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Association of Preference-Based Health-Related Quality of Life with Weight Loss in Obese Adults

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ABSTRACT

Background: The obesity epidemic is linked to substantial health care resource use, reduction in workforce and home productivity, and poor health-related quality of life (HRQOL). Changes in body mass index (BMI) are associated with improvements in HRQOL; the nature of this relationship, however, has not been reliably described. **Objectives:** To determine the independent association between changes in BMI and change in utility-based HRQOL. **Methods:** Data were prospectively collected on 500 severely obese adult patients enrolled in a single-center obesity management clinic. Univariable and multivariable linear regressions were performed, adjusting for the effect of the intervention itself, obesity-related comorbidities, BMI at enrollment, age, and sex. **Results:** A 1-unit reduction in BMI was associated with a 0.0075 (95% confidence interval 0.0041–0.0109) increase in the EuroQol five-dimensional questionnaire score. This relationship was unaltered in various analyses, and is likely applicable to any health-care–induced changes in BMI. **Conclusions:** The quantification of this association advances the understanding of the clinical benefits of interventions that affect BMI, and can inform more robust cost-utility analyses.
Keywords: body mass index, obesity, quality of life.

Introduction

Obesity, defined as having a body mass index (BMI) of more than 30 kg/m^2, affects 24% of Canadians [1] and 13% of the population worldwide, with prevalence doubling since 1980 [2]. It is a well-established risk factor for many disorders, including diabetes, sleep apnea, coronary heart disease, depression, and several types of cancer [3]. The epidemic of obesity is linked to substantial health care resource use, costing between $5 and $11 billion annually in Canada [3,4]. It is associated with reduced workforce and home productivity as well as poor health-related quality of life (HRQOL) [3,5]. The burden of disease increases as BMI increases: moderate obesity, or class II obesity, is associated with an increased rate of chronic disease, and severe obesity, or class III obesity (BMI $>$ 40 kg/m^2), is associated with increased rate of chronic disease and 6.5 to 13.7 years of life lost, relative to the normal-weight population [6,7]. In recent years, numerous strategies have been introduced to treat high-risk obesity directly, and to treat other medical conditions via therapies with weight-neutral or weight-reducing effects. Examples of the latter include sodium-glucose cotransporter 2 inhibitors in diabetes mellitus [8] or antipsychotic medications that have a less harmful impact on weight than do commonly used agents [9]. Novel drugs, however, are typically far more costly [10], and therefore a thorough understanding of their impact on all clinically important outcomes, including quality of life mediated through weight modification, is required to estimate the cost-effectiveness and inform rational use [11,12].

Although interventions that reduce BMI are associated with improvements in HRQOL, this relationship has yet to be reliably and precisely determined in the severely obese adult population in a manner suitable for economic evaluation [5,13]. Previous studies have studied highly selected cohorts (such as patients with diabetes), have been underpowered, or have not used preference-based quality-of-life measures (utility) required for cost-utility analyses [5,14–17]. The application of inappropriately derived HRQOL values for a given change in weight can have a significant impact on incremental cost-effectiveness ratios [18]. Organizations such as the National Institute of Health and the Canadian Agency for Drugs and Technology in Health (CADTH) have highlighted the need for high-quality studies that are applicable to a comprehensive population of obese patients, emphasizing the necessity for reliable cost outcomes [19–21].

We sought to determine the independent association between changes in BMI and change in utility (HRQOL), controlling for baseline comorbidities and the type of treatment (medical,

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surgical, or waitlisted), in a prospective, population-based cohort of adults with class III obesity enrolled in an obesity management program followed over a 2-year period. Greater understanding of this relationship will allow the clinical benefits of interventions that modify BMI, in the population with the greatest burden of disease, to be more accurately estimated.

Methods

We used a prospective observational cohort study of 500 severely obese adults enrolled in an obesity management program in Northern Alberta (catchment population of 1.6 million) followed over 2 years. We previously reported that the minimal weight loss necessary to produce a clinically important change in the EuroQol five-dimensional questionnaire (EQ-5D) score was reached in more than 40% of this cohort [22]. Baseline characteristics and main study results have been described elsewhere [22–24]. Briefly, the cohort consisted of 150 waitlisted, 200 medically treated, and 150 surgically treated patients. All patients were deemed potentially eligible for bariatric surgery, on the basis of the region's previously established surgical criteria, before enrollment. Patients could progress from the waitlist to medical treatment and through to bariatric surgery. Patients were censored if they transitioned to another treatment group, dropped out, died, became pregnant, or had a surgical procedure conducted outside of the region.

Waitlisted patients received no specific interventions but were advised to attend community-based education sessions. Medical management was tailored to individuals and specific causes of excess weight: patients underwent intensive lifestyle counseling and care by a multidisciplinary team in clinics every 4 to 8 weeks for a minimum of 24 weeks. Dietary strategies and antiobesity drug therapy were used, and obesity-related comorbidities (e.g., sleep apnea and mental health disorders) were assessed. Surgical patients underwent laparoscopic procedures, including adjustable gastric banding, sleeve gastrectomy, or Roux-en-Y gastric bypass, using previously described techniques [24].

Anthropometric, quality-of-life, demographic, and comorbidity measures were collected at each patient clinic visit every 6 months for 2 years; the mean number of visits was 5.1. Baseline measurements were recorded before the commencement of the respective treatment. Detailed case report forms have previously been published and are available elsewhere [23].

The primary exposure was the 2-year mean change in BMI (kg/m^2), and the main outcome was the 2-year mean change in preference-based quality of life measured using the three-level EQ-5D. This self-completed, well-validated tool captures performance in five dimensions of quality of life: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, each of which can be scored as either no problems, some problems, or extreme problems. Each permutation of answers classifies patients into a health state for which a preference value, or utility, is available.

The presence of the comorbidities was assessed at the time of study enrollment and every 6 months for 2 years. A "last-observation-carried forward" method was used to account for missing or censored observations. Covariables included age in years, sex, treatment group, and the following comorbidities: diabetes mellitus, insulin resistance, dyslipidemia, coronary heart disease, sleep apnea, hypertension, and depression.

Univariable regression analysis was performed on change in the EQ-5D score with each individual covariable. Multivariable linear regression was conducted using the ordinary least-squares method. The primary analysis (model 1) examined the change in the EQ-5D score as the response variable, with change in BMI over the 2-year period as the independent variable of interest adjusted for treatment group, age, sex, BMI at enrollment (baseline), and change in comorbidity status between first and final clinic visits for all comorbidities. Other models were created: a stepwise model with an addition criteria of P less than 0.01 and a removal criteria of P greater than 0.05 (model 2) and a model examining change in BMI, baseline BMI, age, and sex only (model 3). In addition, models 1 and 2 were replicated using baseline obesity-related comorbidity status (not change in comorbidity over time).

Subgroup analyses were conducted considering only those patients diagnosed with either diabetes, sleep apnea, hypertension, depression, or dyslipidemia, as well as by treatment group at baseline. The assumptions of the model were tested by plotting the residuals against the fitted values and calculating the variance inflation factor. There was no evidence that the assumptions of the model were violated. The analyses were conducted using Stata version 13 (StataCorp, College Station, TX).

Results

Mean age was 43.7 ± 9.6 years, mean BMI was 47.9 ± 8.1 kg/m^2, and 11.8% were men. There was no statistically significant difference between the baseline parameters among the three treatment groups, with the exceptions of mean BMI (lower in the surgical group; $P = 0.003$), health state utility score (higher in the surgical group; $P = 0.0001$), and presence of sleep apnea (more common in the surgical group; $P = 0.01$) (Table 1). At enrollment, 53 patients (10.6%) had no comorbidities, 132 (26.4%) had only one, and 315 (63.0%) had two or more. Among surgically treated patients, 51 patients (34%) had a sleeve gastrectomy, 48 (32%) had gastric banding, and 51 (34%) underwent Roux-en-Y gastric bypass.

The mean change in BMI for all subjects (Table 1) was −3.4 ± 5.2 kg/m^2. The surgical group experienced the largest mean change in BMI at −7.4 ± 5.6 kg/m^2. The mean change in the EQ-5D was 0.047 ± 0.137, and the greatest change was observed in the medical treatment group, with a 0.073 mean change in utility from baseline. The response variable, change in the EQ-5D score, ranged from −0.350 to 0.417.

In the univariable analysis, a 1-unit reduction in BMI was associated with an increase of 0.005 in mean change in the EQ-5D score ($P < 0.001$). Age and sex were not associated with change in the EQ-5D score when assessed independently. In the primary multivariable analysis, a 1-unit reduction in BMI was associated with a 0.0075 (95% CI 0.0041–0.0109) increase in the EQ-5D score (Table 2); this relationship was similar among alternate models, ranging from 0.0051 to 0.0068. The relationship was similar when subgroups of patients, by comorbidity and treatment groups, were considered (Table 3), although the medical treatment subgroup did not achieve statistical significance.

The assumptions of the linear model were tested, and there was no evidence of violation.

Discussion

In a large cohort of patients seeking treatment for severe obesity, we described the association between reduction in BMI and changes in utility-based quality of life. A 1-unit decrease in BMI was associated with an increase in health state utility score by 0.0051 to 0.0075, an association that was unaltered when using various analytic approaches and considering alternate subgroups within a cohort of obese patients seeking treatment for weight loss. This finding provides additional data to inform the clinical benefits of weight loss that may occur across various interventions, fills a knowledge gap, and is consistent with the utility data