perception of their health status may be consequential to increments in BMI units and years of follow-up since the surgical intervention.

We found these findings to be interestingly intuitive; namely, that increase in physical disability may lead to inactivity, which may ultimately lead to increments in BMI units. In turns, these increments in BMI units would lead to decrements in patients' perception of their health status. The opposite could also be argued, decrements in physical disability would lead to more physical activity, which in turn may contribute to better weight management better perception of health status from the patient's perspective.

In order to address the forth objective, related to assessment of the impact of Bariatric surgery on chronic comorbidities, we performed a crosstab analysis to evaluate and compare odds of occurrence, of these comorbid conditions, in the pre and post op groups (within and between group comparison), at baseline and at follow-up. The survey respondents reported in total 17 unique comorbid conditions, explicitly: diabetes mellitus, hypertension, hypercholesterolemia, stroke, dyslipidemia, deep vein thrombosis (DVT), gallbladder disease, osteoarthritis, gout, sleep apnea, GERD, PCOS, stress incontinence, thyroid dysfunction and psychological disorders such as depression and anxiety.

The findings were aligned with currently published data on the matter. Although not clinically significant, we observed trends towards greater decreases in odds of incidence

of comorbid conditions, between baseline and follow-up, within the post-op group when compared to the pre-op group.

When comparing the post-op and pre-op groups with respect to odds of occurrence of comorbid conditions, reduced odds in favour of the post-op group were observed for all but the following 3 conditions: stroke, osteoarthritis, gallbladder disease. Increased odds were observed for stroke, osteoarthritis and gallbladder disease for the post-op group versus the pre-op group. These findings may be explained by the greater median age observed for the post-op group. Stroke, osteoarthritis and gallbladder are conditions with the commonality to increase in risk in aging populations.

A 31% increased in odds of psychological disorder was noted between baseline and follow-up within the pre-op group. Although not clinically significant, this represents and thought-provoking finding, as it would indicate that patients experience deterioration in psychological health while waiting for treatment for morbid obesity. Further research focussed on determining at what stage this psychological deterioration begins, from the onset of the disease to the surgical intervention and the impact of waiting on treatment outcomes, could be of interest. Results from this additional research may point towards recommendations ultimately leading to improved access to appropriate care for patients with morbid obesity; an ever-increasing public health care problem associated with significant economic consequences.

## Study Limitations and Strengths

This study has limitations. This cross-sectional study used a non-experimental research approach. The patient population targeted for this trial originated from a single high volume Bariatric surgery centre and may not reflect practice outside of this setting. Male Bariatric surgery patients were underrepresented in this study; however, this is representative of what is observed in the Canadian setting. According to a Bariatric surgery, report published in 2014 by the Canadian Institute for Health Information (CIHI), 80% of hospital Bariatric surgery patients were women; reflecting the higher percentage of women among Canadians with class II and class III obesity. Study group comparability may be limited given the greater number of patients assigned to the post-op group in comparison to the pre-op group.

Of the 1944 surveys sent to targeted participants, 122 were returned. This postal survey's low response rate potentially contributed to a reduction in the sample effect size and to the introduction of potential nonresponse bias. Since only 6.28% of the targeted participants actually completed the postal survey, the results of this cross-sectional study should be interpreted with caution. Additional research would therefore be necessary in order to gain further clarification on the trends observed as part of this research.

This study has a number of key strengths and its results may have important implications as we continue to gain a better understanding of long-term effects of Bariatric surgery on health related quality of life and productivity loss. To our knowledge, this was the first Canadian study where simultaneous quality of life data, using two different standard measures (SF-36 and EQ-5D), and productivity loss data were collected for a population

of Bariatric surgery patients with an average post-surgery follow-up of more than 10 years. Although small, the study sample was still reflective of the Canadian Bariatric surgery population and would allow for cautious generalizations of the trends and findings.

## Conclusion

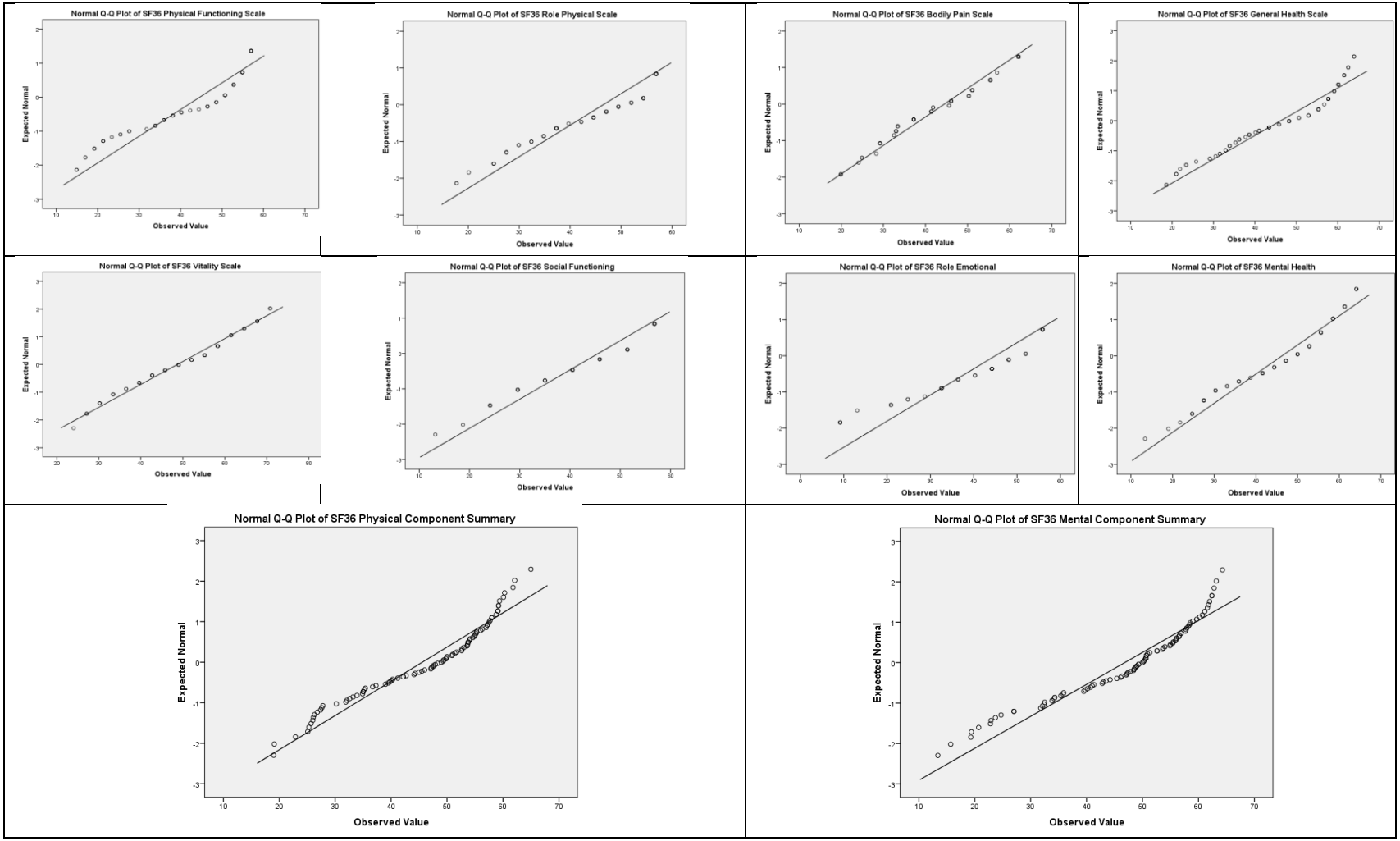
The current research corroborates and adds to the body of evidence related to the impact of Bariatric surgery on HRQoL and work productivity outcomes as follows:

- Bariatric surgery, patients may experience approximately 28% less disability related to bodily pain, 34% less disability due to mental health issues and a 24% improvement in their overall mental health status. Furthermore, the EQ-5D VAS findings suggested that following Bariatric surgery, patients' perception of their health related quality of life state was 41% better than prior to the surgery. Lastly, findings related to the WLQ TM scale highlighted a 32% reduction in difficulties related to time and scheduling management following Bariatric surgery.
- Further to Bariatric surgery and as the EWL and time following the intervention increase, improvements may be observed with regards the disabilities related to social functioning and mental health dimensions.
- Per our findings, the initial positive impact of Bariatric surgery on HRQoL appeared to be sustained over time.
- Increases in physical disability, work limitations and decrements in patients' perception of their health status may be consequential to increments in BMI units and years of follow-up since the surgical intervention.
- Our findings further corroborated trends towards decreases in the occurrence of chronic comorbidities following Bariatric surgery.

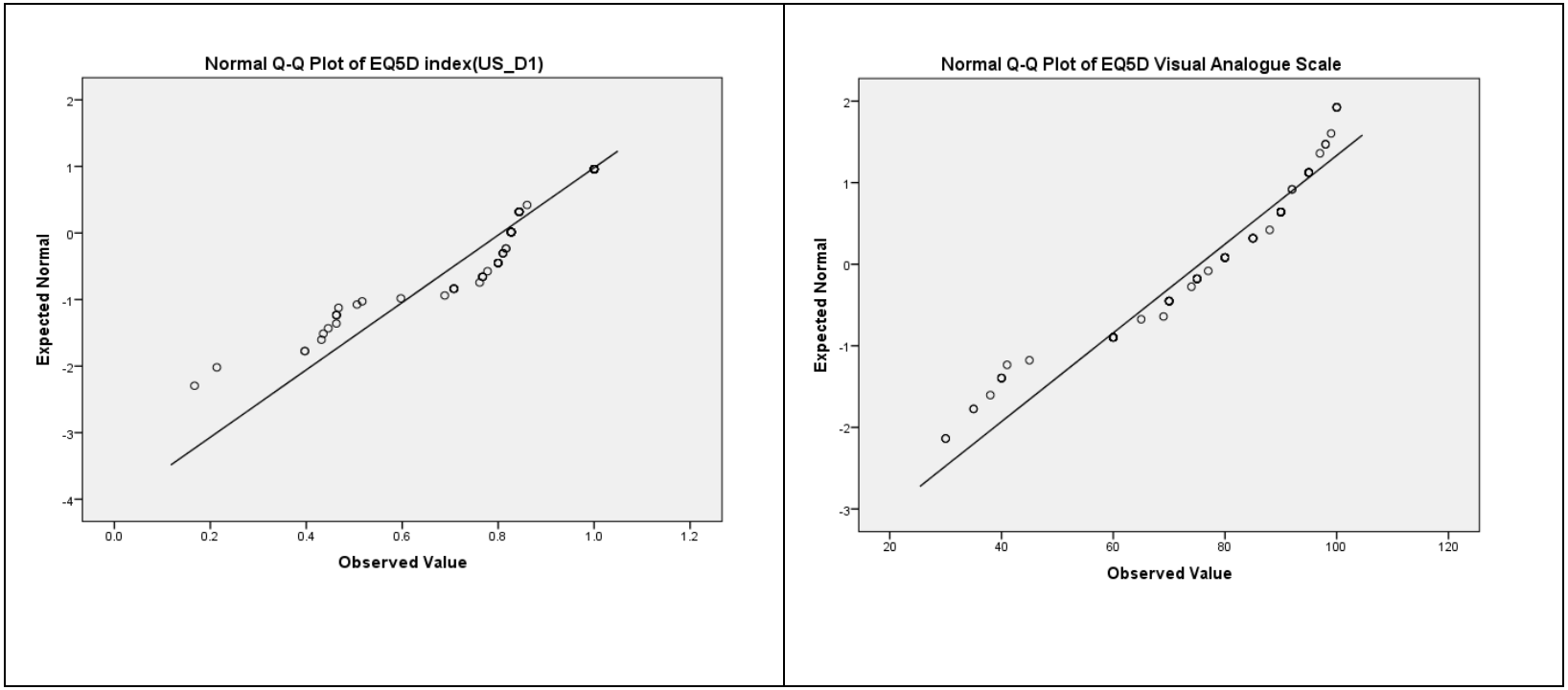
# Appendix 1

## Normality Distributions for SF-36, EQ-5D and WLQ

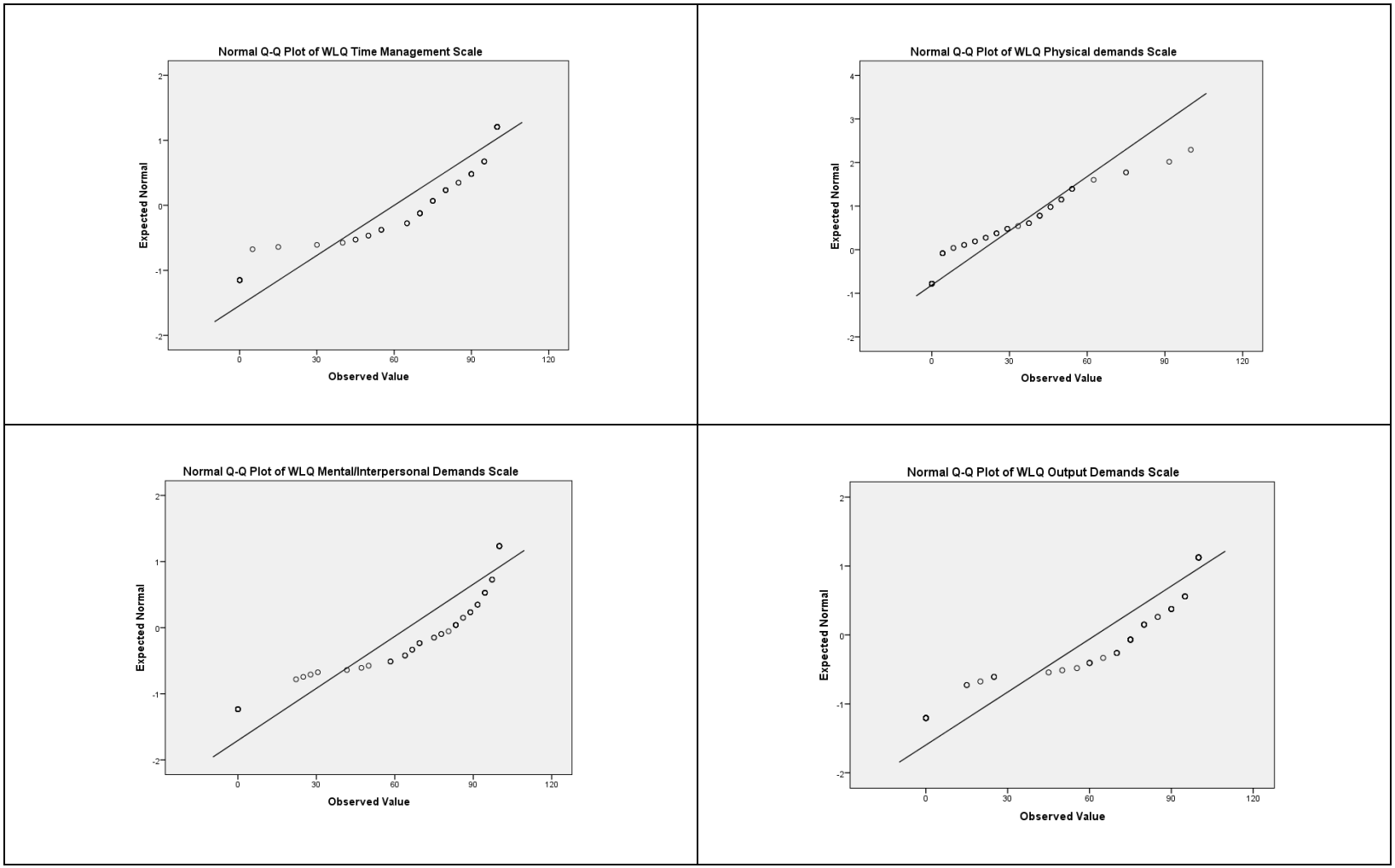
## Figure 7: SF-36 results normality distribution



## Figure 8: EQ-5D results normality distribution



## Figure 9: WLQ results normality distribution

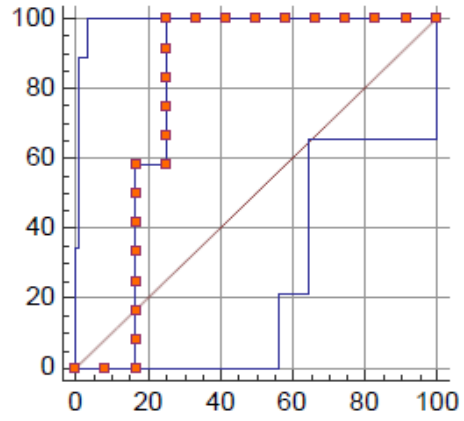


# Appendix 2

## HRQoL & WLQ Outcomes Measure Scales AUCs vs. Follow-up Time

## Table 18: SF-36_PF Scale AUC vs. Follow-up Time

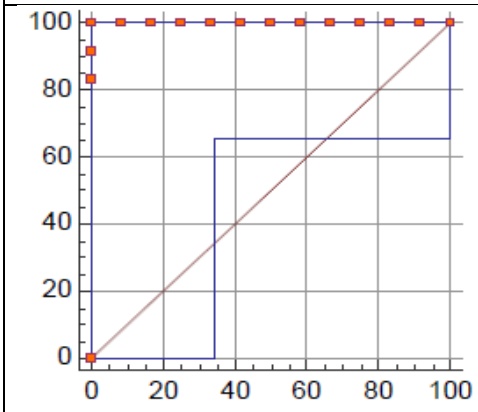
Post-op SF-36_PF$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.799 |
| Standard Error [a] | 0.109 |
| 95% CI [b] | 0.586 to 0.993 |
| z statistic | 2.728 |
| Significance level P (Area=0.5) | 0.0064 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

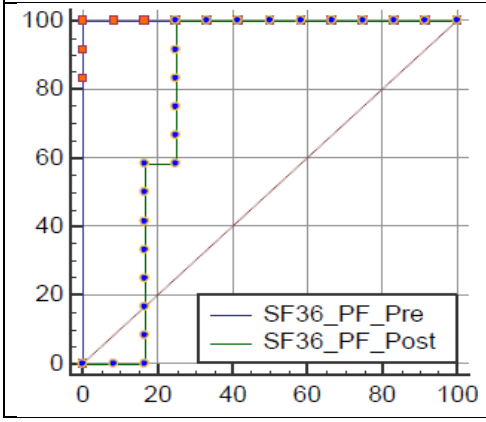
Pre-op SF-36_PF$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

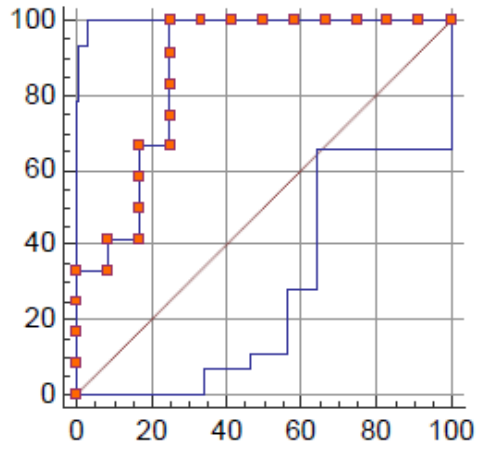



| | |
|---|---|
| AUC | 0.201 |
| Standard Error [a] | 0.109 |
| 95% CI [b] | -0.0132 to 0.416 |
| z statistic | 1.840 |
| Significance level P (Area=0.5) | 0.0658 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 19: SF-36_RP Scale AUC vs. Follow-up Time

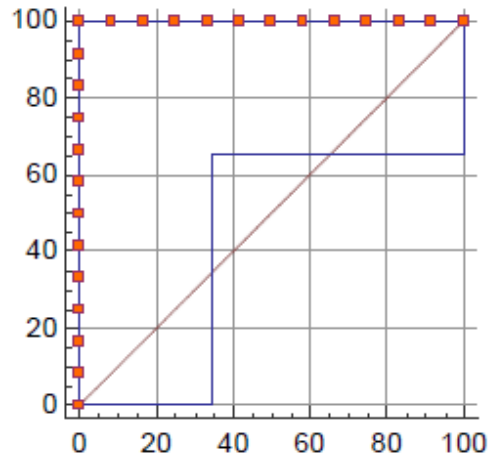
Post-op SF-36_RP$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.868 |
| Standard Error [a] | 0.0775 |
| 95% CI [b] | 0.668 to 0.970 |
| z statistic | 4.750 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

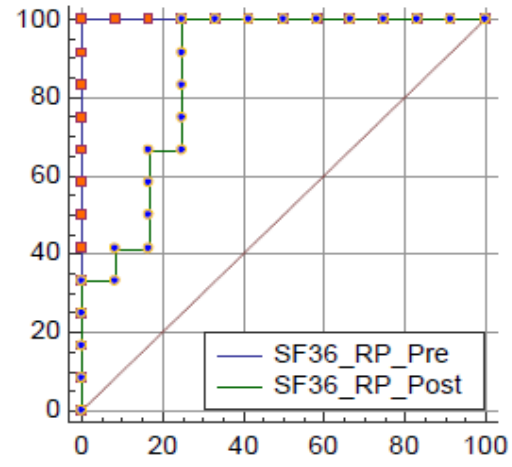
Pre-op SF-36_RP$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

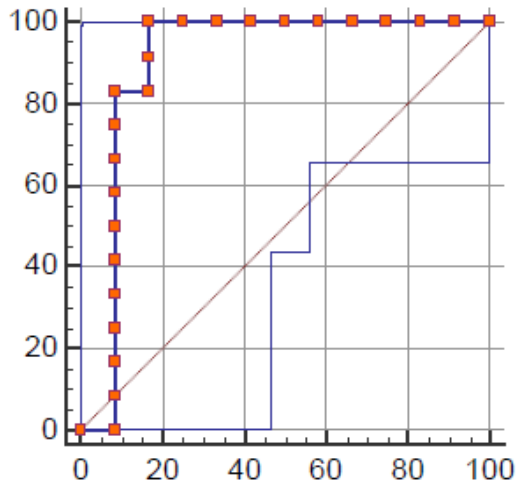



| | |
|---|---|
| AUC | 0.132 |
| Standard Error [a] | 0.0775 |
| 95% CI [b] | -0.0199 to 0.284 |
| z statistic | 1.703 |
| Significance level P (Area=0.5) | 0.0886 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 20: SF-36_BP Scale AUC vs. Follow-up Time

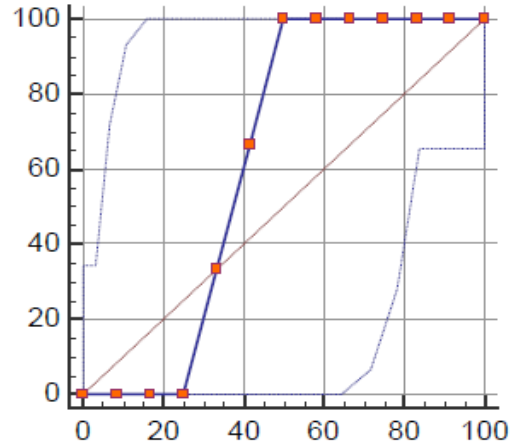
### Post-op SF-36_BP$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.903 |
| Standard Error [a] | 0.0806 |
| 95% CI [b] | 0.712 to 0.985 |
| z statistic | 4.994 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

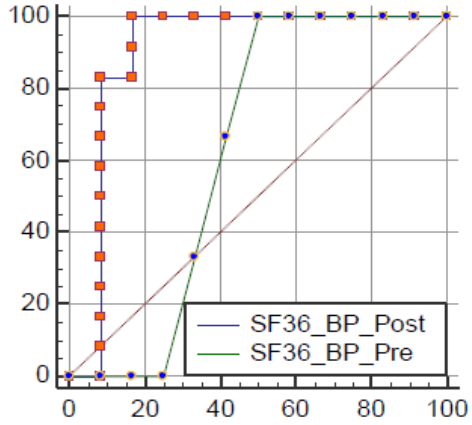
### Pre-op SF-36_BP$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.625 |
| Standard Error [a] | 0.129 |
| 95% CI [b] | 0.406 to 0.812 |
| z statistic | 0.966 |
| Significance level P (Area=0.5) | 0.3341 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

### Pairwise Comparison of Curves

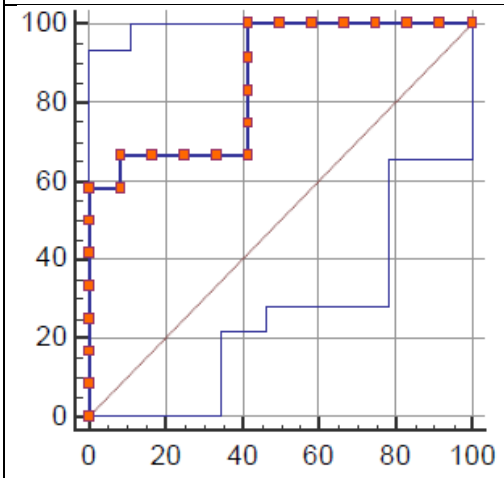



| | |
|---|---|
| AUC | 0.278 |
| Standard Error [a] | 0.126 |
| 95% CI [b] | 0.0315 to 0.524 |
| z statistic | 2.210 |
| Significance level P (Area=0.5) | 0.0271 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 21: SF-36_GH Scale AUC vs. Follow-up Time

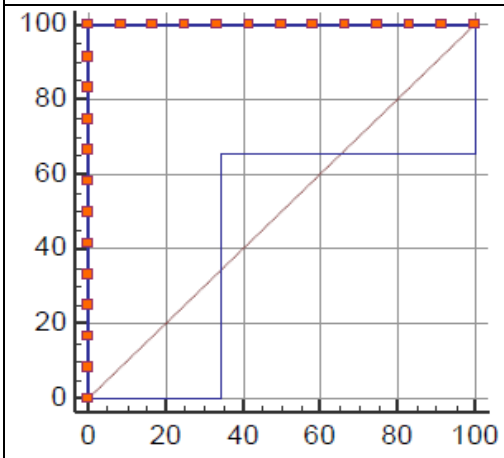
Post-op SF-36_GH$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.854 |
| Standard Error [a] | 0.0776 |
| 95% CI [b] | 0.651 to 0.964 |
| z statistic | 4.567 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

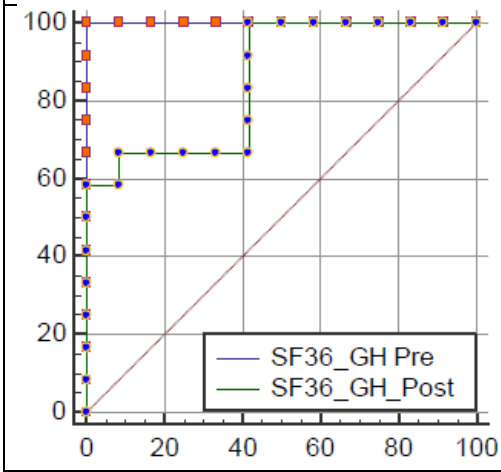
Pre-op SF-36_GH$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

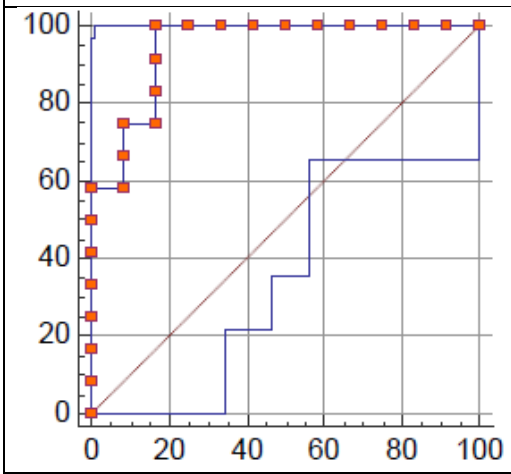



| | |
|---|---|
| AUC | 0.146 |
| Standard Error [a] | 0.0776 |
| 95% CI [b] | -0.0061 to 0.298 |
| z statistic | 1.880 |
| Significance level P (Area=0.5) | 0.0601 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 22: SF-36_VT Scale AUC vs. Follow-up Time

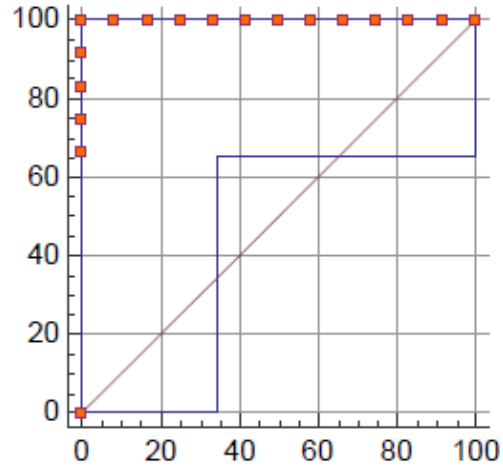
Post-op SF-36_VT$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.944 |
| Standard Error [a] | 0.0449 |
| 95% CI [b] | 0.768 to 0.997 |
| z statistic | 9.902 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

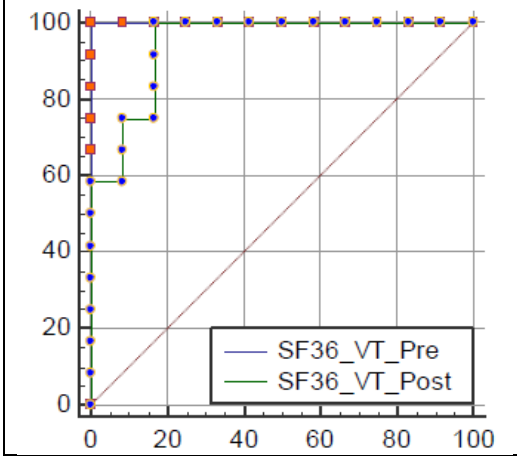
Pre-op SF-36_VT$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

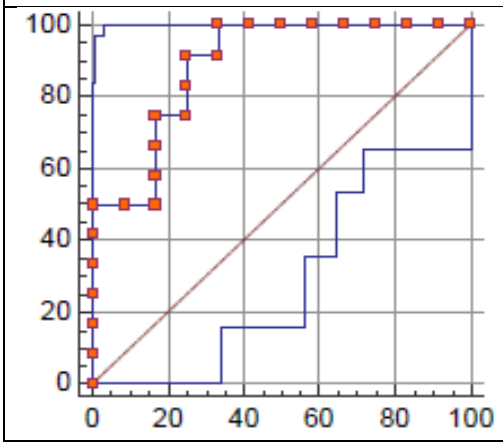



| | |
|---|---|
| AUC | 0.0556 |
| Standard Error [a] | 0.0449 |
| 95% CI [b] | -0.0324 to 0.144 |
| z statistic | 1.238 |
| Significance level P (Area=0.5) | 0.2158 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 23: SF-36_SF Scale AUC vs. Follow-up Time

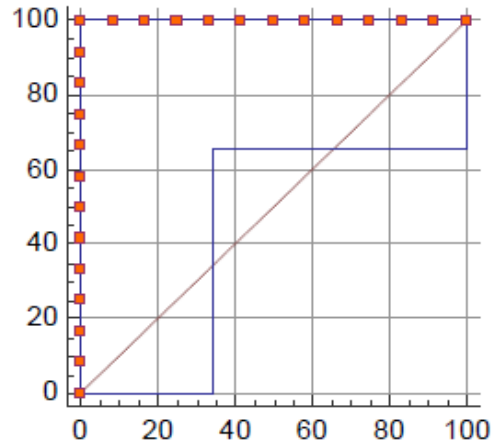
Post-op SF-36_$SF_{scale}$ Curve




| | |
|---|---|
| AUC | 0.889 |
| Standard Error [a] | 0.0668 |
| 95% CI [b] | 0.694 to 0.979 |
| z statistic | 5.824 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

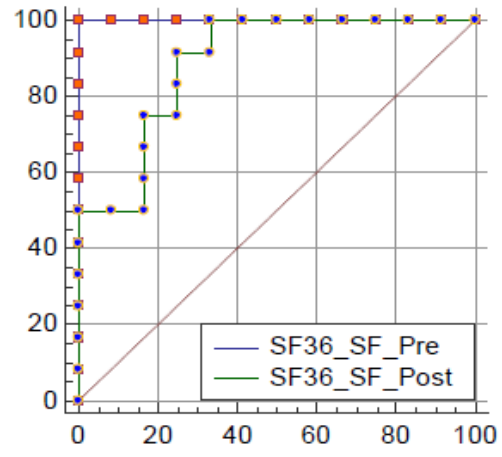
Pre-op SF-36_$SF_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

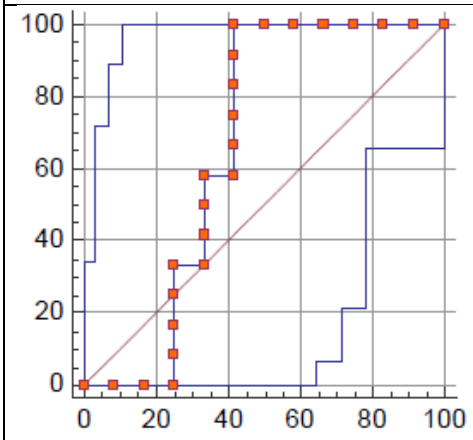



| | |
|---|---|
| AUC | 0.111 |
| Standard Error [a] | 0.0668 |
| 95% CI [b] | -0.0198 to 0.242 |
| z statistic | 1.664 |
| Significance level P (Area=0.5) | 0.0961 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 24: SF-36_RE Scale AUC vs. Follow-up Time

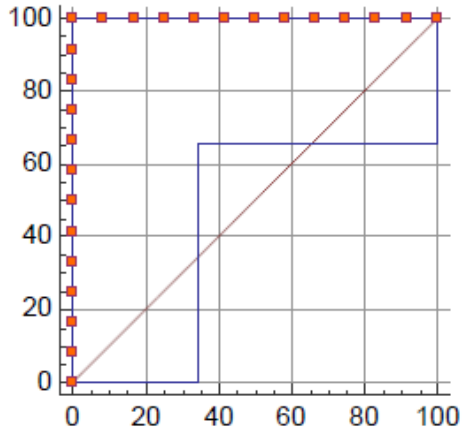
Post-op SF-36_RE$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.660 |
| Standard Error [a] | 0.127 |
| 95% CI [b] | 0.440 to 0.839 |
| z statistic | 1.257 |
| Significance level P (Area=0.5) | 0.2087 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

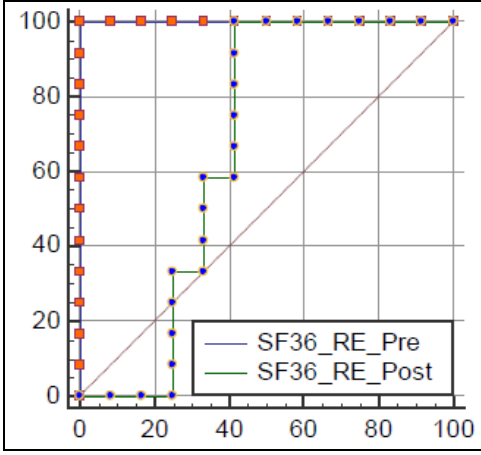
Pre-op SF-36_RE$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

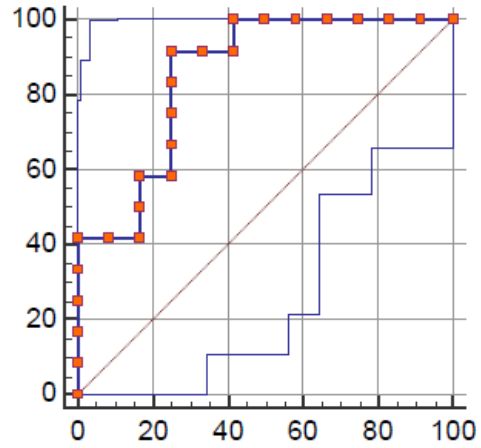



| | |
|---|---|
| AUC | 0.340 |
| Standard Error [a] | 0.127 |
| 95% CI [b] | 0.0913 to 0.589 |
| z statistic | 2.678 |
| Significance level P (Area=0.5) | 0.0074 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 25: SF-36_MH Scale AUC vs. Follow-up Time

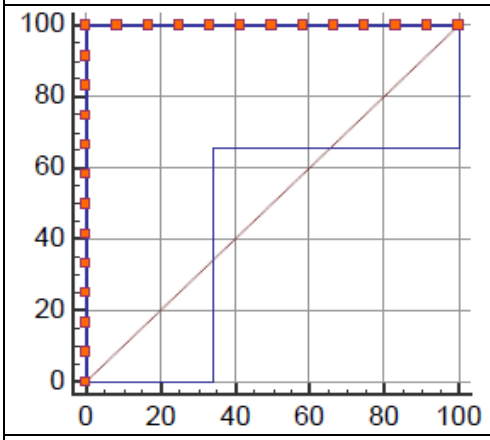
Post-op SF-36_MH$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.854 |
| Standard Error [a] | 0.0787 |
| 95% CI [b] | 0.651 to 0.964 |
| z statistic | 4.501 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

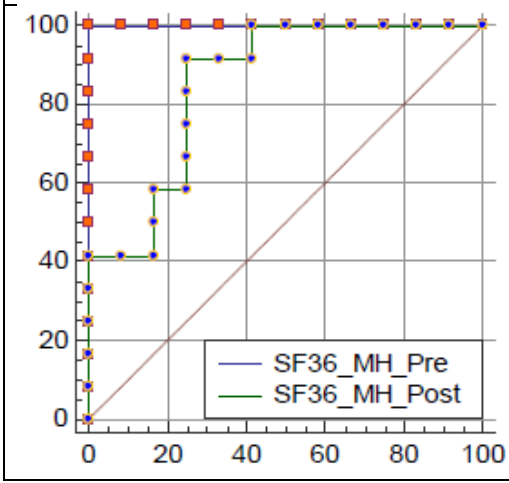
Pre-op SF-36_MH$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

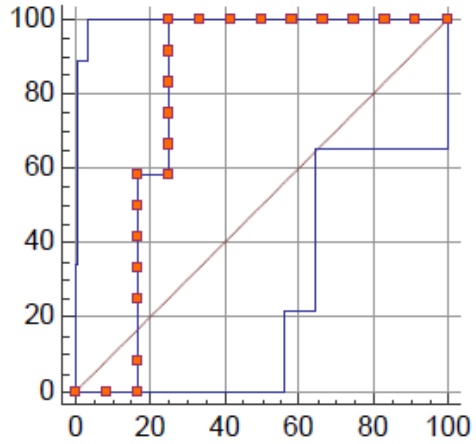



| | |
|---|---|
| AUC | 0.146 |
| Standard Error [a] | 0.0787 |
| 95% CI [b] | -0.008 to 0.300 |
| z statistic | 1.853 |
| Significance level P (Area=0.5) | 0.0638 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 26: SF-36_PCS Scale AUC vs. Follow-up Time

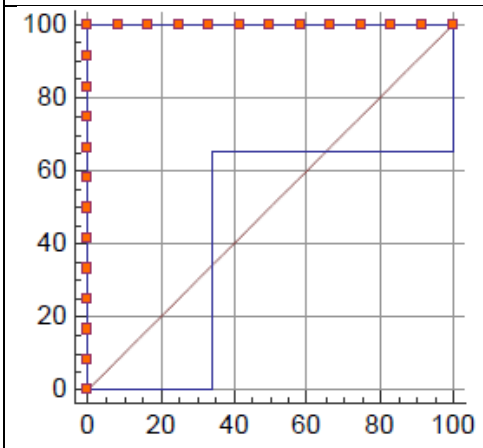
Post-op SF-36_PCS$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.799 |
| Standard Error [a] | 0.109 |
| 95% CI [b] | 0.586 to 0.933 |
| z statistic | 2.728 |
| Significance level P (Area=0.5) | <0.0064 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

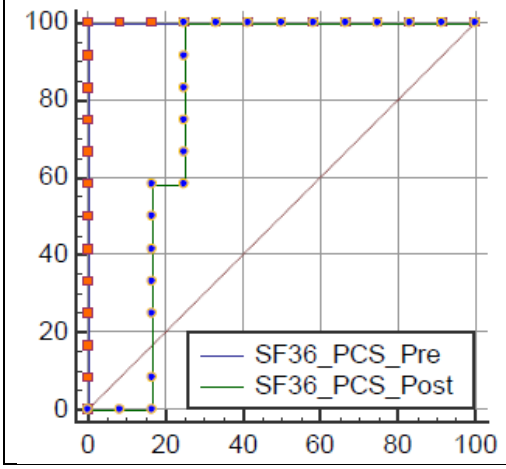
Pre-op SF-36_PCS$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

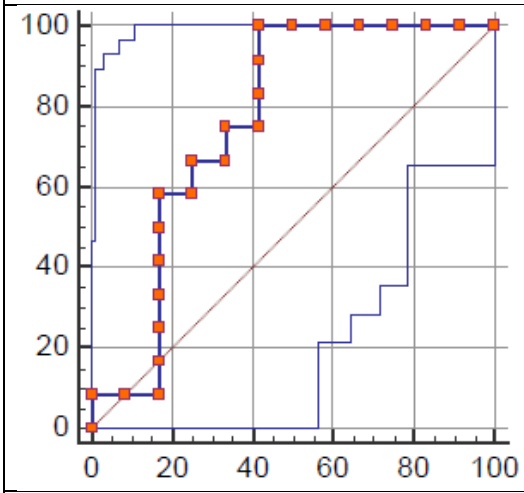



| | |
|---|---|
| AUC | 0.201 |
| Standard Error [a] | 0.0787 |
| 95% CI [b] | -0.0132 to 0.416 |
| z statistic | 1.840 |
| Significance level P (Area=0.5) | 0.0658 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 27: SF-36_MCS Scale AUC vs. Follow-up Time

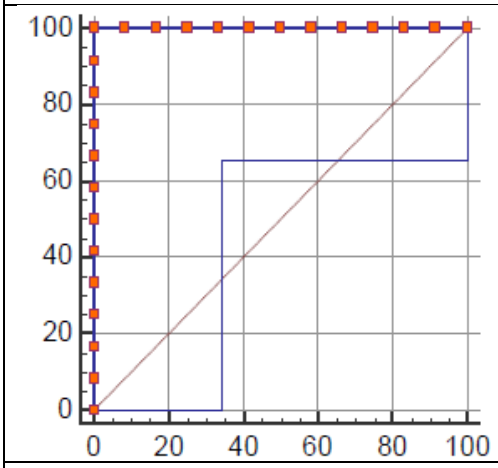
Post-op SF-36_MCS$_{scale}$ Curve




| | |
|---|---|
| AUC | 0.764 |
| Standard Error [a] | 0.105 |
| 95% CI [b] | 0.548 to 0.911 |
| z statistic | 2.502 |
| Significance level P (Area=0.5) | 0.0124 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

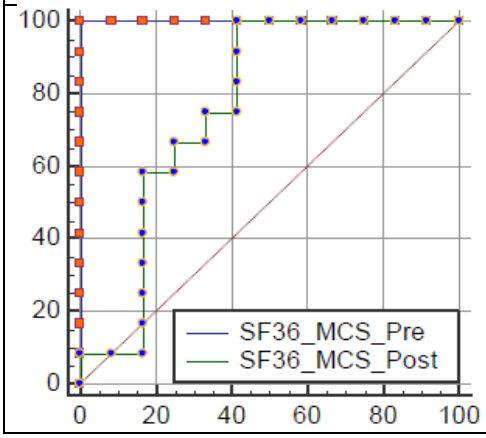
Pre-op SF-36_MCS$_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

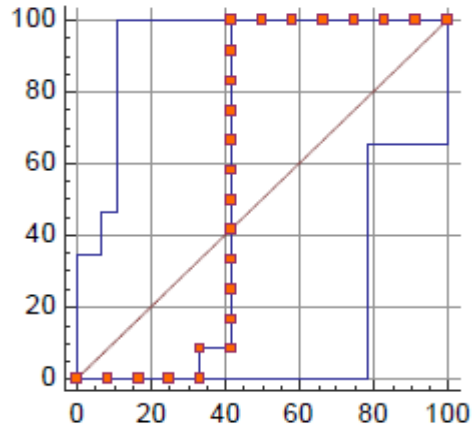



| | |
|---|---|
| AUC | 0.236 |
| Standard Error [a] | 0.105 |
| 95% CI [b] | 0.029 to 0.443 |
| z statistic | 2.239 |
| Significance level P (Area=0.5) | 0.0252 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 28: EQ-5D_VAS AUC vs. Follow-up Time

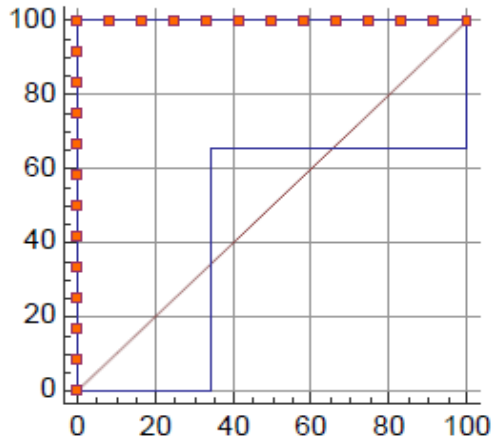
Post-op EQ-5D VAS Curve




| | |
|---|---|
| AUC | 0.590 |
| Standard Error [a] | 0.140 |
| 95% CI [b] | 0.373 to 0.785 |
| z statistic | 0.643 |
| Significance level P (Area=0.5) | 0.520 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

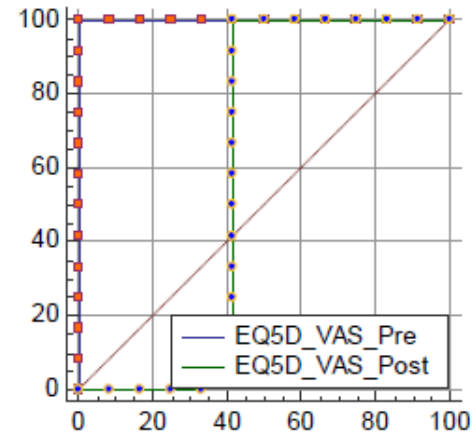
Pre-op EQ-5D VAS Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

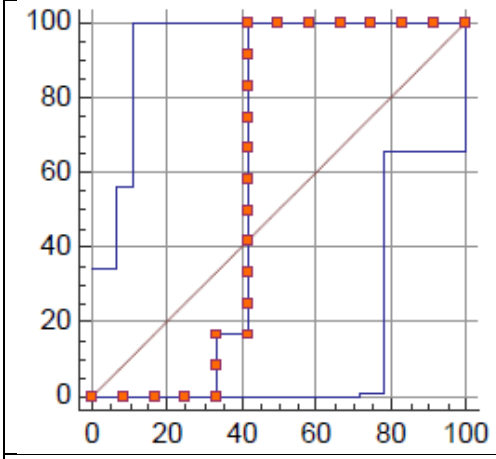



| | |
|---|---|
| AUC | 0.410 |
| Standard Error [a] | 0.140 |
| 95% CI [b] | 0.135 to 0.685 |
| z statistic | 2.919 |
| Significance level P (Area=0.5) | 0.0035 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 29: WLQ TM Scale AUC vs. Follow-up Time

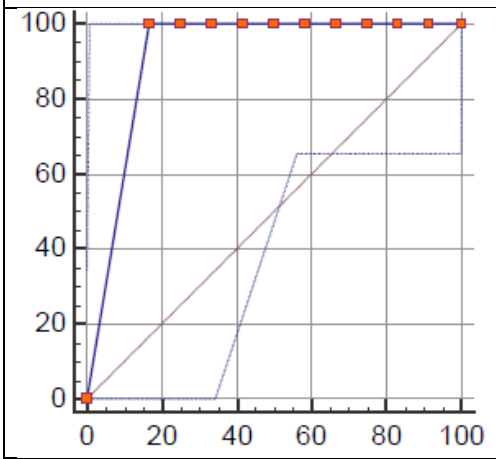
Post-op WLQ TM $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.597 |
| Standard Error [a] | 0.139 |
| 95% CI [b] | 0.379 to 0.790 |
| z statistic | 0.701 |
| Significance level P (Area=0.5) | 0.4833 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

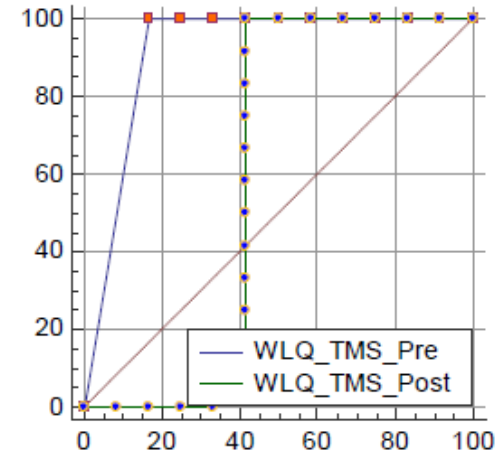
Pre-op WLQ TM $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.917 |
| Standard Error [a] | 0.0665 |
| 95% CI [b] | 0.730 to 0.990 |
| z statistic | 6.267 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

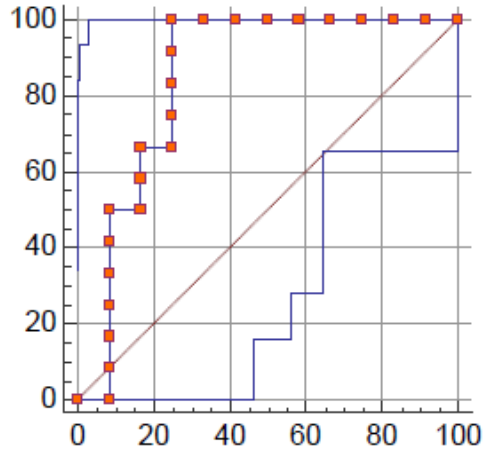



| | |
|---|---|
| AUC | 0.319 |
| Standard Error [a] | 0.154 |
| 95% CI [b] | 0.0182 to 0.621 |
| z statistic | 2.078 |
| Significance level P (Area=0.5) | 0.0377 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 30: WLQ PD Scale AUC vs. Follow-up Time

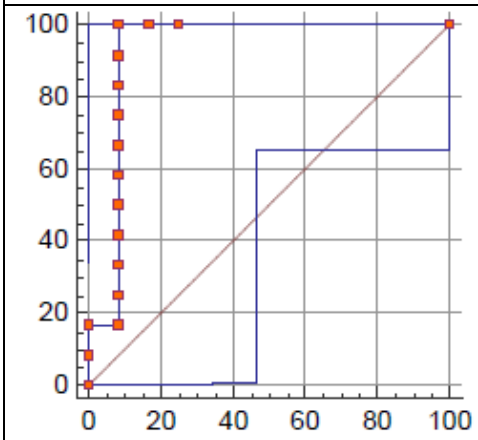
Post-op WLQ PD $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.847 |
| Standard Error [a] | 0.0906 |
| 95% CI [b] | 0.643 to 0.960 |
| z statistic | 3.833 |
| Significance level P (Area=0.5) | 0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

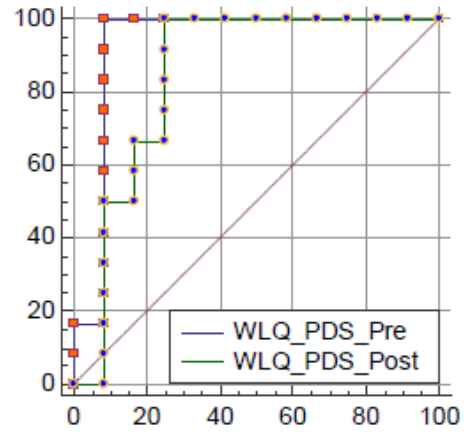
Pre-op WLQ PD $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.931 |
| Standard Error [a] | 0.0676 |
| 95% CI [b] | 0.749 to 0.994 |
| z statistic | 6.366 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

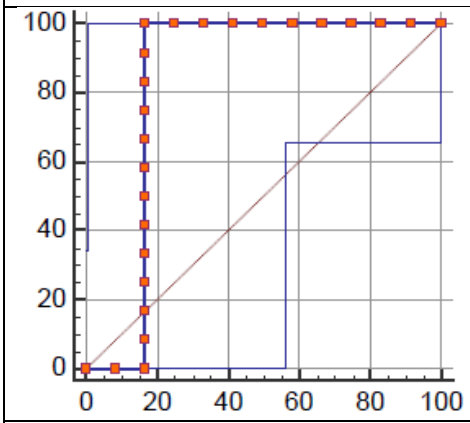



| | |
|---|---|
| AUC | 0.0833 |
| Standard Error [a] | 0.0898 |
| 95% CI [b] | -0.0926 to 0.259 |
| z statistic | 0.928 |
| Significance level P (Area=0.5) | 0.3532 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 31: WLQ MID Scale AUC vs. Follow-up Time

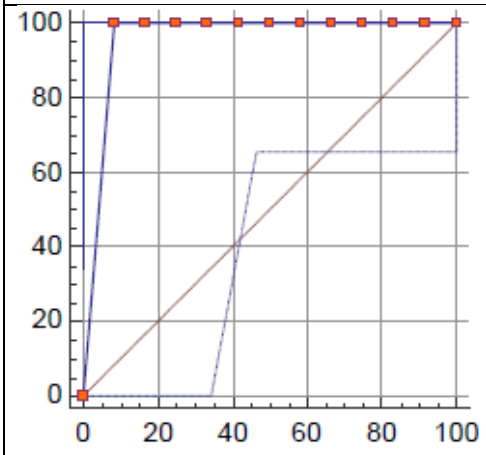
Post-op WLQ MID $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.833 |
| Standard Error [a] | 0.108 |
| 95% CI [b] | 0.626 to 0.953 |
| z statistic | 3.098 |
| Significance level P (Area=0.5) | 0.0019 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

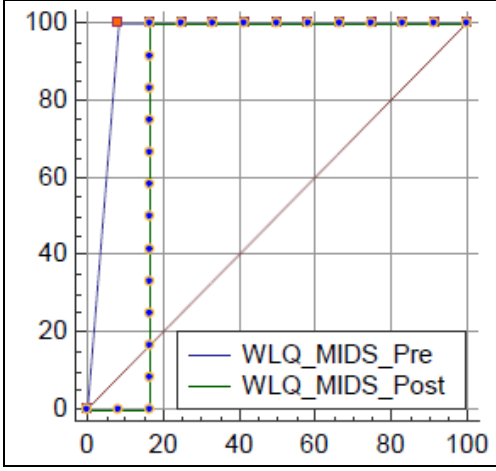
Pre-op WLQ MID $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.958 |
| Standard Error [a] | 0.0481 |
| 95% CI [b] | 0.789 to 0.999 |
| z statistic | 9.535 |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves

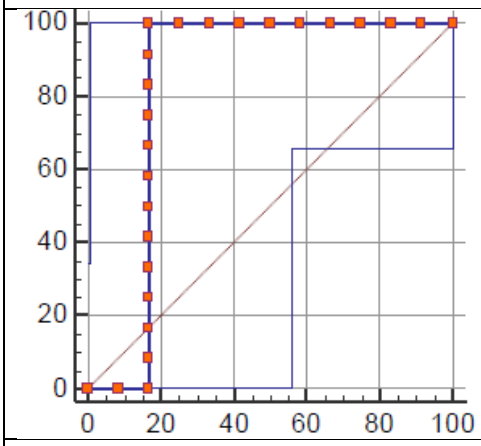



| | |
|---|---|
| AUC | 0.125 |
| Standard Error [a] | 0.114 |
| 95% CI [b] | -0.0977 to 0.348 |
| z statistic | 1.100 |
| Significance level P (Area=0.5) | 0.2712 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

## Table 32: WLQ OD Scale AUC vs. Follow-up Time

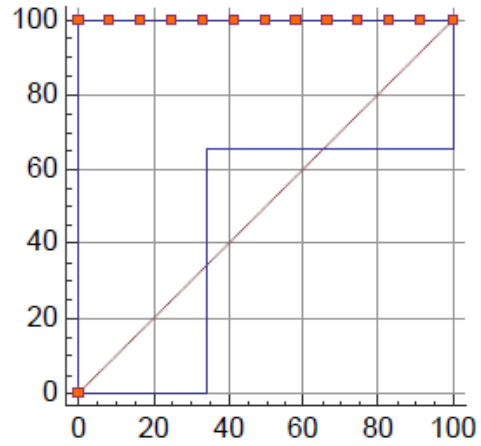
Post-op WLQ OD $_{scale}$ Curve




| | |
|---|---|
| AUC | 0.833 |
| Standard Error [a] | 0.108 |
| 95% CI [b] | 0.626 to 0.953 |
| z statistic | 3.098 |
| Significance level P (Area=0.5) | 0.0019 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

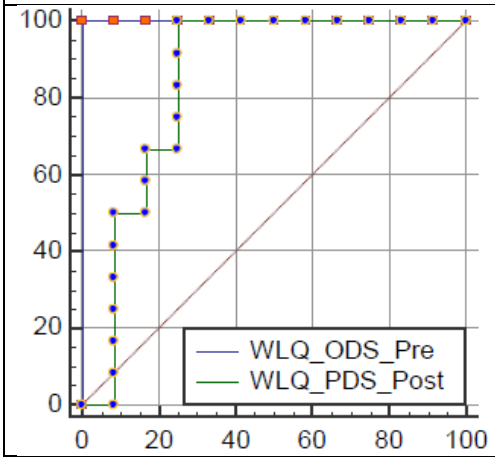
Pre-op WLQ OD $_{scale}$ Curve




| | |
|---|---|
| AUC | 1.000 |
| Standard Error [a] | 0.000 |
| 95% CI [b] | 0.858 to 1.000 |
| z statistic | |
| Significance level P (Area=0.5) | <0.0001 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

Pairwise Comparison of Curves




| | |
|---|---|
| AUC | 0.153 |
| Standard Error [a] | 0.0906 |
| 95% CI [b] | -0.0248 to 0.330 |
| z statistic | 1.686 |
| Significance level P (Area=0.5) | 0.0917 |

[A] Hanley & McNeil, 1982
[B] Binomial exact

# Appendix 3

## Univariate Analysis for HRQoL & WLQ Scales Mean Scores vs. Follow-up Time after Surgery or Wait-Listing

## Table 33: Univariate Analysis for Mean score of SF36 PF Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 52.257[a] | 7.380 | 37.626 | 66.888 |
| | Pre-op | 34.415[a] | 2.348 | 29.760 | 39.071 |
| 4.0 - 6.0 | Post-op | 47.787[a] | 2.298 | 43.231 | 52.343 |
| | Pre-op | 34.791[a] | 3.475 | 27.902 | 41.680 |
| 7.0 - 9.0 | Post-op | 50.844[a] | 2.357 | 46.171 | 55.517 |
| | Pre-op | 28.767[a] | 10.278 | 8.389 | 49.144 |
| 10.0 - 12.0 | Post-op | 46.470[a] | 4.194 | 38.155 | 54.785 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 46.394[a] | 5.949 | 34.600 | 58.187 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 55.352[a] | 10.312 | 34.908 | 75.797 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 36.524[a] | 3.643 | 29.303 | 43.746 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 40.296[a] | 2.861 | 34.624 | 45.969 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 33.842[a] | 5.294 | 23.345 | 44.338 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 42.722[a] | 3.434 | 35.913 | 49.532 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 46.521[a] | 6.059 | 34.507 | 58.534 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 51.476[a] | 7.292 | 37.018 | 65.934 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 34: Univariate Analysis for Mean score of SF36 RP Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 54.164[a] | 6.441 | 41.395 | 66.933 |
| | Pre-op | 38.377[a] | 2.049 | 34.314 | 42.440 |
| 4.0 - 6.0 | Post-op | 51.983[a] | 2.005 | 48.007 | 55.959 |
| | Pre-op | 39.858[a] | 3.033 | 33.846 | 45.871 |
| 7.0 - 9.0 | Post-op | 51.927[a] | 2.057 | 47.849 | 56.005 |
| | Pre-op | 36.608[a] | 8.970 | 18.824 | 54.392 |
| 10.0 - 12.0 | Post-op | 49.923[a] | 3.660 | 42.667 | 57.180 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 51.325[a] | 5.192 | 41.033 | 61.618 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 58.791[a] | 9.000 | 40.948 | 76.634 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 36.691[a] | 3.179 | 30.388 | 42.994 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 39.889[a] | 2.497 | 34.938 | 44.839 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 35.698[a] | 4.621 | 26.538 | 44.859 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 42.813[a] | 2.997 | 36.871 | 48.756 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 44.809[a] | 5.288 | 34.324 | 55.293 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 55.803[a] | 6.364 | 43.185 | 68.421 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 35: Univariate Analysis for Mean score of SF36 BP Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 57.315[a] | 7.626 | 42.195 | 72.435 |
| | Pre-op | 38.229[a] | 2.427 | 33.417 | 43.040 |
| 4.0 - 6.0 | Post-op | 51.316[a] | 2.375 | 46.608 | 56.024 |
| | Pre-op | 40.482[a] | 3.591 | 33.363 | 47.601 |
| 7.0 - 9.0 | Post-op | 45.875[a] | 2.436 | 41.046 | 50.704 |
| | Pre-op | 45.737[a] | 10.621 | 24.679 | 66.795 |
| 10.0 - 12.0 | Post-op | 47.828[a] | 4.334 | 39.236 | 56.421 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 47.169[a] | 6.147 | 34.982 | 59.357 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 63.092[a] | 10.657 | 41.964 | 84.220 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 27.219[a] | 3.764 | 19.756 | 34.682 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 41.004[a] | 2.957 | 35.142 | 46.866 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 37.890[a] | 5.471 | 27.043 | 48.737 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 44.339[a] | 3.549 | 37.302 | 51.376 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 47.302[a] | 6.262 | 34.887 | 59.716 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 40.010[a] | 7.536 | 25.069 | 54.951 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 36: Univariate Analysis for Mean score of SF36 GH Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 56.369[a] | 7.937 | 40.633 | 72.105 |
| | Pre-op | 38.886[a] | 2.526 | 33.878 | 43.893 |
| 4.0 - 6.0 | Post-op | 50.485[a] | 2.471 | 45.586 | 55.385 |
| | Pre-op | 33.467[a] | 3.737 | 26.058 | 40.876 |
| 7.0 - 9.0 | Post-op | 48.949[a] | 2.535 | 43.923 | 53.974 |
| | Pre-op | 36.281[a] | 11.054 | 14.365 | 58.196 |
| 10.0 - 12.0 | Post-op | 39.901[a] | 4.510 | 30.959 | 48.844 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 50.422[a] | 6.398 | 37.738 | 63.105 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 58.879[a] | 11.091 | 36.891 | 80.868 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 40.856[a] | 3.918 | 33.089 | 48.623 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 40.405[a] | 3.077 | 34.304 | 46.506 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 43.085[a] | 5.694 | 31.796 | 54.374 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 40.887[a] | 3.694 | 33.563 | 48.210 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 49.129[a] | 6.517 | 36.209 | 62.050 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 57.542[a] | 7.843 | 41.993 | 73.092 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 37: Univariate Analysis for Mean score of SF36 VT Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 60.119[a] | 7.420 | 45.408 | 74.831 |
| | Pre-op | 45.921[a] | 2.361 | 41.239 | 50.602 |
| 4.0 - 6.0 | Post-op | 53.733[a] | 2.311 | 49.152 | 58.314 |
| | Pre-op | 45.625[a] | 3.494 | 38.698 | 52.553 |
| 7.0 - 9.0 | Post-op | 52.296[a] | 2.370 | 47.597 | 56.994 |
| | Pre-op | 40.060[a] | 10.335 | 19.570 | 60.549 |
| 10.0 - 12.0 | Post-op | 45.340[a] | 4.217 | 36.979 | 53.701 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 50.429[a] | 5.981 | 38.571 | 62.288 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 53.943[a] | 10.369 | 33.385 | 74.500 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 37.651[a] | 3.663 | 30.389 | 44.912 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 44.750[a] | 2.877 | 39.046 | 50.453 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 39.381[a] | 5.324 | 28.827 | 49.935 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 45.522[a] | 3.453 | 38.675 | 52.369 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 46.166[a] | 6.093 | 34.086 | 58.245 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 51.200[a] | 7.333 | 36.663 | 65.738 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 38: Univariate Analysis for Mean score of SF36 SF Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 57.343[a] | 7.683 | 42.110 | 72.576 |
| | Pre-op | 37.906[a] | 2.445 | 33.059 | 42.753 |
| 4.0 - 6.0 | Post-op | 50.301[a] | 2.392 | 45.558 | 55.044 |
| | Pre-op | 38.902[a] | 3.618 | 31.729 | 46.075 |
| 7.0 - 9.0 | Post-op | 48.506[a] | 2.454 | 43.641 | 53.371 |
| | Pre-op | 35.137[a] | 10.701 | 13.922 | 56.353 |
| 10.0 - 12.0 | Post-op | 42.285[a] | 4.366 | 33.628 | 50.942 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 49.343[a] | 6.193 | 37.064 | 61.622 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 56.425[a] | 10.736 | 35.139 | 77.711 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 34.453[a] | 3.792 | 26.934 | 41.972 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 41.199[a] | 2.979 | 35.293 | 47.104 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 33.115[a] | 5.512 | 22.186 | 44.043 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 44.375[a] | 3.576 | 37.286 | 51.464 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 49.049[a] | 6.309 | 36.541 | 61.557 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 53.831[a] | 7.592 | 38.779 | 68.884 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 39: Univariate Analysis for Mean score of SF36 RE Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 54.882[a] | 8.642 | 37.749 | 72.015 |
| | Pre-op | 39.024[a] | 2.750 | 33.573 | 44.476 |
| 4.0 - 6.0 | Post-op | 47.676[a] | 2.691 | 42.341 | 53.011 |
| | Pre-op | 38.549[a] | 4.069 | 30.482 | 46.617 |
| 7.0 - 9.0 | Post-op | 50.142[a] | 2.760 | 44.670 | 55.614 |
| | Pre-op | 40.043[a] | 12.036 | 16.181 | 63.905 |
| 10.0 - 12.0 | Post-op | 42.280[a] | 4.911 | 32.543 | 52.016 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 48.490[a] | 6.966 | 34.680 | 62.300 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 56.603[a] | 12.076 | 32.662 | 80.545 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 38.158[a] | 4.266 | 29.701 | 46.615 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 39.643[a] | 3.350 | 33.000 | 46.286 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 41.329[a] | 6.200 | 29.037 | 53.620 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 39.652[a] | 4.022 | 31.678 | 47.625 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 49.104[a] | 7.096 | 35.036 | 63.172 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 54.453[a] | 8.540 | 37.523 | 71.384 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 40: Univariate Analysis for Mean score of SF36 MH Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 57.925[a] | 8.046 | 41.972 | 73.878 |
| | Pre-op | 33.718[a] | 2.560 | 28.641 | 38.794 |
| 4.0 - 6.0 | Post-op | 46.532[a] | 2.506 | 41.565 | 51.500 |
| | Pre-op | 36.308[a] | 3.789 | 28.796 | 43.820 |
| 7.0 - 9.0 | Post-op | 51.213[a] | 2.570 | 46.118 | 56.308 |
| | Pre-op | 36.121[a] | 11.207 | 13.903 | 58.339 |
| 10.0 - 12.0 | Post-op | 40.620[a] | 4.573 | 31.554 | 49.686 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 44.060[a] | 6.486 | 31.201 | 56.919 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 54.995[a] | 11.244 | 32.703 | 77.287 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 40.699[a] | 3.972 | 32.825 | 48.573 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 44.639[a] | 3.120 | 38.454 | 50.824 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 43.512[a] | 5.773 | 32.067 | 54.957 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 43.641[a] | 3.745 | 36.216 | 51.065 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 41.633[a] | 6.607 | 28.534 | 54.731 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 53.767[a] | 7.951 | 38.003 | 69.532 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 41: Univariate Analysis for Mean score of SF36 PCS Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time since (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 53.905[a] | 6.680 | 40.661 | 67.148 |
| | Pre-op | 38.461[a] | 2.126 | 34.247 | 42.675 |
| 4.0 - 6.0 | Post-op | 51.608[a] | 2.080 | 47.484 | 55.732 |
| | Pre-op | 37.998[a] | 3.145 | 31.762 | 44.234 |
| 7.0 - 9.0 | Post-op | 49.246[a] | 2.133 | 45.016 | 53.475 |
| | Pre-op | 36.281[a] | 9.303 | 17.836 | 54.725 |
| 10.0 - 12.0 | Post-op | 48.756[a] | 3.796 | 41.230 | 56.282 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 49.730[a] | 5.384 | 39.055 | 60.405 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 59.467[a] | 9.334 | 40.961 | 77.972 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 34.168[a] | 3.297 | 27.631 | 40.705 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 40.164[a] | 2.590 | 35.030 | 45.299 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 35.431[a] | 4.792 | 25.930 | 44.932 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 43.617[a] | 3.109 | 37.453 | 49.780 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 47.513[a] | 5.485 | 36.639 | 58.387 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 49.707[a] | 6.601 | 36.620 | 62.794 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 42: Univariate Analysis for Mean score of SF36 MCS Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 58.470[a] | 8.025 | 42.560 | 74.380 |
| | Pre-op | 39.462[a] | 2.554 | 34.400 | 44.525 |
| 4.0 - 6.0 | Post-op | 48.395[a] | 2.499 | 43.441 | 53.349 |
| | Pre-op | 40.338[a] | 3.779 | 32.846 | 47.829 |
| 7.0 - 9.0 | Post-op | 50.771[a] | 2.563 | 45.689 | 55.852 |
| | Pre-op | 39.773[a] | 11.177 | 17.614 | 61.931 |
| 10.0 - 12.0 | Post-op | 40.124[a] | 4.560 | 31.082 | 49.165 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 47.311[a] | 6.469 | 34.487 | 60.136 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 54.207[a] | 11.214 | 31.975 | 76.439 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 40.337[a] | 3.961 | 32.484 | 48.190 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 43.832[a] | 3.111 | 37.663 | 50.000 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 42.830[a] | 5.757 | 31.416 | 54.245 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 43.128[a] | 3.735 | 35.724 | 50.533 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 46.150[a] | 6.589 | 33.086 | 59.214 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 54.875[a] | 7.930 | 39.153 | 70.597 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 43: Univariate Analysis for Mean score of EQ-5D VAS Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 95.596[a] | 11.033 | 73.722 | 117.471 |
| | Pre-op | 62.702[a] | 3.511 | 55.741 | 69.662 |
| 4.0 - 6.0 | Post-op | 82.679[a] | 3.436 | 75.867 | 89.490 |
| | Pre-op | 58.493[a] | 5.195 | 48.193 | 68.793 |
| 7.0 - 9.0 | Post-op | 80.539[a] | 3.524 | 73.553 | 87.525 |
| | Pre-op | 63.151[a] | 15.367 | 32.685 | 93.616 |
| 10.0 - 12.0 | Post-op | 66.836[a] | 6.270 | 54.404 | 79.267 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 81.458[a] | 8.893 | 63.825 | 99.090 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 89.588[a] | 15.417 | 59.021 | 120.154 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 59.502[a] | 5.446 | 48.705 | 70.299 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 68.880[a] | 4.278 | 60.399 | 77.361 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 65.412[a] | 7.916 | 49.719 | 81.105 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 70.489[a] | 5.135 | 60.309 | 80.669 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 78.765[a] | 9.059 | 60.804 | 96.726 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 87.205[a] | 10.903 | 65.589 | 108.821 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 44: Univariate Analysis for Mean score of WLQ TM Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 66.675[a] | 23.831 | 19.427 | 113.922 |
| | Pre-op | 48.638[a] | 7.583 | 33.603 | 63.673 |
| 4.0 - 6.0 | Post-op | 61.737[a] | 7.421 | 47.024 | 76.449 |
| | Pre-op | 56.708[a] | 11.221 | 34.461 | 78.955 |
| 7.0 - 9.0 | Post-op | 66.511[a] | 7.611 | 51.421 | 81.601 |
| | Pre-op | 71.000[a] | 33.191 | 5.196 | 136.805 |
| 10.0 - 12.0 | Post-op | 73.276[a] | 13.543 | 46.425 | 100.126 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 72.211[a] | 19.210 | 34.126 | 110.295 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 110.938[a] | 33.301 | 44.915 | 176.961 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 44.123[a] | 11.763 | 20.801 | 67.444 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 58.567[a] | 9.240 | 40.248 | 76.885 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 48.106[a] | 17.097 | 14.209 | 82.003 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 62.552[a] | 11.091 | 40.563 | 84.541 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 70.087[a] | 19.568 | 31.292 | 108.883 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 82.826[a] | 23.550 | 36.137 | 129.515 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 45: Univariate Analysis for Mean score of WLQ PD Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | -1.868[a] | 14.938 | -31.484 | 27.748 |
| | Pre-op | 45.822[a] | 4.754 | 36.397 | 55.246 |
| 4.0 - 6.0 | Post-op | 10.118[a] | 4.652 | .896 | 19.340 |
| | Pre-op | 43.597[a] | 7.034 | 29.651 | 57.542 |
| 7.0 - 9.0 | Post-op | 10.707[a] | 4.771 | 1.248 | 20.165 |
| | Pre-op | 53.695[a] | 20.805 | 12.446 | 94.943 |
| 10.0 - 12.0 | Post-op | 19.438[a] | 8.489 | 2.607 | 36.269 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 3.432[a] | 12.041 | -20.441 | 27.305 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 1.291[a] | 20.874 | -40.094 | 42.676 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 45.435[a] | 7.373 | 30.816 | 60.053 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 34.991[a] | 5.792 | 23.508 | 46.473 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 18.509[a] | 10.717 | -2.739 | 39.756 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 32.850[a] | 6.952 | 19.066 | 46.633 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 10.114[a] | 12.266 | -14.204 | 34.432 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 13.424[a] | 14.762 | -15.843 | 42.690 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 46: Univariate Analysis for Mean score of WLQ MID Scale vs. Follow- up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 55.684[a] | 23.549 | 8.996 | 102.373 |
| | Pre-op | 45.827[a] | 7.494 | 30.970 | 60.684 |
| 4.0 - 6.0 | Post-op | 63.714[a] | 7.333 | 49.176 | 78.252 |
| | Pre-op | 53.928[a] | 11.088 | 31.945 | 75.912 |
| 7.0 - 9.0 | Post-op | 69.713[a] | 7.521 | 54.801 | 84.624 |
| | Pre-op | 60.060[a] | 32.798 | -4.965 | 125.085 |
| 10.0 - 12.0 | Post-op | 67.537[a] | 13.383 | 41.004 | 94.070 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 71.974[a] | 18.982 | 34.340 | 109.607 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 110.471[a] | 32.907 | 45.230 | 175.711 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 53.364[a] | 11.624 | 30.319 | 76.410 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 74.627[a] | 9.130 | 56.526 | 92.729 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 55.217[a] | 16.895 | 21.721 | 88.712 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 68.806[a] | 10.960 | 47.078 | 90.535 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 68.146[a] | 19.336 | 29.811 | 106.482 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 99.158[a] | 23.271 | 53.022 | 145.295 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

## Table 47: Univariate Analysis for Mean score of WLQ OD Scale vs. Follow-up Time after Surgery or Wait-Listing

| Follow-up time (Binned) | | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|---|
| | | | | Lower Bound | Upper Bound |
| 1.0 - 3.0 | Post-op | 68.113[a] | 24.412 | 19.714 | 116.512 |
| | Pre-op | 47.353[a] | 7.768 | 31.952 | 62.754 |
| 4.0 - 6.0 | Post-op | 64.186[a] | 7.601 | 49.115 | 79.256 |
| | Pre-op | 51.226[a] | 11.495 | 28.437 | 74.016 |
| 7.0 - 9.0 | Post-op | 62.015[a] | 7.797 | 46.558 | 77.473 |
| | Pre-op | 60.732[a] | 34.000 | -6.676 | 128.139 |
| 10.0 - 12.0 | Post-op | 69.172[a] | 13.873 | 41.667 | 96.677 |
| | Pre-op | .[a,b] | | | |
| 13.0 - 15.0 | Post-op | 72.582[a] | 19.678 | 33.570 | 111.595 |
| | Pre-op | .[a,b] | | | |
| 16.0 - 18.0 | Post-op | 111.672[a] | 34.112 | 44.041 | 179.303 |
| | Pre-op | .[a,b] | | | |
| 19.0 - 21.0 | Post-op | 52.021[a] | 12.050 | 28.132 | 75.911 |
| | Pre-op | .[a,b] | | | |
| 22.0 - 24.0 | Post-op | 67.241[a] | 9.465 | 48.477 | 86.006 |
| | Pre-op | .[a,b] | | | |
| 25.0 - 27.0 | Post-op | 52.903[a] | 17.514 | 18.180 | 87.625 |
| | Pre-op | .[a,b] | | | |
| 28.0 - 30.0 | Post-op | 69.461[a] | 11.361 | 46.937 | 91.986 |
| | Pre-op | .[a,b] | | | |
| 31.0 - 33.0 | Post-op | 74.433[a] | 20.044 | 34.693 | 114.173 |
| | Pre-op | .[a,b] | | | |
| 34.0+ | Post-op | 85.851[a] | 24.123 | 38.024 | 133.678 |
| | Pre-op | .[a,b] | | | |

a. Covariates appearing in the model are evaluated at the following values: Participants age = 52.213.
b. This level combination of factors is not observed; thus, the corresponding population marginal mean is not estimable.

# Appendix 4

## Comorbidities Odd Ratio Cross Tables

## Table 48: Odds ratio for Diabetes Mellitus (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 59 | 68 |
| Positive count (N) | 32 | 23 |
| $X^2$ | 2.111 | |
| Odds Ratio (OD) (-/+) | 0.624 | |
| OD 95% CI | [0.329 – 1.182] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 18 | 20 |
| Positive count (N) | 13 | 11 |
| $X^2$ | 0.272 | |
| Odds Ratio (OD) (-/+) | 0.762 | |
| OD 95% CI | [0.273 – 2.122] | |

## Table 49: Odds Ratio for Hypertension (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 47 | 60 |
| Positive count (N) | 44 | 31 |
| $X^2$ | 3.833 | |
| Odds Ratio (OD) (-/+) | 0.552 | |
| OD 95% CI | [0.304 – 1.003] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 16 | 17 |
| Positive count (N) | 15 | 14 |
| $X^2$ | 0.065 | |
| Odds Ratio (OD) (-/+) | 0.878 | |
| OD 95% CI | [0.324 – 2.384] | |

## Table 50: Odds Ratio for Hypercholesterolemia (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 64 | 69 |
| Positive count (N) | 27 | 22 |
| $X^2$ | 0.698 | |
| Odds Ratio (OD) (-/+) | 0.756 | |
| OD 95% CI | [0.392 – 1.459] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 22 | 23 |
| Positive count (N) | 9 | 8 |
| $X^2$ | 0.081 | |
| Odds Ratio (OD) (-/+) | 0.850 | |
| OD 95% CI | [0.278 – 2.599] | |

## Table 51: Odds Ratio for Stroke (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 76 | 78 |
| Positive count (N) | 15 | 13 |
| $X^2$ | 0.169 | |
| Odds Ratio (OD) (-/+) | 0.844 | |
| OD 95% CI | [0.377 – 1.893] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 27 | 27 |
| Positive count (N) | 4 | 4 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.226 – 4.415] | |

## Table 52: Odds Ratio for Dyslipidemia (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 74 | 76 |
| Positive count (N) | 17 | 15 |
| $X^2$ | 0.152 | |
| Odds Ratio (OD) (-/+) | 0.859 | |
| OD 95% CI | [0.400 – 1.845] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 24 | 24 |
| Positive count (N) | 7 | 7 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.304 – 3.289] | |

## Table 53: Odds Ratio for DVT (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 80 | 80 |
| Positive count (N) | 11 | 11 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.410 – 2.438] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 26 | 26 |
| Positive count (N) | 5 | 5 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.258 – 3.871] | |

## Table 54: Odds Ratio for Gallbladder Disease (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 70 | 74 |
| Positive count (N) | 21 | 17 |
| $X^2$ | 0.532 | |
| Odds Ratio (OD) (-/+) | 0.766 | |
| OD 95% CI | [0.373 – 1.570] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 26 | 26 |
| Positive count (N) | 5 | 5 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.258 – 3.871] | |

## Table 55: Odds Ratio for Osteoarthritis (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 66 | 66 |
| Positive count (N) | 25 | 25 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.526 – 1.903] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 23 | 23 |
| Positive count (N) | 8 | 8 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.321 – 3.120] | |

## Table 56: Odds Ratio for Gout (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 72 | 74 |
| Positive count (N) | 19 | 17 |
| $X^2$ | 0.139 | |
| Odds Ratio (OD) (-/+) | 0.871 | |
| OD 95% CI | [0.419 – 1.807] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 23 | 24 |
| Positive count (N) | 8 | 7 |
| $X^2$ | 0.088 | |
| Odds Ratio (OD) (-/+) | 0.839 | |
| OD 95% CI | [0.262 – 2.687] | |

## Table 57: Odds Ratio for Sleep Apnea (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 52 | 59 |
| Positive count (N) | 39 | 32 |
| $X^2$ | 1.132 | |
| Odds Ratio (OD) (-/+) | 0.723 | |
| OD 95% CI | [0.398 – 1.315] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 18 | 19 |
| Positive count (N) | 13 | 12 |
| $X^2$ | 0.067 | |
| Odds Ratio (OD) (-/+) | 0.874 | |
| OD 95% CI | [0.317 – 2.414] | |

## Table 58: Odds Ratio for GERD (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 65 | 69 |
| Positive count (N) | 26 | 22 |
| $X^2$ | 0.453 | |
| Odds Ratio (OD) (-/+) | 0.797 | |
| OD 95% CI | [0.412 – 1.544] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 19 | 22 |
| Positive count (N) | 12 | 9 |
| $X^2$ | 0.650 | |
| Odds Ratio (OD) (-/+) | 0.648 | |
| OD 95% CI | [0.224 – 1.870] | |

## Table 59: Odds Ratio for Asthma (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 75 | 75 |
| Positive count (N) | 16 | 16 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.466 – 2.145] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 24 | 26 |
| Positive count (N) | 7 | 5 |
| $X^2$ | 0.413 | |
| Odds Ratio (OD) (-/+) | 0.659 | |
| OD 95% CI | [0.184 – 2.359] | |

## Table 60: Odds Ratio for PCOS (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 79 | 81 |
| Positive count (N) | 12 | 10 |
| $X^2$ | 0.207 | |
| Odds Ratio (OD) (-/+) | 0.813 | |
| OD 95% CI | [0.332 – 1.988] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 24 | 27 |
| Positive count (N) | 7 | 4 |
| $X^2$ | 0.995 | |
| Odds Ratio (OD) (-/+) | 0.508 | |
| OD 95% CI | [0.132 – 1.951] | |

## Table 61: Odds Ratio for Stress incontinence (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 71 | 85 |
| Positive count (N) | 20 | 6 |
| $X^2$ | 0.554 | |
| Odds Ratio (OD) (-/+) | 0.757 | |
| OD 95% CI | [0.364 – 1.576] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 25 | 25 |
| Positive count (N) | 6 | 6 |
| $X^2$ | 0.000 | |
| Odds Ratio (OD) (-/+) | 1.000 | |
| OD 95% CI | [0.284 – 3.526] | |

## Table 62: Odds Ratio for Thyroid dysfunction (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 78 | 79 |
| Positive count (N) | 23 | 22 |
| $X^2$ | 0.192 | |
| Odds Ratio (OD) (-/+) | 0.825 | |
| OD 95% CI | [0.349 – 1.952] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 23 | 26 |
| Positive count (N) | 8 | 5 |
| $X^2$ | 0.876 | |
| Odds Ratio (OD) (-/+) | 0.553 | |
| OD 95% CI | [0.158 – 1.930] | |

## Table 63: Odds Ratio for Psychological disorders (Depression/Anxiety) (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 53 | 61 |
| Positive count (N) | 38 | 30 |
| $X^2$ | 1.503 | |
| Odds Ratio (OD) (-/+) | 0.686 | |
| OD 95% CI | [0.375 – 1.255] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 20 | 18 |
| Positive count (N) | 11 | 13 |
| $X^2$ | 0.272 | |
| Odds Ratio (OD) (-/+) | 1.313 | |
| OD 95% CI | [0.471 – 3.659] | |

## Table 64: Odds Ratio for Cancer (Post-op & Pre-op)

| **Post-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 87 | 86 |
| Positive count (N) | 4 | 5 |
| $X^2$ | 0.117 | |
| Odds Ratio (OD) (-/+) | 1.265 | |
| OD 95% CI | [0.328 – 4.869] | |

| **Pre-op** | Follow-up Status | |
|---|---|---|
| | Baseline | Questionnaire |
| Negative count (N) | 30 | 29 |
| Positive count (N) | 1 | 2 |
| $X^2$ | 0.350 | |
| Odds Ratio (OD) (-/+) | 2.069 | |
| OD 95% CI | [0.178 – 24.075] | |

# Appendix 5

## Study Informed Consent Document

# Informed Consent Form

<<Mrs, Ms, Mr>>
<<ADRESS>>

**Sponsor: McGill University**

**Protocol Title: Health Economic Evaluation of Bariatric Surgery for the Management of Morbid Obesity in the Canadian Health Care System**

**Subject: Survey participation – McGill University – Academic Research**

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<<Mrs, Ms, Mr>>

You are invited to consider taking part in a non-interventional research involving patients diagnosed with morbid obesity. This research is being conducted for academic purposes and is part of a graduate student's (student researcher) research program currently under the supervision of McGill University. The objective of this student's research is to determine the economic impact of bariatric surgery as different interventions used to treat obesity (such as bariatric surgery, diet and change of lifestyle and medications).

Your participation in this research will involve the completion of patient reported questionnaires. The purpose of these questionnaires is to gather information related to quality of life and work limitation. This quality of life information will be important in helping the student researcher determine the costs of health care associated with the different interventions used to treat obesity.

Included with this letter are three questionnaires and a stamped return envelope. If you decide to take part in this survey, you will be required to complete these 3 questionnaires. You will need to respond to all questions found in these questionnaires. After completing these questionnaires, you will be required to return the documents to my attention using the stamped envelope. Completing the questionnaires should take about 30 minutes of your time.

Should your decision be to participate to this research, we encourage you to complete the questionnaires shortly after having received them. Survey responses will be gathered until August 30, 2013.

Once received, your survey responses will be provided to the student researcher using a code number and will bear no mention of your name, initials or date of birth. Some additional information found in your medical records (i.e.: age, sex, change in weight, change in body mass index and hospitalizations) will also be anonymously provided to the student researcher (i.e.: using a code number bearing no mention of your name, initials or date of birth). The student researcher will only be able to associate your survey responses to the medical information provided using the corresponding code number. Therefore, throughout the entire data transfer process, your identity will never be disclosed to the student researcher.

However, while every effort will be made to protect the privacy of your information, absolute confidentiality cannot be guaranteed. Nevertheless, this does not limit the duty of the researchers and others to protect your privacy.

Please keep in mind that participation in this survey is entirely voluntary. Your refusal to participate will in no way affect the quality of care received in your doctor's office. Your survey responses and medical information will remain completely confidential. The results of this research may be presented at meetings or in publications but your identity will not be disclosed.

By returning the completed questionnaires to my attention, you are implicitly consenting to participate in this research and therefore allowing me to share relevant medical information with the student researcher. If you have any questions or concerns regarding this research, please do not hesitate to contact me at (514)-747-8888. You may also reach out to IRB services if you have any questions about your role and rights as a research participant, or have concerns, complaints or general questions about the research, either by phone: 1-(866)-499-8591 or email: subjectinquiries@irbservices.com. IRB services is an independent committee (i.e.: not affiliated with the research or the research team) that reviewed this research.

I thank you in advance for taking the time to consider this project.

Sincerely,

Dr. Nicolas V Christou

# Formulaire de Consentement

<<Mme, Mlle, M.>>
<<ADRESS>>

**Commanditaire: Université McGill**

**Titre du protocole de recherche: Évaluation économique de la chirurgie bariatrique pour la gestion de l'obésité morbide dans cadre du système de soins de santé canadien**

**Sujet: Participation à un projet de recherche– Université McGill – Recherche Académique**

<< Mme, Mlle, M. >>

Vous êtes invités à participer à un projet de recherche non interventionnelle impliquant des patients atteints d'obésité morbide. Cette recherche est menée à des fins strictement académiques et s'inscrit dans le cadre d'un programme de recherche d'une étudiante diplômée (étudiante-chercheur) actuellement sous la supervision de l'Université McGill. Cette recherche a pour but de déterminer l'impact économique de différentes interventions utilisées pour traiter l'obésité morbide (telles que la chirurgie Bariatrique, la diète et le changement de style de vie ou les médicaments).

Afin de prendre part à cette recherche, il vous sera nécessaire de compléter des questionnaires qui serviront à recueillir de l'information pertinente à votre qualité de vie ainsi qu'aux limitations au travail. La collecte de cette information sera importante afin d'aider l'étudiante-chercheur à déterminer les coûts des soins de santé associés aux différentes interventions utilisées pour traiter l'obésité morbide.

Vous trouverez inclus avec cette lettre, trois questionnaires et une enveloppe de retour affranchie. Si vous décidez de participer à ce projet de recherche, vous serez tenu de compléter ces questionnaires. Nous vous demandons de répondre à toutes les questions qui se trouvent dans ces questionnaires. Après les avoir complète, vous serez tenu de les retourner à mon attention en utilisant l'enveloppe de retour affranchie. Compléter les
questionnaires devrait prendre environ 30 minutes de votre temps.

Si vous décidez de participer à ce projet de recherche, nous vous invitons à compléter les questionnaires peu de temps après les avoir reçus. Les réponses aux questionnaires seront rassemblées jusqu'au 30 Août 2013.

Une fois vos réponses reçues, elles seront fournies à l'étudiante en utilisant un numéro de code, et n'incluront pas votre nom, initiales ou date de naissance. Quelques informations supplémentaires trouvées dans votre dossier médical (ex: âge, sexe, changement de poids, changement de l'indice de masse corporelle ainsi que les hospitalisations) seront aussi anonymement fournies à l'étudiante (c'est-à-dire, utilisant un numéro de code, et n'incluant pas votre nom, initiales ou date de naissance). L'étudiante sera uniquement en mesure d'associer vos réponses à l'information médicale en utilisant le numéro de code correspondant. Par conséquent, tout au long du processus de transfert de données, votre identité ne sera jamais divulguée à l'étudiant-chercheur.

Toutefois, malgré le fait que tous les efforts seront pris dans le but de protéger la confidentialité de vos informations, la confidentialité absolue ne peut être garantie. Néanmoins, cela ne limite pas l'obligation des chercheurs et d'autres en ce qui concerne la protection de votre vie privée.

S'il vous plaît gardez à l'esprit que votre participation à ce projet de recherche est entièrement volontaire. Votre refus de participer n'affectera en aucun cas la qualité des soins reçus dans le bureau de votre médecin. Vos réponses aux questionnaires ainsi que vos informations médicales resteront strictement confidentielles. Les résultats de cette recherche peuvent être présentés lors de réunions ou dans le cadre de publications, mais votre identité ne sera jamais divulguée.

Comprenez bien qu'en retournant les questionnaires remplis à mon attention, vous consentez implicitement à participer à cette recherche et me permettez à partager certains renseignements médicaux pertinents avec l'étudiante-chercheur. Si vous avez des questions ou des préoccupations en ce qui concerne cette recherche, s'il vous plaît n'hésitez pas à me contacter au (514) (747) - (8888). Vous pouvez également rejoindre ''IRB Services'' si vous avez des questions sur votre rôle et vos droits en tant que participant à la recherche, ou si vous avez des préoccupations, des plaintes ou des questions générales sur la recherche, soit par téléphone : 1-(866)-(499)-(8591) ou par courriel: subjectinquiries@irbservices.com. ''IRB Services'' est un comité indépendant (ex : non affilié à la recherche ou l'équipe de recherche) qui a examiné cette recherche.

Je vous remercie à l'avance d'avoir pris le temps de considérer ce projet.

Cordialement,

Dr. Nicolas V. Christou

# Appendix 6

## SF-36

# SF-36 Health Survey Questionnaire

## English Version

Please fill in your initials: |_|_|_|

Your birthdate (Day, Month, Year): |_|_|_|_|_|_|_|_|

Today's date (Day, Month, Year): |_|_|_|_|_|_|_|_|

SF-36 Health Survey Questionnaire

# Your Health and Well-Being

**This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.**
***Thank you for completing this survey!***

**For each of the following questions, please tick the one box that best describes your answer.**

1. **In general, would you say your health is:**

| Excellent | Very good | Good | Fair | Poor |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

2. **<u>Compared to one year ago</u>, how would you rate your health in general <u>now</u>?**

| Much better now than one year ago | Somewhat better now than one year ago | About the same as one year ago | Somewhat worse now than one year ago | Much worse now than one year ago |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?**

| | | Yes, limited a lot | Yes, limited a little | No, not limited at all |
|---|---|---|---|---|
| a | Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports | ☐ 1 | ☐ 2 | ☐ 3 |
| b | Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf | ☐ 1 | ☐ 2 | ☐ 3 |
| c | Lifting or carrying groceries | ☐ 1 | ☐ 2 | ☐ 3 |
| d | Climbing several flights of stairs | ☐ 1 | ☐ 2 | ☐ 3 |
| e | Climbing one flight of stairs | ☐ 1 | ☐ 2 | ☐ 3 |
| f | Bending, kneeling, or stooping | ☐ 1 | ☐ 2 | ☐ 3 |
| g | Walking more than a mile | ☐ 1 | ☐ 2 | ☐ 3 |
| h | Walking several hundred yards | ☐ 1 | ☐ 2 | ☐ 3 |
| i | Walking one hundred yards | ☐ 1 | ☐ 2 | ☐ 3 |
| j | Bathing or dressing yourself | ☐ 1 | ☐ 2 | ☐ 3 |

**4. During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?**

| | | All of the time | Most of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|---|---|
| a | Cut down on the amount of time you spent on work or other activities | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| b | Accomplished less than you would like | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| c | Were limited in the kind of work or other activities | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| d | Had difficulty performing the the work or other activities (for example, it took extra effort) | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

5. **During the <u>past 4 weeks</u>, how much of the time have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?**

| | All of the time | Most of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|---|
| a Cut down on the <u>amount of time</u> you spent on work or other activities | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| b <u>Accomplished less</u> than you would like | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| c Did work or other activities <u>less carefully than usual</u> | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

6. **During the <u>past 4 weeks</u>, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?**

| Not at all | Slightly | Moderately | Quite a bit | Extremely |
|---|---|---|---|---|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

7. **How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>?**

| None | Very mild | Mild | Moderate | Severe | Very severe |
|---|---|---|---|---|---|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 | ☐ 6 |

8. **During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work (including both work outside the home and housework)?**

| Not at all | A little bit | Moderately | Quite a bit | Extremely |
|---|---|---|---|---|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

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

| | All of the time | Most of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|---|
| a Did you feel full of life? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| b Have you been very nervous? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| c Have you felt so down in the dumps that nothing could cheer you up? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| d Have you felt calm and peaceful? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| e Did you have a lot of energy? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| f Have you felt downhearted and low? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| g Did you feel worn out? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| h Have you been happy? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| i Did you feel tired? | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

**10. During the <u>past 4 weeks</u>, how much of the time has your <u>physical health or emotional problems</u> interfered with your social activities (like visiting with friends, relatives, etc.)?**

| All of the time | Most of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

**11. How TRUE or FALSE is <u>each</u> of the following statements for you?**

| | Definitely true | Mostly true | Don't know | Mostly false | Definitely false |
|---|---|---|---|---|---|
| a. I seem to get ill more easily than other people | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| b. I am as healthy as anybody I know | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| c. I expect my health to get worse | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| d. My health is excellent | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

***Thank you for completing these questions!***

# SF-36 Health Survey Questionnaire

## Version Française

Merci de préciser :

vos initiales : |_|_|_|

votre date de naissance (jour/mois/année) : |_|_|_|_|_|_|_|_|

la date d'aujourd'hui (jour/mois/année) : |_|_|_|_|_|_|_|_|

# Votre Santé et Votre Bien-Être

**Les questions qui suivent portent sur votre santé, telle que vous la percevez. Vos réponses permettront de suivre l'évolution de votre état de santé et de savoir dans quelle mesure vous pouvez accomplir vos activités courantes.**
***Merci d'avoir complété ce questionnaire!***

**Pour chacune des questions suivantes, cochez la case ☒ correspondant le mieux à votre réponse.**

**1. En général, diriez-vous que votre santé est:**

| Excellente | Très bonne | Bonne | Passable | Mauvaise |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**2. <u>Par comparaison à l'an dernier</u>, comment évaluez-vous, maintenant, votre santé générale?**

| Bien meilleure maintenant que l'an dernier | Un peu meilleure maintenant que l'an dernier | À peu près la même que l'an dernier | Un peu moins bonne maintenant que l'an dernier | Bien moins bonne maintenant que l'an dernier |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**3. Les questions suivantes portent sur les activités que vous pourriez avoir à faire au cours d'une journée normale. <u>Votre état de santé actuel vous limite-t-il</u> dans ces activités? Si oui, dans quelle mesure?**

| | Mon état de santé me limite beaucoup | Mon état de santé me limite un peu | Mon état de santé ne me limite pas du tout |
|---|---|---|---|
| a. Dans les activités exigeant un effort physique important comme courir, soulever des objets lourds, pratiquer des sports violents | ☐ 1 | ☐ 2 | ☐ 3 |
| b. Dans les activités modérées comme déplacer une table, passer l'aspirateur, jouer aux quills ou au golf | ☐ 1 | ☐ 2 | ☐ 3 |
| c. Pour soulever ou transporter des sacs d'épicerie | ☐ 1 | ☐ 2 | ☐ 3 |
| d. Pour monter plusieurs étages à pied | ☐ 1 | ☐ 2 | ☐ 3 |
| e. Pour monter un seul étage à pied | ☐ 1 | ☐ 2 | ☐ 3 |
| f. Pour me pencher, me mettre à genoux ou m'accroupir | ☐ 1 | ☐ 2 | ☐ 3 |
| g. Pour faire plus d'un kilomètre à pied | ☐ 1 | ☐ 2 | ☐ 3 |
| h. Pour faire plus de deux cents mètres à pied | ☐ 1 | ☐ 2 | ☐ 3 |
| i. Pour faire cent mètres à pied | ☐ 1 | ☐ 2 | ☐ 3 |
| j. Pour prendre un bain ou m'habiller | ☐ 1 | ☐ 2 | ☐ 3 |

**4. Au cours des quatre dernières semaines, combien de fois avez-vous eu l'une ou l'autre des difficultés suivantes au travail ou dans vos autres activités quotidiennes à cause de votre état de santé physique?**

| | Tout le temps | La plupart du temps | Parfois | Rare-ment | Jamais |
|---|---|---|---|---|---|
| a. Avez-vous dû consacrer moins de temps à votre travail ou à d'autres activités? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| b. Avez-vous accompli moins de choses que vous l'auriez voulu? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| c. Avez-vous été limité(e) dans la nature de vos tâches ou de vos autres activités? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| d. Avez-vous eu de la difficulté à accomplir votre travail ou vos autres activités (par exemple vous a-t-il fallu fournir un effort supplémentaire)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**5. Au cours des quatre dernières semaines, combien de fois avez-vous eu l'une ou l'autre des difficultés suivantes au travail ou dans vos autres activités quotidiennes à cause de l'état de votre moral (comme le fait de vous sentir déprimé(e) ou anxieux(se))?**

| | Tout le temps | La plupart du temps | Parfois | Rare-ment | Jamais |
|---|---|---|---|---|---|
| a. Avez-vous dû consacrer moins de temps à votre travail ou à d'autres activités? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| b. Avez-vous accompli moins de choses que vous l'auriez voulu? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| c. Avez-vous fait votre travail ou vos autres activités avec moins de soin qu'à l'habitude? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

6. **Au cours des quatre dernières semaines, dans quelle mesure votre état physique ou moral a-t-il nui à vos activités sociales habituelles (famille, amis, voisins ou autres groupes)?**

| Pas du tout | Un peu | Moyennement | Beaucoup | Énormément |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

7. **Au cours des quatre dernières semaines, avez-vous éprouvé des douleurs physiques?**

| Aucune douleur | Douleurs très légères | Douleurs légères | Douleurs moyennes | Douleurs intenses | Douleurs très intenses |
|---|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

8. **Au cours des quatre dernières semaines, dans quelle mesure la douleur a-t-elle nui à vos activités habituelles (au travail comme à la maison)?**

| Pas du tout | Un peu | Moyennement | Beaucoup | Énormément |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**9. Ces questions portent sur les quatre dernières semaines. Pour chacune des questions suivantes, donnez la réponse qui s'approche le plus de la façon dont vous vous êtes senti(e). Au cours des quatre dernières semaines, combien de fois:**

| | Tout le temps | La plupart du temps | Parfois | Rare-ment | Jamais |
|---|---|---|---|---|---|
| a. Vous êtes-vous senti(e) plein(e) d'entrain? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| b. Avez-vous été très nerveux(se)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| c. Vous êtes-vous senti(e) si déprimé(e) que rien ne pouvait vous remonter le moral? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| d. Vous êtes-vous senti(e) calme et serein(e)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| e. Avez-vous eu beaucoup d'énergie? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| f. Vous êtes-vous senti(e) triste et démoralisé(e)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| g. Vous êtes-vous senti(e) épuisé(e) et vidé(e)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| h. Vous êtes-vous senti(e) heureux(se)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| i. Vous êtes-vous senti(e) fatigué(e)? | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**10. Au cours des quatre dernières semaines, combien de fois votre état physique ou moral a-t-il nui à vos activités sociales (comme visiter des amis, des parents, etc.)?**

| Tout le temps | La plupart du temps | Parfois | Rarement | Jamais |
|---|---|---|---|---|
| ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**11. Dans quelle mesure <u>chacun</u> des énoncés suivants est-il VRAI ou FAUX dans votre cas?**

| | Tout à fait vrai | Plutôt vrai | Ne sais pas | Plutôt faux | Tout à fait faux |
|---|---|---|---|---|---|
| a. Il me semble que je tombe malade un peu plus facilement que les autres | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| b. Je suis en aussi bonne santé que les gens que je connais | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| c. Je m'attends à ce que ma santé se détériore | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| d. Ma santé est excellente | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

***MERCI D'AVOIR BIEN VOULU REPONDRE A CES QUESTIONS!***

# Appendix 7

## EQ-5D

# EQ - 5D

**Health Questionnaire**

***(Canadian English version)***

Please fill in your initials: |_|_|_|_|

Your birthdate (Day, Month, Year): |_|_|_|_|_|_|_|_|

Today's date (Day, Month, Year): |_|_|_|_|_|_|_|_|

By placing a check-mark in one box in each group below, please indicate which statements best describe your own state of health today.

**Mobility**

| | |
|---|---|
| I have no problems in walking about | ❑ |
| I have some problems in walking about | ❑ |
| I am confined to bed | ❑ |

**Self-Care**

| | |
|---|---|
| I have no problems with self-care | ❑ |
| I have some problems washing or dressing myself | ❑ |
| I am unable to wash or dress myself | ❑ |

**Usual Activities** (*e.g. work, study, housework, family or leisure activities)*

| | |
|---|---|
| I have no problems with performing my usual activities | ❑ |
| I have some problems with performing my usual activities | ❑ |
| I am unable to perform my usual activities | ❑ |

**Pain/Discomfort**

| | |
|---|---|
| I have no pain or discomfort | ❑ |
| I have moderate pain or discomfort | ❑ |
| I have extreme pain or discomfort | ❑ |

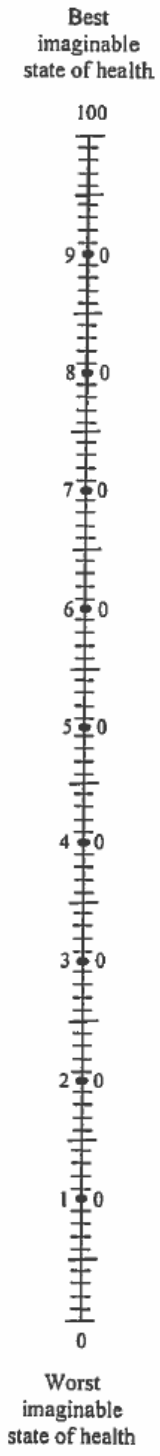
**Anxiety/Depression**

| | |
|---|---|
| I am not anxious or depressed | ❑ |
| I am moderately anxious or depressed | ❑ |
| I am extremely anxious or depressed | ❑ |

To help people say how good or bad their state of health is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your state of health is today.

**Your own state of health today**



# EQ - 5D

**Questionnaire sur la santé**

**Version Québécoise**

***(French version for Canada)***

Merci de préciser :

vos initiales : |_|_|_|

votre date de naissance (jour/mois/année) : |_|_|_|_|_|_|_|_|

la date d'aujourd'hui (jour/mois/année) : |_|_|_|_|_|_|_|_|

Veuillez indiquer, pour chacune des rubriques suivantes, l'affirmation qui décrit le mieux votre état de santé aujourd'hui, en cochant la case appropriée.

**Mobilité**

Je n'ai aucun problème pour me déplacer à pied ❑

J'ai des problèmes pour me déplacer à pied ❑

Je suis obligé(e) de rester alité(e) ❑

**Autonomie de la personne**

Je n'ai aucun problème pour prendre soin de moi ❑

J'ai des problèmes pour me laver ou m'habiller tout(e) seul(e) ❑

Je suis incapable de me laver ou de m'habiller tout(e) seul(e) ❑

**Activités courantes** (*exemples : travail, études, travaux domestiques, activités familiales ou loisirs)*

Je n'ai aucun problème pour accomplir mes activités courantes ❑

J'ai des problèmes pour accomplir mes activités courantes ❑

Je suis incapable d'accomplir mes activités courantes ❑

**Douleurs/gêne**

Je n'ai ni douleurs ni gêne ❑

J'ai des douleurs ou une gêne modérée(s) ❑

J'ai des douleurs ou une gêne extrême(s) ❑

**Anxiété/Dépression**

Je ne suis ni anxieux(se) ni déprimé(e) ❑

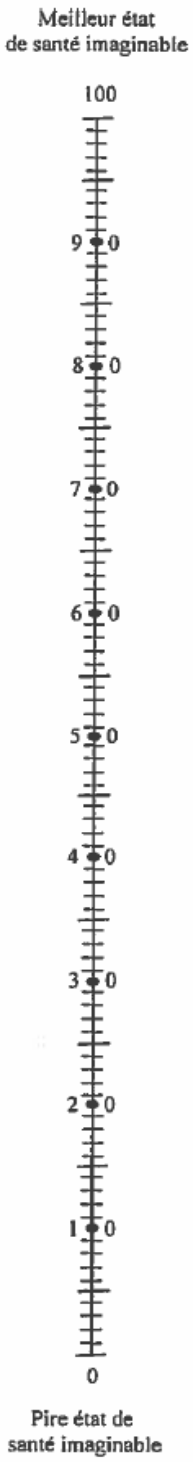
Je suis modérément anxieux(se) ou déprimé(e) ❑

Je suis extrêmement anxieux(se) ou déprimé(e) ❑

Pour vous aider à indiquer dans quelle mesure tel ou tel état de santé est bon ou mauvais, nous avons tracé une échelle graduée (comme celle d'un thermomètre) sur laquelle 100 correspond au meilleur état de santé que vous puissiez imaginer et 0 au pire état de santé que vous puissiez imaginer.

Nous aimerions que vous indiquiez sur cette échelle où vous situez votre état de santé aujourd'hui. Pour cela, veuillez tracer une ligne allant de l'encadré ci-dessous à l'endroit qui, sur l'échelle, correspond à votre état de santé aujourd'hui.

Votre état de santé



# Appendix 8

## Work Limitation Questionnaire (WLQ)

# WORK LIMITATION QUESTIONNAIRE

## WLQ

### English Version

Please fill in your initials: |_|_|_|_|

Your birthdate (Day, Month, Year): |_|_|_|_|_|_|_|_|

Today's date (Day, Month, Year): |_|_|_|_|_|_|_|_|

Please specify if you are (circle your response): Pre op / Post op

# Instructions

Health problems can make it difficult for working people to perform certain parts of their jobs. We are interested in learning about how your health may have affected you at work during the past 2 weeks.

(1) The questions will ask you to think about your physical health or emotional problems. These refer to any ongoing or permanent medical conditions you may have and the effects of any treatments you are receiving for these conditions. Emotional problems may include feeling depressed or anxious.

(2) The questions are multiple-choice. Indicate your answer by putting a checkmark in the appropriate box.

For example:

How satisfied are you with each of the following:

(Checkmark one box on each line for a. and b.)

| | Not at All Satisfied | Moderately Satisfied | Very Satisfied |
|---|---|---|---|
| a. Your local schools. . . . . | ☐₁ | ☐₂ | ☑₃ |
| b. Your local police department. . . | ☐₁ | ☑₂ | ☐₃ |

These checkmarks tell us you are very satisfied with your local schools and moderately satisfied with your local police department.

These questions ask you to assess the amount of time you had difficulty handling certain parts of your job. Please read every question. Then choose a response.

- Checkmark the "Does not apply to my job" box only if the question describes something that is not part of your job.
- If you have more than one job, report on your main job only.

1. In the past 2 weeks, how much of the time did your physical health or emotional problems make it difficult for you to do the following:

*(Checkmark one box on each line for a. through e)*

| | **Difficult** all of the time (100%) | **Difficult** most of the time | **Difficult** some of the time (about 50%) | **Difficult** a little bit of the time | **Difficult** none of the time (0%) | Does not apply to my job |
|---|---|---|---|---|---|---|
| a. work the required number of hours | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. get going easily at the beginning of the workday | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. begin your job activities as soon as you arrive at work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. do your work without stopping more than usual to take breaks or rests | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. stick to a routine or schedule | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

## PLEASE READ CAREFULLY

These questions ask you to assess the amount of time you were able to handle certain parts of your job without difficulty.

2. a. In the past 2 weeks, how much of the time were you **able** to walk or move around different work locations (for example: go to meetings), without difficulty caused by physical health or emotional problems?

(*Checkmark one box.*)

| | |
|---|---|
| All of the time (100%) | ☐ 1 |
| Most of the time | ☐ 2 |
| Some of the time (about 50%) | ☐ 3 |
| A little bit of the time | ☐ 4 |
| None of the time (0%) | ☐ 5 |
| Does not apply to my job | ☐ 6 |

b. In the past 2 weeks, how much of the time were you **able** to lift, carry, or move objects at work weighing more than 10 lbs./5 kilos, without difficulty caused by physical health or emotional problems?

(*Checkmark one box.*)

| | |
|---|---|
| All of the time (100%) | ☐ 1 |
| Most of the time | ☐ 2 |
| Some of the time (about 50%) | ☐ 3 |
| A little bit of the time | ☐ 4 |
| None of the time (0%) | ☐ 5 |
| Does not apply to my job | ☐ 6 |

c. In the past 2 weeks, how much of the time were you **able** to sit, stand, or stay in one position for longer than 15 minutes while working, without difficulty caused by physical health or emotional problems?

*(Checkmark one box.)*

| | |
|---|---|
| All of the time (100%) | ☐1 |
| Most of the time | ☐2 |
| Some of the time (about 50%) | ☐3 |
| A little bit of the time | ☐4 |
| None of the time (0%) | ☐5 |
| Does not apply to my job | ☐6 |

d. In the past 2 weeks, how much of the time were you **able** to repeat the same motions over and over while working, without difficulty caused by physical health or emotional problems?

*(Checkmark one box.)*

| | |
|---|---|
| All of the time (100%) | ☐1 |
| Most of the time | ☐2 |
| Some of the time (about 50%) | ☐3 |
| A little bit of the time | ☐4 |
| None of the time (0%) | ☐5 |
| Does not apply to my job | ☐6 |

e. In the past 2 weeks, how much of the time were you **able** to bend, twist, or reach while working, without difficulty caused by physical health or emotional problems?

*(Checkmark one box.)*

| | |
|---|---|
| All of the time (100%) | ☐1 |
| Most of the time | ☐2 |
| Some of the time (about 50%) | ☐3 |
| A little bit of the time | ☐4 |
| None of the time (0%) | ☐5 |
| Does not apply to my job | ☐6 |

f. In the past 2 weeks, how much of the time were you **able** to use hand-held tools or equipment (for example: a phone, pen, keyboard, computer mouse, drill, cutting scissors, or sander), without difficulty caused by physical health or emotional problems?

*(Checkmark one box.)*

| | |
|---|---|
| All of the time (100%) | ☐1 |
| Most of the time | ☐2 |
| Some of the time (about 50%) | ☐3 |
| A little bit of the time | ☐4 |
| None of the time (0%) | ☐5 |
| Does not apply to my job | ☐6 |

## PLEASE READ CAREFULLY

These questions ask about difficulties you may have had at work.

3. In the past 2 weeks, how much of the time did your physical health or emotional problems make it difficult for you to do the following:

*(Checkmark one box on each line for a. through f.)*

| | **Difficult** all of the time (100%) | **Difficult** most of the time | **Difficult** some of the time (about 50%) | **Difficult** a little bit of the time | **Difficult** none of the time (0%) | Does not apply to my job |
|---|---|---|---|---|---|---|
| a. pay attention to your work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. think clearly when working | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. do your work carefully | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. concentrate on your work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. work without losing your train of thought | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| f. easily read or use your eyes when working | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

The next questions ask about difficulties in relation to the people you came into contact with while working. These may include employers, supervisors, coworkers, clients, customers, or the public.

4. In the past 2 weeks, how much of the time did your physical health or emotional problems make it difficult for you to do the following:

*(Checkmark one box on each line for a. through c.)*

| | **Difficult** all of the time (100%) | **Difficult** most of the time | **Difficult** some of the time (about 50%) | **Difficult** a little bit of the time | **Difficult** none of the time (0%) | Does not apply to my job |
|---|---|---|---|---|---|---|
| a. speak with people in-person, in meetings or on the phone | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. control your temper around people when working | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. help other people to get work done | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

These questions ask about how things went at work overall.

5. In the past 2 weeks, how much of the time did your physical health or emotional problems make it difficult for you to do the following:

*(Checkmark one box on each line for a. through e.)*

| | **Difficult** all of the time (100%) | **Difficult** most of the time | **Difficult** some of the time (about 50%) | **Difficult** a little bit of the time | **Difficult** none of the time (0%) | Does not apply to my job |
|---|---|---|---|---|---|---|
| a. handle the workload | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. work at the expected speed | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. finish your work by the expected deadline | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. do your work without making mistakes | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. feel you've done what you are capable of doing | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

# WORK LIMITATION QUESTIONNAIRE

## WLQ

### Version Française

Merci de préciser :

vos initiales : |_|_|_|_|

votre date de naissance (jour/mois/année) : |_|_|_|_|_|_|_|_|

la date d'aujourd'hui (jour/mois/année) : |_|_|_|_|_|_|_|_|

Merci de préciser si vous êtes (encercler votre réponse): Pré op / Post op

# WLQ

Des problèmes de santé peuvent rendre difficiles certaines tâches dans le cadre d'une activité professionnelle. Nous aimerions savoir de quelle façon votre état de santé pourrait avoir affecté votre capacité à travailler au cours des deux dernières semaines.

(1) Les questions qui suivent vous demanderont de songer à vos problèmes de santé physique ou émotionnels. Elles portent sur des troubles médicaux permanents ou de longue durée que vous pouvez avoir et les effets des traitements que vous suivez. Les problèmes émotionnels peuvent comprendre un état dépressif ou de l'anxiété.

(2) La plupart des questions sont à choix multiples. Vous devez y répondre en cochant une case.

- Par exemple:

Dans quelle mesure êtes-vous satisfait des services suivants?

(Cochez une case sur chacune des lignes a. et b.)

| | Pas du tout satisfait | Modérément satisfait | Très satisfait |
|---|---|---|---|
| a. Vos établissements scolaires locaux | ☐₁ | ☐₂ | ■₃ |
| b. Vos services de police locaux. . . . . | ☐₁ | ■₂ | ☐₃ |

Ces réponses nous apprennent que vous êtes très satisfait des établissements scolaires locaux et modérément satisfait de vos services de police locaux.

Dans les questions suivantes, vous devez estimer pendant combien de temps vous avez eu de la difficulté avec certains aspects de votre travail. Veuillez lire chacune des questions et y répondre. Puis choisissez une réponse.

- Cochez la case « Ne s'applique pas à mon emploi » uniquement si la question décrit quelque chose qui ne s'applique pas à votre travail.
- Si vous avez plus d'un emploi, veuillez vous en tenir à votre principal emploi seulement.

1. Au cours des deux dernières semaines, pendant combien de temps vos problèmes de santé physique ou émotionnels ont-ils rendu difficiles les actions suivantes ?

*(Cochez une case sur chacune des lignes a. à e.)*

| | Tout le temps **difficile** (100 %) | La plupart du temps **difficile** | Parfois **difficile** (environ 50 %) | Rarement **difficile** | Jamais **difficile** (0 %) | Ne s'applique pas à mon emploi |
|---|---|---|---|---|---|---|
| a. travailler le nombre d'heures exigé | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. commencer facilement la journée de travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. commencer à travailler dès votre arrivée au travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. travailler sans devoir arrêter pour faire une pause ou vous reposer | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. respecter une routine ou un horaire | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

## VEUILLEZ LIRE SOIGNEUSEMENT

Dans les questions ci-dessous, vous devez estimer pendant combien de temps vous avez été capable d'accomplir certaines actions sans difficulté au travail.

2. a. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de marcher ou vous déplacer d'un lieu de travail à l'autre (par exemple, vous rendre à des réunions), sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels ?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

b. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de soulever, transporter ou déplacer des objets pesant plus de 5 kg au travail, sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels ?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

c. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de demeurer assis(e), debout ou dans la même position pendant plus de 15 minutes en travaillant, sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

d. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de répéter continuellement les mêmes mouvements en travaillant, sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels ?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

e. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de vous pencher, de tourner le haut du corps ou de vous étirer en travaillant, sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels ?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

f. Au cours des deux dernières semaines, pendant combien de temps avez-vous été **capable** de manipuler des outils ou des appareils (p. ex. téléphone, stylo, clavier, souris d'ordinateur, perceuse, séchoir à cheveux ou ponceuse), sans éprouver de difficultés en raison de vos problèmes de santé physique ou émotionnels ?

*(Cochez l'une des cases.)*

| | |
|---|---|
| Tout le temps (100 %) | ☐1 |
| La plupart du temps | ☐2 |
| Parfois (environ 50 %) | ☐3 |
| Rarement | ☐4 |
| Jamais (0 %) | ☐5 |
| Ne s'applique pas à mon emploi | ☐6 |

## VEUILLEZ LIRE SOIGNEUSEMENT

Les questions ci-dessous portent sur des difficultés que vous pourriez avoir eues au travail.

3. Au cours des deux dernières semaines, pendant combien de temps vos problèmes de santé physique ou émotionnels ont-ils rendu difficiles les actions suivantes ?

*(Cochez une case sur chacune des lignes a. à f.)*

| | Tout le temps **difficile** (100 %) | La plupart du temps **difficile** | Parfois **difficile** (environ 50 %) | Rarement **difficile** | Jamais **difficile** (0 %) | Ne s'applique pas à mon emploi |
|---|---|---|---|---|---|---|
| a. fixer votre attention sur votre travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. avoir les idées claires en travaillant | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. accomplir votre travail soigneusement | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. vous concentrer sur votre travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. travailler sans perdre le fil de vos pensées | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| f. lire ou utiliser vos yeux sans difficulté en travaillant | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

Les questions ci-dessous portent sur les difficultés ayant pu survenir dans vos relations avec les gens au travail. Ces derniers peuvent inclure les employeurs, les superviseurs, les collègues, les clients ou le public.

4. Au cours des deux dernières semaines, pendant combien de temps vos problèmes de santé physique ou émotionnels ont-ils rendu difficiles les actions suivantes ?

*(Cochez une case sur chacune des lignes a à c.)*

| | Tout le temps **difficile** (100 %) | La plupart du temps **difficile** | Parfois **difficile** (environ 50 %) | Rarement **difficile** | Jamais **difficile** (0 %) | Ne s'applique pas à mon emploi |
|---|---|---|---|---|---|---|
| a. parler aux gens face à face, dans les réunions ou au téléphone | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. garder votre calme avec les gens au travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. aider d'autres collègues à accomplir des tâches | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

Les questions ci-dessous portent sur la façon dont les choses se sont passées pour vous au travail en général.

5. Au cours des deux dernières semaines, pendant combien de temps vos problèmes de santé physique ou émotionnels ont-ils rendu difficiles les actions suivantes ?

*(Cochez une case sur chacune des lignes a. à e.)*

| | Tout le temps **difficile** (100 %) | La plupart du temps **difficile** | Parfois **difficile** (environ 50 %) | Rarement **difficile** | Jamais **difficile** (0 %) | Ne s'applique pas à mon emploi |
|---|---|---|---|---|---|---|
| a. vous acquitter de votre charge de travail | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| b. travailler assez rapidement | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| c. terminer le travail à temps | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| d. travailler sans commettre d'erreurs | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |
| e. sentir que vous avez travaillé selon votre capacité | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐6 |

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