Cost-utility analysis of different bariatric surgeries in Hungary

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Background: Obesity has become a major health issue in Hungary during the last 30 years. Two-thirds of the population is considered overweight or obese, and lifestyle-related chronic diseases and mortality data are amongst the worst in Europe. Recently published economic evaluations of bariatric surgical interventions suggests that these interventions are not only cost-effective compared with conservative therapy, but they generate lower costs and better health outcomes.

Aim: The aim of this study was to; outline the cost structure of bariatric surgeries in Hungary; to propose a potential reimbursement for social security, and to evaluate the cost-utility of laparoscopic Roux-en-Y gastric bypass (LRGB) and laparoscopic gastric sleeve resection (LGSR) compared with conservative treatment.

Methods: Analysis was conducted from a healthcare provider perspective, using a Markov model with a time horizon of 10 years and a discount rate of 3.7% (costs and health). QALY data were derived from literature focusing on relevant European populations. Other parameters were based on national publications and registries, supplemented where needed by European data.

Results: The mean costs were HUF 3,240,316 (€10,479) and HUF 5,453,095 (€17,635), and the mean incremental QALYs 5.35 and 3.28 for bariatric surgery and conservative treatment, respectively. Bariatric surgery was both more effective and less costly than conservative treatment from the 4th year of the model, and was thus demonstrated as the dominant strategy.

Conclusions: In the right patient population, bariatric surgery results in both better health outcomes and lower costs than conservative treatment in Hungary. Due to the high prevalence of obesity and related diseases, the reimbursement of laparoscopic Roux-en-Y gastric bypass and laparoscopic gastric sleeve resection would generate significant savings for the National Health Insurance Fund and increase the quality of life for patients.

BACKGROUND

According to the World Health Organization (WHO), obesity is one of the key public health challenges of the 21st century: worldwide obesity has nearly tripled since 1975. Hungary is one of the country's most seriously impacted: In 2015, adult obesity rates were the fourth highest in Hungary among OECD countries [1]. Two-thirds of the population is considered overweight or to have obesity, with 34% of the population having a body mass index (BMI) between 25-29.9 and 30% having a BMI ≥30 [1,2]. Life-style related chronic diseases and mortality data, especially those related to nutrition, are amongst the worst in Europe, and the prevalence of obesity increases with age.

The economic burden of obesity in European countries could be estimated to be between 2-6% of total healthcare expenditure [3,4]. The costs of treating overweight patients is estimated to exceed the treatment of those with normal weight by 32% in Hungary [5]. According to conservative approximations, the economic burden of obesity in Hungary is above 25 billion HUF (€80 million) [6]. In addition, there are significant negative impacts on patients' quality of life due to their health status and the societal judgement associated with obesity.

Economic evaluations are the comparative analysis of alternative courses of actions in terms of both costs and effectiveness [15]. Economic evaluations can help decision makers in assessing whether an intervention provides value for money and decide which interventions should be reimbursed when resources are finite. Recently published economic evaluations of bariatric surgical interventions suggests [7, 8, 9, 10,11,12,13,14] that these interventions are not only cost-effective compared with conservative therapy (diet, lifestyle change, physical activity, medication), but they generate better health outcomes and lower costs. In these situations, surgical intervention can be described as the dominant option.

Cost-utility analysis (CUA) is a specific type of economic evaluations which allows for the incorporation of multiple effects and the comparison of interventions across different diseases and interventions because it expresses health consequences in Quality-Adjusted Life Years (QALYs). To allow for a comparative assessment, the result of an economic evaluation is reported in Incremental Cost-Effectiveness Ratio (ICER) which is the difference in costs moving from the comparator treatment to the "new" intervention divided by the marginal difference in their consequences [16].

Due to the high burden of obesity and the promising findings of international economic assessments in this area, there is need for an economic evaluation of bariatric surgical interventions in the treatment of obesity in Hungary. Hence,

our aim was to evaluate the cost-utility of bariatric surgery (laparoscopic Roux-en-Y gastric bypass and laparoscopic gastric sleeve resection) compared with conservative treatment in Hungary.

METHODS

Intervention

The surgical procedures in the scope of this evaluation are Roux-en-Y gastric bypass (LRYGB) and laparoscopic gastric sleeve resection (LGSR), as these are the most commonly used surgeries and have developed in Hungary within the private healthcare services. LRYGB changes the stomach to a small upper pouch and a larger lower pouch, and LGSR is a size reduction along a major curve in the stomach [17]. LRYGB and LGSR constitute 70% and 30% of Hungarian bariatric procedures respectively, based on consultation with Hungarian specialists. LRYDB and LGSR are compared with the currently available standard treatment: conservative therapy including lifestyle change, diet, physical activity and occasional pharmaceutical treatment.

Target population

There are approximately 250,000 people with severe obesity (BMI≥40,0 kg/m^2) in Hungary [18, 19]. Hungarian clinical expertise indicates that due to individual (mainly psychological) reasons, only 10% of these are likely candidates for surgery (25,000 people). In addition, our calculations assume that 5% of these people will go ahead with bariatric surgery (1,250 people). The specific conditions for the operation are the following:

- BMI greater than 40 kg/m^2 or
- BMI greater than 35 kg/m^2 with comorbidities such as hypertension or diabetes
- overweight for several years
- unsuccessful conservative therapies for at least one year
- collaborative patient
- alcohol abuse or drug abuse excluded.

Type of analysis

Cost-utility analysis (CUA) was performed, taking into account Hungarian guidelines [20] and available QALY data. The analysis was done from a healthcare provider perspective using a time horizon of 10 years. An existing Markov model was adapted to Hungarian settings to extrapolate costs and effects to 10 years. The structure of the model is based on the standard pathway of obese patients (Figure 1). A discount rate of 3.7% was applied for both costs and effectiveness, following the recommendation of the Hungarian national guideline for economic evaluations [20] The Markov model is based on a cohort of 1,000 patients, who are representative of typical bariatric-eligible patients.

Health-related Quality of Life

QALYs data was derived from the international literature following a pragmatic review. The selection of sources was based on four criteria, including:

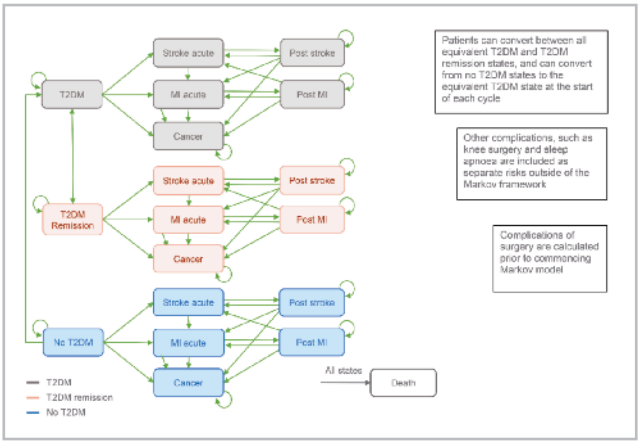

Figure 1
Overview of Markov model

- the coverage of relevant European population;
- the availability of utility data for different categories of BMI;
- large sample size and that the method of data collection was based on widely accepted tools for the measurement and valuation of health-related quality of life, e.g. EQ-5D, time-trade-off, standard gamble.

The utility parameters derived from the literature are presented in Table 1.

Parameter	Utility (disutility)	Source
Baseline utility – BMI ≥40 or BMI ≥35 with comorbidities	0.4632	Lee, 2005 [25]
Disutility due to surgery – (only in the 1st year for 30 days)	-0.22	Campbell, 2010 [26]
Disutility due to reoperation – (for 30 days)	-0.36	Campbell, 2010 [26]
Disutility due to complications – (for 30 days)	-0.11	Campbell, 2010 [26]
Disutility due to one unit of increase in BMI	-0.017	Hakim, 2012 [27]
Disutility due to diabetes	-0.0621	Sullivan, 2011 [28]
Disutility due to acute stroke	-0.1171	
Disutility following stroke	-0.0349	Borisenko, 2015 [8]
Disutility due to acute AMI	-0.0626	Borisenko, 2015 [8]
Disutility following AMI	-0.0368	Borisenko, 2015 [8]
Disutility due to cancer	-0.073	Gough, 2009 [29]

AMI: Acute Myocardial Infarction BMI: Body Mass Index

Table 1
Utility parameters derived from the literature

Costs

Cost parameters included: estimated personal costs; costs of materials, especially those of disposable items; diagnosis costs, and treatment costs. Cost parameters were based on expert consultations, national publications and registries. If necessary, they were supplemented by European data available in the literature. Costs were calculated in Hungarian Forints (HUF). Costs from earlier years were inflation-adjusted to 2017 using the Consumer Price Index for healthcare in Hungary (21), and an estimation of its value in EUR are provided at the results with an exchange rate of HUF 309,22 per EUR [22].

The calculation of costs was based on the treatment pathway described by physicians and the coding system used in Hungarian healthcare (DRG, ICPM), considering costs separated for pre-, intra-, and post- surgery. The cost of diagnosis

Type of cost related to the surgery	Costs in HUF	
	LRYGB	LGSR
Personnel	78 571	58 929
Disposable items	1 210 310	892 810
Reusable items	20 000	20 000
Professional materials	56 189	56 189
Pharmaceuticals	39 705	39 705
Operating theatre, cleaning infrastructure	25 600	19 600
Treatment costs in intensive care	66 752	66 752
Treatment costs in surgical ward	54 696	24 000
Laboratory and diagnostic examinations	17 598	17 598
Central management	28 054	25 054
TOTAL	**1 597 476**	**1 220 637**

LRYGB: Laparascopic Roux-en-Y Gastric Bypass LGSR Laparoscopic Gastric Sleeve

Table 2
Cost of LRYGB and LGSR surgeries (own calculation based on specialist's opinion and hospital accounting data)

is HUF 26,314 including physical, psychological and laboratory examination, and consultations with a nutrition, surgeon and anesthesiologist. The cost of surgery is presented in Table 2. The weighted average of LRYGB (70%) and LGSR (30%) treatment costs were used for the calculation which resulted in HUF 1.48 million (€ 4,800). Costs prior to and during the operation were used as baseline costs in the model.

During the first-year post-surgery, patients had one consultation with a dietitian, two with the psychologist, and four surgical control, laboratory and diagnostic examination. This resulted in HUF 43,952 annual cost per patient. The second year after surgery included one consultation with a dietitian, one with the psychologist, and two surgical control, laboratory and diagnostic examinations. This resulted in HUF 43,952 annual cost per patient.

The costs of the conservative therapy were based on a recent publication [23] which estimated the burden of illness based on Hungarian national data from 2012. The calculation included the overall costs of inpatient and outpatient treatment, and the reimbursement of relevant pharmaceuticals and medical devices. The calculation of costs for co-morbid diseases is presented in Table 3.

Parameter	Cost in HUF	Source
Acute stroke	544,208	Karpati, 2007 [30]
Stroke	76,214	Karpati, 2007 [30]
Acute Myocardial Infaction (AMI)	778,050	Gulacsi, 2007 [31]
Post AMI treatment per year	62,282	Gulacsi, 2007 [31]
Colorectal cancer	1,396,236	NEAK, 2016 [32]
Any type of cancer	2,000,000	AIPM, 2016 [33]
Diabetes	440,929	Voko, 2009 [34]
Knee operation	377,808	Hungarian DRG [35]

Table 3
Costs of comorbidities

RESULTS

Bariatric surgery was both more effective and less costly than conservative treatment from the 4th year of the model. The mean costs were HUF 3,240,316 (€10,479) and HUF 5,453,095 (€17,635), and the mean number of QALYs 5.35 and 3.28 for bariatric surgery and conservative treatment, respectively. Table 4 provides an overview of the results.

The results of the modelling have shown that bariatric surgery is less costly and more effective over the examined 10-year period. Surgical intervention is therefore dominant, resulting in cost savings of HUF 1,054,420 (€3,410) over a 10-year period.

	Costs in HUF	Δ Costs HUF	QALY gain	Δ QALY	ICER (HUF/QALY)
Conservative therapy	5 453 095	-	3,28	-	-
Bariatric surgery	3 240 316	-2 212 778	5,35	2,07	Dominant

Table 4
Overview of results

	Bariatric surgery	Conservative treatment	Difference
Costs per cohort	3 240 434 502	5 452 998 842	-2 212 564 340
Costs per patient	3 240 316	5 453 095	--2 212 778
QALY/patient	5,35	3,28	2,07
Cost/QALY (HUF/QALY)	599 980	1 654 399	-1 054 420

Table 5
Results of modeling

The input parameter values of any model are subject to change and error. Sensitivity analysis was conducted to investigate these potential changes and errors and their impacts on conclusions. Probabilistic sensitivity analysis (PSA) was performed, running 1,000 simulations of the model in which inputs are automatically modified based on a probability distribution. The PSA showed that bariatric surgery remains the dominant intervention in terms of cost-effectiveness when compared with conservative treatment based on variable inputs.

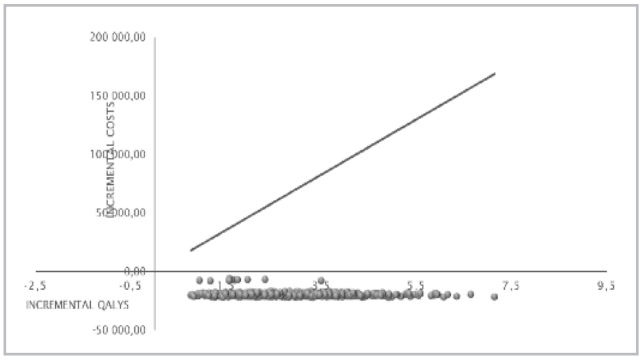

Figure 2
PSA scatter plot – the black line denotes the willingness-to-pay threshold (set at €23,600/QALY)

DISCUSSION

The analysis compares laparoscopic Roux-en-Y gastric bypass and laparoscopic gastric sleeve resection with lifestyle- and medication-based conservative treatment of obesity in Hungary. The results suggest that bariatric surgery is not only cost-effective but dominant, generating lower costs and more health benefits only four years after the surgery. These findings are in line with other reported, similar cost-utility analysis. Borisenko [8, 9,10,11] developed a similar Markov model of these interventions in a Swedish, Danish, German and Belgian settings and found that bariatric surgery was cost-effective after a few years post-surgery, and it

became dominant on a long-term basis. Further recent, European studies [7, 8, 9, 10, 11,12,13,14] confirmed these findings. It can therefore be concluded that bariatric surgery is a cost-effective or cost-saving option to treat patients with severe obesity.

Given that the costs of bariatric surgery are incurred upfront, but the cost savings can take some time to accrue, it is crucial to examine the cost-effectiveness of bariatric surgery over a longer time period and extrapolate the results to at least 5-10 years. In Hungary, these upfront costs are driven primarily by disposable items. In contrast, health benefits and quality of life gains will slowly accumulate over time: it can take years before an intervention has reached full effectiveness [24], and the full cost savings are demonstrated. This means an initial budget investment is required, which is not necessarily offset in the same financial year. However, as obesity poses long-term challenge both for individuals and the society, the investment in bariatric surgery provides value for money.

This study has some limitations. First, it is the adaptation of an international economic model for a Hungarian setting. The model adapted was based on some assumptions due to the limited availability of Hungarian data. Secondly, the model is a simplified version of the typical treatment pathway which varies across patients and could change over time. It is not a tool to support individual treatment decisions at a patient level.

CONCLUSIONS

As two-third of the Hungarian population overweight or obese, and the obesity rate is one of the highest in Hungary among OECD countries. Conservative treatments may not result in long-term positive outcomes for patients. Seemingly, there is a need for solutions that improve health outcomes while being economically sustainable. Recently published European economic evaluations of bariatric surgeries state that these interventions are not only cost-effective compared with conservative therapy, but they generate lower costs and better health impacts, offering dominant treatment strategies. Based on our analysis, bariatric surgery is also dominant in Hungary.

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Szimpózium a komplex gyógyszerekről *című cikk folytatása a 62. oldalról*

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