

Healthcare use and costs associated with obesity in Badalona, Spain: a study protocol

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ABSTRACT

Introduction: The objectives of the study are twofold. First, to calculate healthcare resource utilisation and costs for a cohort of adult overweight and obese patients observed in primary and hospital care centres during eight consecutive years (2003–2010) in an urban setting in Spain. An analysis of whether these costs vary by groups of individuals and types of disease, and of how they compare with the previous literature, is carried out in order to predict actions or policies for resource optimisation. The second objective is to estimate the impact of overweight and obesity on the consumption of resources and costs, accounting for a wide array of controls.

Methods and analysis: Observational and retrospective cohort data are used, consisting of medical records of patients followed up in outpatient and hospital care facilities during the years 2003–2010. Three cohorts of patients are analysed: normal weight (18.5 \geq body mass index (BMI) <25), overweight (25 \geq BMI <30) and obese (BMI \geq 30); BMI is computed using clinical information. Individual-level data on comorbidity, resource utilisation and costs are available, and external information provided by the population census regarding socioeconomic status is used. Utilisation and associated costs across BMI groups are compared by computing ratios for overweight and obese individuals relative to those of normal weight. Count data regression models (hurdle and finite mixture models) are used, together with two-part model regression models and taking into account the panel structure of the data set to explore the impact of overweight and obesity on the increased utilisation of health services and costs, accounting for a wide set of controls.

BACKGROUND

Obesity is the accumulation of excessive fat in the body. Its prevalence has tripled in Europe over the last two decades, and it is estimated that 150 million adults and 15 million children and adolescents in the region are obese.¹ A similar trend is observed in the USA, and Spain is likewise no exception, with an estimated 37.8% (15.6%) of Spanish adults being overweight (obese).² For the EU15, annual deaths attributable to

ARTICLE SUMMARY

Article focus

- To assess the magnitude of the incremental use of healthcare resources and their associated costs for a population of adult overweight and obese patients compared with normal weight individuals observed in primary care and hospital facilities over a period of eight consecutive years (2003–2010).
- To explore the impact of overweight and obesity on the consumption of resources and costs, accounting for a wide array of controls.

Key messages

- Obesity is the accumulation of excessive fat in the body. Its prevalence has tripled in Europe over the last two decades, and it is estimated that 150 million adults and 15 million children and adolescents in the region are obese.
- As a consequence of its high prevalence and association with multiple chronic illnesses, obesity tends to substantially increase healthcare resource utilisation and costs.
- Some authors report that the cost of obesity could reach 7% of total healthcare expenditure in Spain. Within this strand of literature, another set of papers estimates medical costs and obesity based on survey data.

Strengths and limitations of this study

- The resulting study population included approximately 112 000 individuals (50.48% women; mean age 42.7 years).
- Possible limitations of the study relate to the categorisation of diseases, the possible bias in patient classification, the selection of therapeutic groups, the extent of operating costs attributable to the information system, the potential impact of disease under-reporting, the variability of professional practice and information biases related with retrospective observational data.

overweight were 7.7%, ranging from 5.8% in France to 8.7% in the UK. One of every 13 deaths per year produced in the European Union is probably related to excess weight.^{3 4}

Although obesity is considered a multifactorial chronic disease linked to genetic,

perinatal, socioeconomic and other factors, it is primarily the consequence of an energy imbalance.^{5–8} The epidemic is a major public health concern as it is a key risk factor for a range of chronic conditions (ie, hypertension, diabetes, dyslipidaemia, heart disease, stroke, narcolepsy, osteoarthritis, asthma, apnoea, gout and certain cancers), which tend to reduce quality of life and ultimately cause death.^{9–10} In addition, most of these patients suffer from mental disorders and perceived social rejection leading to loss of self-esteem, a particularly sensitive concern in children.¹¹

As a consequence of its high prevalence and association with multiple chronic illnesses, obesity tends to substantially increase healthcare resource utilisation and costs. Two different approaches may be identified in the literature for analysing the relationship between obesity and healthcare costs. First, there are those studies that present estimates of the direct costs of obesity at the national level. For instance, it is estimated that the proportion of national healthcare expenditure attributable to obesity ranges from 5.3% to 7.0% for the USA^{12–17} and from 0.7% to 2.6% for other countries.¹⁸ However, some authors report that the cost of obesity could reach 7% of total healthcare expenditure in Spain.¹⁹ Within this strand of literature, another set of papers estimates medical costs and obesity based on survey data.^{20–25}

The second approach takes a lifetime perspective based on retrospective databases or medical record reviews and aims to estimate the impact of body mass index (BMI) categories on use of resources and direct costs for a set of related diseases. Most of these studies are drawn from US data,^{26–35} with very few referring to other national contexts.^{36–38} When production losses, reduced labour productivity, higher rates of work disability and lower salaries (due to problems of absenteeism, fewer job promotions or patterns of social exclusion) are added to healthcare costs, the obesity epidemic accounts for a larger fraction of GDP.^{39–40}

OBJECTIVES

The objectives of the study are twofold. First, to assess the magnitude of the incremental use of healthcare resources and their associated costs for a population of adult overweight and obese patients compared with normal weight individuals observed in primary care and hospital facilities over a period of eight consecutive years (2003–2010). An analysis of whether these additional costs vary by groups of individuals and types of disease, and of how they compare with previous related studies, is carried out in order to predict actions or policies for resource optimisation. The second objective is to explore the impact of overweight and obesity on the consumption of resources and costs, accounting for a wide array of controls.

METHODS/DESIGN

Study design and population

We use observational, longitudinal and retrospective data based on medical records of patients followed up in

primary care and hospital facilities. The study population comprises patients from six primary care centres (Apenins-Montigalà, Morera-Pomar, Montgat-Tiana, Nova Lloreda, Progrés-Raval and Marti i Julià) and two reference hospitals (Hospital Municipal de Badalona and Hospital Universitari Germans Trias i Pujol), serving >110 000 inhabitants in the north-eastern area of Barcelona. This population is mostly urban, of lower-middle socioeconomic status and from a predominantly industrial context.

The study includes all patients aged 18 years and over who were seen from 1 January 2003 to 31 December 2010 and who were regularly assigned to the above-mentioned healthcare centres during the study period. We exclude subjects who were transferred or moved to other centres, patients from other areas or regions. The resulting study population included approximately 112 000 individuals (50.48% women; mean age 42.7 years).

Data

Overweight and obesity are assessed for each patient through the BMI (kilograms per square metre), computed from measured weight and height, and three cohorts are distinguished: normal weight ($18.5 \geq \text{BMI} < 25$), overweight ($25 \geq \text{BMI} < 30$) and obese ($\text{BMI} \geq 30$). Given that not all patients were measured annually, we will need to assume BMI stability over the analysed period. That is, BMI will be imputed for those individuals with a small number of measurements and interpolated when having partial information. Mirroring previous literature, the measures for the utilisation of healthcare resources analysed in this study are medical visits (primary care, specialist care and emergency visits), the number and duration of hospital visits, laboratory and radiology tests, diagnostic or therapeutic tests, referrals and drug prescriptions defined annually. We hypothesize that the consumption of resources and medical costs incurred by overweight and obese patients differ from those of normal weight patients.

As for chronic conditions, the number of health problems per patient/year (mean episodes/patient) is considered as a process of care comparable to a disease diagnosis. According to the International Classification of Primary Care (ICPC-2), we account for a wide set of conditions related to overweight and obesity: hypertension (K86, K87), diabetes mellitus (T89, T90), dyslipidaemia (T93), smoking (P17), alcoholism (P15, P16), all types of organic failures (heart, liver and kidney), stroke/cerebrovascular accident (K90), cerebrovascular disease (K91), pulmonary embolism (K93), chronic obstructive pulmonary disease (R95, chronic airflow obstruction), bronchial asthma (R96), dementia or memory disorders (P70, P20), neurological diseases (Parkinson's disease (N87), epilepsy (N88), multiple sclerosis (N86) and other neurological diseases (N99)), depression (P76) and malignant neoplasms (all types, A79, B72–75, D74–78, F75, H75, K72, L71, L97, N74–76, R84–86, T71–73, U75–79, W72–73, X75–81,

Y77–79). The data set will collect information on all diseases associated with each patient.

To compute comorbidity for each treated patient, we use two indices: (1) the Charlson comorbidity index⁴¹ as a proxy for patient acuity and (2) the individual case-mix index obtained from the 'Adjusted Clinical Groups' (ACG), a patient classification system for iso-consumption of resources.⁴² A task force consisting of five professionals (a document administrator, two clinicians and two technical consultants) will be set up to convert (map) the ICPC-2 episodes to the International Classification of Diseases (ICD-9-CM). The criteria used will vary depending on whether the relationship between the codes is null (one to none), univocal (one to one) or multiple (one to many). The operational algorithm of the Grouper ACG® Case-Mix System consists of a series of consecutive steps to obtain the 106 mutually exclusive ACG groups, one for each patient. The application of ACG provides the resource utilisation bands so that each patient, depending on his/her overall morbidity, is grouped into one of five mutually exclusive categories (1: healthy users or very low morbidity; 2: low morbidity; 3: moderate morbidity; 4: high morbidity and 5: very high morbidity).

The data set includes other relevant information for the empirical analysis, such as the patient's age, gender, employment status (active/retired), place of birth and habitual residence, date of admission and discharge, type of healthcare professionals contacted and reason for the visit. Likewise, we include other confounding factors such as smoking and drinking status among others. In addition, data retrieved from the population census will allow us to consider other socioeconomic information, such as the distance from the current place of residence to the healthcare centre, educational level and marital status. Finally, an ID variable will capture information regarding other household individuals related to the patient.

Model of use of resources and costs

The design of the costs system is defined by taking into account the characteristics of the organisation, reporting requirements and the degree of development of the available information systems. The cost per treated patient during the study period is taken as the unit of measurement. The adaptation (conciliation or deputation) of incurred expenditures from the Profit and Loss Statement (Financial Accounting) to the costs of Analytical Accounting is carried out in two stages: (1) the conversion of natural expenditures into costs and (2) the allocation and classification of costs. Those expenditures not directly related to care (eg, financial spending, losses due to fixed assets, etc) are excluded from the analysis. Depending on volume of activity, we consider two types of costs: fixed or semi-fixed costs and variable costs. The former include personnel (wages and salaries, indemnifications and social security contributions paid by the company), consumption of goods (medicines, intermediate products, health material and

Table 1 Estimates of unitary costs per patient in 2003 and 2009

Healthcare resources	Unitary costs (€) Year 2003	Unitary costs (€) Year 2009
Medical visits		
Visit to medical primary care	15.02	22.74
Visit to emergency care	73.80*	115.23
Hospitalisation (per day)	201.50*	314.61
Visit to specialist care	66.20*	102.36
Complementary tests		
Laboratory tests	17.69	21.86
Conventional radiology	14.02	18.14
Diagnostic/therapeutic tests	19.21	36.45
Pharmaceutical prescriptions	PVP	PVP

Source: Own analytical accounts.

*These figures were estimated using the growth rate experienced by primary care visits during the period 2003–2009. PVP is retail price.

instruments), expenditures related to external services (cleaning and laundry), structure (building repair and conservation, clothes and office material) and management of healthcare centres, according to the Spanish General Accounting Plan for Healthcare Centres. Variable costs are those related to diagnostic and therapeutic tests and referrals.

More specifically, the concepts analysed are (1) complementary tests, including (a) laboratory tests (haematology, biochemistry, serology and microbiology: average cost per request), (b) conventional radiology (plain films requests, contrast radiology, ultrasound scans, mammograms and radiographs: expenditure per request) and (c) complementary tests (endoscopy, electromyography, spirometry, CT, densitometry, perimetry, stress testing, echocardiography, etc: expenditure per request); (2) pharmaceutical prescriptions (acute, chronic or on demand: retail price per package at the time of prescription) and (3) referrals made to referenced specialists or to hospital centres on either an ordinary or emergency basis. From semi-fixed costs, we derive an estimation of the average cost per medical visit. Table 1 shows an estimate of the resulting rates for the years 2003 and 2009.

The different unitary cost rates used in the calculations are derived from cost accounting carried out by primary healthcare and hospital centres for the available years, from invoices of intermediate products issued by different providers and from prices set by CatSalut (Catalan Health Service). Therefore, total medical cost per patient in each period will be calculated as semi-fixed costs (average cost per visit multiplied by the number of medical visits) plus variable costs. In this study, we do not account for the computation of 'out-of-pocket payments' paid by the patient or family that are not registered in the database. Healthcare costs will be adjusted for each period according to the Consumer Price Index.

Statistical analysis

We begin the statistical analysis by carefully reviewing our data set through a series of exploratory analyses in order to detect possible mistakes in coding. Descriptive and univariate statistical analyses are also performed regarding the main variables of interest, while the presence of outliers is detected by means of ad-hoc techniques (Hadi method) or graphical representation using box plots. Stochastic kernels are estimated in order to observe the characteristics of the distributions.

Given the above-mentioned objectives, the statistical approach of the study is then divided in two stages. In the first stage, we calculate use and cost (total and by sub-categories) of the considered healthcare services, differentiating by BMI groups for the period 2003–2010. Annualised means are computed for each measure of interest. In order to compare resource utilisation and associated costs across BMI groups, we will compute ratios for overweight and obese individuals relative to those with normal weight.

In the second stage, we use standard count data regression models (ie, hurdle and finite mixture models), together with a two-part regression models, taking into account the panel structure of the data set, to explore the impact of overweight and obesity on the utilisation of health services and costs, accounting for a wide set of controls. Sensitivity analysis is also performed based on thresholds that define overweight and obesity, levels of use of healthcare resources outside the extreme percentiles and the problems caused by 'attrition'.^{43 44}

Study timeline

Phases 1–2. Meeting to decide general planning of the study. Tasks will be assigned to investigators and informative meetings held with physicians from participating primary healthcare centres. Posterior follow-ups will be quarterly. A bibliographic and document search will be carried out and a structured summary drawn up. Time: 1 month.

Phase 3. Preparation of the database and collection of patient variables (quantitative information).

This includes (1) design and drawing up of a morbidity database (care episodes attended by patient/year), (2) design and drawing up of a pharmaceutical prescription database, (3) design and drawing up of a database covering healthcare services use and direct costs (laboratory, radiology, referrals and pharmaceutical prescription per patient/year) and (4) obtaining an ACG per patient/year. Time: 2 months.

Phase 4. Validation of data quality. Verification of univariate results by ranges. Identification of inadequate categories. Time: 1 month.

Phase 5. Data analysis, including: (1) statistical analysis: descriptive, bivariate and multivariate analysis and regression analyses and (2) interpretation of the results. Time: 2 months.

Phase 6. Scientific diffusion of the results: this will include the writing and publication of the results obtained. Time: 1 year.

DISCUSSION

No previous study on the calculation of healthcare use and costs according to BMI categories have been computed in Spain taking into account a longitudinal perspective. This protocol study aims to cover this gap.

Among the strengths of the study, we can remark that we use population data, low cost based in electronic medical records and long follow-up information. Possible limitations of the study relate to the categorisation of diseases, the possible bias in patient classification, the selection of therapeutic groups, the extent of operating costs attributable to the information system, the potential impact of disease under-reporting, the variability of professional practice and information biases related with retrospective observational data. Further research is needed regarding cost-effectiveness and the delay in diagnosis and treatment, as well as to replicate the study in other healthcare organisations. Despite the success of care for patients with chronic diseases such as obesity, interventions should be based on multidisciplinary teams so as to promote effective interventions in which patients are highly engaged in self-care.

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Competing interests None.

Ethics approval The study protocol was approved by the Clinical Research and Ethics Committee of the Hospital Universitari Germans Trias i Pujol, in accordance with Spanish conventions. Confidentiality was respected at all times according to the Spanish data protection law (*LO del 15/1999 de 13 de diciembre, de Protección de Datos de Carácter Personal, LOPD*).

Contributors AS-M, JG, TM, RN-A and JA drew up the study protocol and structured the literature search. All authors have read and accepted the latest version of the study protocol.

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