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Cost-effectiveness of bariatric surgery versus community weight management to treat obesity-related idiopathic intracranial hypertension: evidence from a single-payer healthcare system


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Abstract

Background: Idiopathic intracranial hypertension (IIH) is associated with significant morbidity, predominantly affecting women of childbearing age living with obesity. Weight loss has demonstrated successful disease-modifying effects; however, the long-term cost-effectiveness of weight loss interventions for the treatment of IIH has not yet been established.

Objectives: To estimate the cost-effectiveness of weight-loss treatments for IIH.


Methods: A Markov model was developed comparing bariatric surgery with a community weight management intervention over 5-, 10-, and 20-year time horizons. Transition probabilities, utilities, and resource use were informed by the IIH Weight Trial (IIH:WT), alongside the published literature. A probabilistic sensitivity analysis was conducted to characterize uncertainty within the model.
**Results:** In the base case analysis, over a 20-year time horizon, bariatric surgery was “dominant,” led to cost savings of £49,500, and generated an additional 1.16 quality-adjusted life years in comparison to the community weight management intervention. The probabilistic sensitivity analysis indicated a probability of 98% that bariatric surgery is the dominant option in terms of cost-effectiveness.

**Conclusion:** This economic modeling study has shown that when compared to community weight management, bariatric surgery is a highly cost-effective treatment option for IIH in women living with obesity. The model shows that surgery leads to long-term cost savings and health benefits, but that these do not occur until after 5 years post surgery, and then gradually increase over time. (Surg Obes Relat Dis 2021;17:1310–1316.) © 2021 American Society for Bariatric Surgery. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

**Keywords:** Cost-effectiveness; Bariatric surgery; Idiopathic intracranial hypertension; Weight loss
approved the trial (14/WM/0011). The economic evaluation was conducted using a decision-analytic model to facilitate extrapolation of trial findings over an extended time horizon.

**Model structure**

A Markov model was applied to reflect cyclical fluctuations in weight over time and to allow for the consideration of weight recidivism following bariatric surgery. The model structure is shown in Fig. 1. The model compares bariatric surgery with community weight management, and therefore the surgical arm comprises the suite of surgical procedures that were performed within the IIH:WT. A cycle length of 1 year was used, as this was considered to be the shortest sufficient time period for patients to change between BMI categories. The time horizons for the model were 5, 10, and 20 years.

The model started with a hypothetical cohort of 1000 patients who were considered to have a health state of either obesity or severe obesity, as determined by their BMI and in line with NICE guidance for eligibility for bariatric surgery [17]. Classifying the states according to weight (BMI) category enabled the effects of weight recidivism on IIH status to be captured, as well as allowed for the wider consideration of the health impacts of obesity, such as the incidence of co-morbidities other than IIH.

Patients were distributed between the baseline health states in line with the distribution of BMI from the IIH:WT. Following intervention, the patients then progressed to 1 of 3 states: severe obesity (BMI ≥40 kg/m²), obesity (BMI 30–39.9 kg/m²), or no obesity (BMI <30 kg/m²), or into an absorbing state, death. Maximum weight loss generally occurs between 12–24 months following surgery [18], and from that point onwards, patients typically experience some degree of weight regain. Weight regain continues gradually until approximately 10 years postsurgery, at which point it plateaus [19]. To reflect this process, the model required distinct transition probabilities between health states over 4 time periods: cycle 1, cycle 2, cycles 3–10, and cycle 11 onwards.

**Sources of data**

Both primary and secondary data were used to inform the model parameters (Table S1). Data on resource use, costs, and effectiveness were derived from the IIH:WT and supplemented with data from targeted literature review where necessary.

**Transition probabilities**

The IIH:WT followed patients for 24 months, and these data were used to estimate the transition probabilities for the first 2 model cycles (Table S2). From year 2 onwards, transition probabilities were calculated using weight regain data from the Swedish Obese Subjects (SOS) study [19], in conjunction with data from the IIH:WT. Once the patients reached cycle 10, their weight was assumed to plateau. Hence, the transition probabilities applied in cycles 11–20 assume only the possibility of transitioning to dead or remaining within the same state. The model included a BMI-specific mortality risk [20] and an additional mortality risk associated with bariatric surgery [21].

**Costs**

The costs included in the model were those relevant to the healthcare service, detailed in Table S1. All costs are reported in 2017/2018 GBP prices [22]. For the surgical arm, the design of the IIH:WT did not predetermine the

Fig. 1. Markov model structure. The structure is identical for both the bariatric surgery arm and the community weight management intervention arm. Arrows indicate possible transitions between states. Patients can transition to “Dead” from any of the states. The dashed line indicates the interventions taking place following baseline measurements.
Table 1
Cost-utility analysis

<table>
<thead>
<tr>
<th>Time horizon for model</th>
<th>5 yr</th>
<th>10 yr</th>
<th>20 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgery</td>
<td>WM</td>
<td>Surgery</td>
</tr>
<tr>
<td>Total costs</td>
<td>£15,900</td>
<td>£27,400</td>
<td>£29,900</td>
</tr>
<tr>
<td>Incremental costs</td>
<td>−£11,500</td>
<td>−£28,700</td>
<td>−£57,300</td>
</tr>
<tr>
<td>Incremental QALYs</td>
<td>0.29</td>
<td>0.58</td>
<td>1.16</td>
</tr>
<tr>
<td>ICER*</td>
<td>−£39,900</td>
<td>−£49,300</td>
<td>−£49,500</td>
</tr>
</tbody>
</table>

WM = weight management; QALY = quality-adjusted life years; ICER = incremental cost-effectiveness ratio.
* ICER = difference in total costs between surgery versus WM/Difference in total QALYs between surgery versus WM.

Cost-effectiveness ratio, which is the difference in costs divided by the difference in QALYs and gives an estimate of the cost per QALY gained.

Scenario and sensitivity analysis

To assess the uncertainty around the model parameters, a probabilistic sensitivity analysis was conducted. The probability that surgery is cost-effective when compared to weight management is then estimated for different threshold values of willingness to pay for a QALY, presented as a cost-effectiveness acceptability curve.

To account for the wider cost impact from weight loss and lowering the incidence of these co-morbidities associated with obesity, a scenario analysis was conducted that included costs associated with type 2 diabetes and coronary heart disease (CHD). The annual incidences and associated healthcare costs of CHD and type 2 diabetes were obtained [26] and applied to the health states using the same method described above for IIH. Any disutility associated with diabetes and CHD was not applied, as it was felt that this was already captured within the self-reported HRQoL values from the trial data.

Results

Across all 3 time horizons of 5, 10, and 20 years, bariatric surgery dominates (less cost and more benefit) the community weight management intervention, generating more QALYs with cost savings (Table 1). The extent of dominance increases over time, with more cost savings accumulating the longer patients are followed-up. At 20 years, surgery led to an incremental cost saving of £49,500 and an additional 1.16 QALYs when compared to community weight management. When the additional costs of type 2 diabetes and CHD were considered, these cost savings increased to £54,300.

The probabilistic sensitivity analysis confirmed the base case results, producing a cost saving of £47,200 and an incremental gain of 1.12 QALYs. The distribution of incremental cost-effectiveness ratios is shown in Fig. S1. At a willingness to pay £20,000 per QALY, the lower threshold
used by decision-making bodies such as NICE, there is a 98% chance that bariatric surgery is cost-effective when compared to the community weight management intervention (Fig. 2).

Discussion

This paper is the first to report on the long-term cost-effectiveness of bariatric surgery compared to a community weight management intervention to treat IIH. This was done within the context of a single-payer healthcare system. The economic model combined the costs associated with bariatric surgery to treat IIH with the HRQOL benefits and found it to increase QALYs and decrease costs, when compared to community weight management. This finding was robust to sensitivity analysis. Varying the time horizon showed that both the incremental costs saved and the incremental QALYs gained from surgery increase over time.

Although there is evidence for the cost-effectiveness of bariatric surgery and despite multiple guidelines for treatment, including from NICE [17], access to bariatric surgery within the English healthcare service remains limited, with less than .002% of the potentially eligible adults having surgery annually [27]. This is due to barriers for referral from primary care and funding constraints from the commissioners [27]. This economic model demonstrates that improving access to bariatric surgery is likely to be cost saving, reduce the burden of IIH in women with BMIs ≥35 kg/m², and improve patient HRQoL.

The economic model only included the co-morbidities of type 2 diabetes and CHD as part of a scenario analysis. Expanding the model to account for additional cost savings from reducing the risks of further obesity-related co-morbidities will only make bariatric surgery even more cost saving. Furthermore, the model was conducted from a health service perspective, meaning that any out-of-pocket payments or indirect costs of IIH were not included. If these indirect costs, such as days off work or time to travel to appointments to manage ongoing IIH symptoms, were included, then this would make surgery even more cost saving. The model classified health states according to BMI category with the aim of capturing the wider health impacts of obesity (type 2 diabetes and CHD), as well as effects of weight recidivism on IIH status. A strength of the model is that it used data from the IIH:WT study, including EQ-5D-5L data that were directly collected from patients to construct QALYs. And as the patients moved between the BMI health states over time, the effects of weight loss upon IIH symptoms and wider obesity effects will have been captured within this EQ-5D-5L data and modeled accordingly. Using QALYs as a commensurate outcome allows comparisons of cost-effectiveness to be made between alternative treatments across different disease areas.

![Cost-effectiveness acceptability curve](image-url)

Fig. 2. Cost-effectiveness acceptability curve. QALY = quality-adjusted life years.
There are some limitations to consider. The model uses data from the IIH:WT, and as IIH is a rare condition, the model was unable to differentiate between the different surgery types offered in IIH:WT due to the reduced sample size within each group, so any differential costs and effects were not included. There is evidence that LAGB is associated with lower procedure costs, but has a much higher rate of revisional surgery, as well as a smaller and less well-maintained effect on body weight than RYGB and LSG [28]. However, the range and distribution of bariatric surgeries performed in the IIH:WT broadly reflect current practice in the English healthcare system [15,21], and therefore the results are applicable to assessing surgery versus community weight management for treatment of IIH. At an international level, more research is needed to fully estimate the differential cost-effectiveness between the surgery types. Within the IIH:WT, only half of the community weight management cohort attended 75%–100% of weekly sessions, but evidence suggests this is similar attendance to that seen in other trials [29], and it is unknown how adherence would have varied outside the trial setting. The model used data from the IIH:WT up to the end of cycle 2; beyond that, data from the SOS study were used, as this study contained some of the longest follow-up data available on bariatric surgery. However, this study was conducted 16 years ago, was based exclusively in Sweden, and the surgical techniques differ, as the SOS study also used vertical banded gastroplasty, which is no longer performed; techniques differ, as the SOS study also used vertical banded gastroplasty, which is no longer performed; therefore, surgical outcomes may have since changed. Alternative sources of long-term data were available, including a meta-analysis [30]; however, the data were reported as percentages of expected weight loss and the economic model tracked weight trajectories using BMI categories, making it challenging to use these data for the model structure. Within the SOS study, vertical banded gastroplasty weight loss at 10 years was similar to LABG weight loss, and we know that LSG is more effective than LAGB at achieving long-term weight loss; therefore, by using the SOS data to populate the model, we believe this to be a conservative estimate for the likely long-term effectiveness for the surgical arm.

Conclusion

The results suggest that bariatric surgery is a dominant treatment option for IIH patients living with obesity when compared to a community weight management intervention. It provides evidence to inform funding bodies that IIH should qualify as a co-morbidity of obesity that can be improved with weight loss. Hence, IIH patients with a BMI over 35 kg/m\(^2\) should meet the criteria to be recommended for bariatric surgery under NICE clinical guidance [17].

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Disclosures

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.soard.2021.03.020.
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