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Obesity morbidity and health care costs in France: an analysis of the 1991–1992 Medical Care Household Survey

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OBJECTIVE: To estimate the direct medical costs associated with obesity in France.
DESIGN: Analysis of the French 1991–1992 National Household Survey database comprising a representative sample of 14,670 individuals aged 18 y and over. A subgroup of subjects with a body mass index (BMI) $\geq$ 30 kg/m^2 was compared with a control group of normal-weight individuals (BMI 18.5–25 kg/m^2) matched on age, gender and education level.
MEASUREMENTS: Self-reported weight and height used to calculate individual body mass index and health expenditures in a 3 month period, and morbidity as declared by respondents to the national household survey and verified on medical records.
RESULTS: The direct cost attributable to obesity (BMI $\geq$ 30 kg/m^2) was estimated to be in the range 4.2–8.7 billion French Francs (FF) in 1992 value, that is between 0.7 and 1.5% of total health expenditures.
CONCLUSION: These results were of the same order of magnitude as similar estimates obtained by a top-down approach for the same year and setting.
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Introduction

The economic costs of overweight and obesity are important issues to health care payers and policy-makers in most developed countries.[1,2] Among economic studies, cost-of-illness studies have the objective of quantifying the economic and social burden of obesity-related morbidity and mortality. They also aim to synthesize the various parameters which are deemed relevant to describe the current medical management and the consequences of the conditions associated with obesity.[3] Three components are generally accounted for in these studies: the direct costs which are related to the consumption of resources, mainly medical, used in the treatment of obesity and related conditions;[4] the indirect costs which measure the lost productivity due to work-related absenteeism and premature mortality; and the intangible costs which are related to suffering and loss in quality of life.[5] Most published studies so far have focused on the direct costs, generally using a top-down approach which quantifies attributable fractions of national direct costs associated with obesity-related diseases.[6–12] These approaches are based on a series of assumptions and estimates of various relevance and it is interesting to compare their results with those obtained by other methods. One alternative approach considers individual data collected by medical resources utilization in a representative group of the obese population and compares results to data related to a relevant control group.[13] We had the opportunity to conduct this methodology through the secondary analysis of a French database describing a national representative sample of the French population in terms of morbidity and health expenditures.

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Materials and methods

Definition of obesity

Only recently has consensus been achieved internationally on the definition of obesity based on body mass index (BMI), which has been published by the World Health Organisation.[1] The classification of BMI sets the thresholds for normal weight at 18.5–24.9 kg/m^2 and that for obesity at 30 kg/m^2. This definition allows a standardization of studies at an international level and was utilized in the present analysis of a sample of the French adult population over 18 y of age.

The 1991–1992 medical care household survey

The present analysis was based on the data collected in France through the 1991–1992 Medical Care

Household Survey.[14] This survey has been conducted every 10 y since 1960 using a similar methodology. It is considered the most comprehensive French database on medical expenditures and general morbidity. This survey was carried out by professional interviewers belonging to the National Institute of Statistics and Economic Studies (INSEE) in association with the French Research and Information Center on Health Economics (CREDES). The national random sample was designed in 1991 and comprised 11,500 representative households in France. The individuals living in institutions of all categories (including nursing homes and long-term care hospitals) were excluded from the sampling. The sample was divided into four groups, each of which was studied over successive 3 month periods between April 1991 and March 1992. The fieldwork involved face-to-face interviews with a member of the family. Five interviews were planned at 3 week intervals and a household health care expenditures record book was provided. Between visits, subjects were asked to keep a record of all medical consumption that occurred for each member of the household. This consumption was composed of any type of service or procedure used, whatever their reimbursement modalities (out-of-pocket expenditures or free utilization).

The corresponding unit costs of services and procedures were then used for cost calculation. Unit cost estimations were performed on the basis of current tariffs and fees used in ambulatory care and in clinics for reimbursement purposes. For public hospitals, full daily costs per category of ward and hospital were utilized.

Information on expenditures and resource consumption then was coded and interpreted to be translated in terms of total real costs. This work was performed by using a series of unit costs and assumptions. The cost estimates used in this analysis are the 'real' costs and are not restricted to the corresponding charges for the Social Security system (National Illness Funds) or any other specific payers.

The questionnaires used included detailed items concerning the current morbidity based on the declarations of the respondents. This information was systematically verified by the physicians involved in the coding of the data. The consistency with related prescriptions and services used was checked and the initial data eventually corrected. The ICD (9th revision) was used to code the diseases.

The weight and height of individuals were also collected on the basis of the declaration of the respondents. These values were used to calculate individual body mass index (BMI). In this survey, an imputation procedure of item consumption to each specific morbidity was performed.

In summary, the effective number of households which were identified and participated was 8,235, representing a total population of 21,586 individuals, which is 93.5% of the initial sample of population contacted. The data collected were considered exploitable if the period of observation was greater than 65 days. With this restriction, only 20,416 individual observations remained, from which individuals under 18 y of age and pregnant women were then excluded. Finally, our analysis was conducted on 14,670 individuals (7,066 males and 7,604 females).

Evaluation of the direct cost of obesity

From the available database, various methodological approaches for calculating direct costs for obesity were performed. As a first step, we focused on obesity itself, identified as a condition reported by respondents and inducing specific medical consumption. It must be pointed out that the definition of obesity here might in some cases be inconsistent with the clinical one defined by the BMI. Therefore, all medical consumption associated with overweight as described by respondents was taken into account only for people with BMI > 30 kg/m^2.

As a second step, we had to estimate the extra medical consumption in the obese population through a comparison with a control group. The question was raised about the definition of an adequate control group. Several preliminary analyses and the literature suggested that this group should be the population characterized by a normal BMI (range 18.5–25 kg/m^2), therefore excluding the underweight group. It actually appeared that a significant proportion of underweight in the male population was associated with or caused by severe conditions, especially those related to cancer and tobacco consumption. A reason to exclude the overweight population was that normal weight ought to be considered as the theoretical target of any therapeutic or preventive intervention in obesity and the estimation of costs should reflect the potentially avoidable cost of this condition.

Other usual confounding factors were also taken into account (that is age, gender and education level). Ethnicity was not documented in the survey for regulatory reasons. We chose to take education level as a proxy for socio-economic status. In other preliminary analyses, we introduced 'income' as another confounding factor, but the results appeared similar to those presented here and we decided not to add it to the analysis for sake of simplicity. We adjusted for these variables by matching each individual in the BMI ≥ 30 kg/m^2 group with two controls in the normal weight group (BMI 18.5–25 kg/m^2). This adjustment was feasible due to the large sample size in the normal weight group. Educational level was controlled for in the analysis since many studies have demonstrated a correlation between obesity and social status.[15,16]

Breakdown of costs according to categories of medical consumption

The medical consumption was categorized into two groups according to inpatient care and ambulatory

care. Cost of ambulatory care comprised visits to physicians, drug expenses, dental care, imaging procedures, biological tests and paramedical procedures, while the cost of inpatient care was more difficult to estimate precisely due to the limited number of hospital stays in the sample. Only 388 hospital stays (with an average length of 8.1 d) were recorded in the database for a population of 14,670 individuals. Therefore, it was decided not to estimate a detailed breakdown of total costs by ICD category.

Extrapolation to national annual costs

The extrapolation of the study's estimates of average medical costs per person to national annual values was performed in an exploratory manner following a two-step procedure. It appears that the average spending on medical consumption per person estimated from data from the population sample (including people under the age of 18 y) was underestimated by 34% when compared with global aggregates established through national accounting of health expenditures (FF6,217 as compared with FF10, 316 per annum per person).[17,18] This difference in estimates is likely to be due to a number of factors such as the exclusion by the study protocol of individuals living in institutions and the selection bias concerning patients living along and presenting with severe conditions.

Two different adjustment coefficients (ratio between national data and average medical consumption observed in the survey) were used for ambulatory (1.48) and ambulatory plus inpatient care (1.66), respectively, to account for these discrepancies. The assumption was made that the underestimation of costs was homogeneous in all groups. The results obtained are then conservative and are furnished as an approximation which could be compared to results obtained by other approaches. Average individual cost results were then extrapolated using the ratio between the sample size (14,670) and French national demographic data for 1992. The costs are all expressed in French Francs (1992 values) as estimates of annual prevalence national costs.

Results

Table 1 summarizes the main characteristics of the representative sample of the French adult (for example ≥ 18 y, not living in an institution and excluding pregnant women) population. The breakdown of the variables according to BMI is presented, showing large differences in socio-demographic parameters such as age, gender and education level. The mean annual health care cost per person appearing in Table 1 reflects the influence of all preceding variables and not just the consequences of overweight.

The adjusted extra cost attributable to obesity was then calculated by subtracting the costs in the BMI ≥ 30 kg/m^2 group from the costs in the control group (BMI 18.5–24.9 kg/m^2 group) which were matched for age, gender an education level. The mean annual health care cost in the 'normal' BMI group of persons with the same characteristics as the obese people thus increased from FF5,417 to 7,323 after adjustment.

Table 2 displays the breakdown of this cost by category of medical consumption. The mean adjusted extra cost attributable to obesity was estimated at FF911. However, this difference was not statistically significant ($P = 0.1565$) using a non-parametric Willcoxon test.

The difference comes from the extra ambulatory care costs among the obese population in the sample (Table 2). Due to the limitations already identified concerning the evaluation of inpatient costs in this survey, we may consider this value as a lower range estimate. The extrapolation to national annual health care cost yields an estimate of FF4.2 billion (1992 values), which is 0.7% of total health expenditure.

We then disaggregated the global cost according to prevalent diseases in the sample. From the literature, it is well established that obesity yields an increased relative risk for conditions such as type 2 diabetes mellitus, dyslipidaemia, hypertension, coronary heart disease and gallbladder disease. We estimated in our sample the adjusted relative risk for all diseases generally considered as more prevalent among the obese.[1] Table 3 presents the results of this calculation

Table 1 Non-adjusted mean annual medical consumption per person in the sample (age $\geq$18 y; non-pregnant women; individuals not living in institutions)

	BMI (kg/m^2)				
	< 18.5	*18.5–25*	*25–30*	*≥ 30*	*All*
Number of observations	692	9,173	3,852	953	14,670
Percentage	4.7%	62.5%	26.3%	6.5%	100%
Male %	16.2%	45.3%	61.2%	46.4%	48.2%
Meane age (y)	39.0	42.7	51.3	54.0	45.5
Education level $\geq$ Baccalaureat	34.1%	30.3%	19.6%	12.1%	26.5%
Mean annual health care cost/person, FF (s.d.)	5,612 (18,164)	5,417 (29,848)	7,920 (33,427)	8,234 (24,337)	6,267 (30,097)
Ambulatory care cost %	73.5%	60.5%	51.9%	61.2%	58.2%

Table 2 Comparison of adjusted mean annual medical cost per person (matched for age, gender and education with the BMI ≥ 30 kg/m^2 group

Mean annual cost/person	*BMI*				*Ratio of mean health services costs*
	18.5–25 kg/m^2 (matched for age, gender and education with the BMI ≥ 30 kg/m^2 group)		*≥ 30 kg/m^2*		
Hospital	FF3,231	44.1%	FF3,187	38.7%	0.98
Ambulatory care:	FF4,092	55.9%	FF5,047	61.3%	1.23
Physician visits	FF791	10.8%	FF979	11.9%	1.24
Paramedical care	FF382	5.2%	FF598	7.3%	1.56
Pharmaceuticals	FF1,642	22.4%	FF2,541	30.9%	1.55
Dental care	FF935	12.8%	FF530	6.4	0.57
Imaging procedures	FF194	2.6%	FF168	2.0%	0.86
Biological tests	FF148	2.0%	FF231	2.8%	1.56
Total	FF7,323	100%	FF8,234	100%	1.12

for all diseases where a statistically significant adjusted relative risk was found between the ≥ 30 kg/m^2 and 18.5–25 kg/m^2 groups.

It is important to note that a lack of statistical power may explain the absence of significant association with other conditions like cancer (breast, colorectal or endometrial) or pulmonary disease, for example (Table 3).

The prevalence rate among the group with BMI ≥ 30 kg/m^2 was defined as the percentage of persons presenting with at least one disease under the relevant morbid category. It is important to notice that this morbidity was either declared by the respondent or identified from the analysis of current treatment and that it did not necessarily reflect all diagnosed diseases. (Table 4).

Table 3 Adjusted (age, gender, education) relative risk for various conditions in the sample (BMI ≥ 30 vs $18.5 <$ BMI < 25 kg/m^2)

Disease groups	*Relative Risk*	*CI*	*Prevalence rate in the group BMI ≥ 30*
Osteo-articular disease	1.25	(1.11–1.41)	32.6%
Coronary heart disease[a]	1.51	(1.15–2.0)	8.5%
Diabetes mellitus	3.8	(2.71–5.32)	9.8%
Gastric complications[b]	1.25	(1.03–1.5)	15.9%
Hyperuiecaemia, gout	3.73	(2.52–5.52)	7.2%
Hypetension	2.49	(2.2–2.82)	42.1%
Dyslipidaemia	1.5	(1.23–1.84)	15.2%
Venous disease	1.26	(1.1–1.43)	28.0%
Gallbladder disease	1.70	(1.27–2.27)	8.3%

CI = confidence interval.
[a]Includes MI, angina pectoris, congestive heart failure, etc. (event having occurred during the period or history of such event).
[b]Includes ulcer, gastritis, dyspepsia, etc.

For the group of diseases identified with a statistically significant elevated relative risk, we calculated the corresponding aggregated mean annual costs. The results for both obese and normal weight groups are presented in Table 4. As was mentioned before, the lack of statistical power, especially in the estimates of hospital costs, made it impossible to give detailed pathology, inpatient and outpatient care costs. The extra cost of obesity itself (FF172; $P < 0.0001$) and the cost of all diseases associated with obesity in the sample were significantly different between the obese group and the normal weight group.

It may be noticed that the global adjusted difference of costs (FF911) between the two groups is much lower than the extra cost associated with the obesity-related diseases (FF1,711 + 172 = FF1,883). This extra cost was actually offset by the lower health expenditures associated with other conditions (−FF972; $P < 0.0001$). This difference was not explained by the lower social status of the obese group, which was controlled for in the calculation. A complementary analysis showed that obese individuals had lower hospitalization, dental care and imaging procedures costs for conditions not associated with obesity than the matched group. This difference did not exist for other costs. However, this last result is unclear and it must be confirmed by other similar investigations. In summary, the value of FF1,883 may be considered as an upper range estimate of obesity-related cost. The corresponding extrapolation to national annual cost then was FF8.7 billion (~1.5% of total French health expenditure).

Table 4 Breakdown of adjusted mean annual direct cost per person (age > 18 y) according to disease category (adjustment on age, gender, and education level)

	Cost BMI 18.5–25 kg/m^2 (1)	*Cost BMI ≥ 30 kg/m^2 (2)*	*Difference (1) − (2)*	*P (Willcoxon)*
Obesity-specific medical consumption	—	FF172	+FF172	0.0001
Obesity-related disease cost[a]	FF1,887	FF3,598	+FF1,711	0.0001
Total	FF1,887	FF3,770	+FF1,883	—
(All other diseases)	FF5,436	FF4,464	− FF972	0.0001

[a]See Table 3.

Discussion

This study provided the opportunity to compare the results of two alternative methods for estimating the direct costs of obesity for France in the year 1992: our results based on a bottom-up approach could be compared with those published by Levy *et al*[7] concerning the same period and setting, but based on a top-down approach. Our range of estimates (FF4.2–8.7 billion) is consistent with the result (FF5.8 billion) obtained using attributable fractions of total obesity-related disease costs.

One major drawback of the top-down approach is related to the utilization of population-attributable fractions for the different obesity-related diseases considered. There is a complex array of casual relationships in the medical expenditures for diabetes mellitus, hypertension, dislipidaemia and cardiovascular diseases, for example. An assumption made in top-down analysis is to restrict the cost of these conditions to their current management at the exclusion of the associated complications, but such limits are difficult to control; risk of double-counting is thus possible. A more striking remark concerns our paradoxical finding that the extra cost of obesity-related diseases was partially offset by a lower cost of non-related morbidity, even after controlling for socio-economic confounding factors. Such a result has to be confirmed by other studies using a similar approach.

In summary, it may be noticed that both approaches (top-down and bottom-up) have their advantages and limitations and that none may be considered as definitely superior to the other. Our data on costs were limited due to lack of statistical power an selection bias, especially for hospital costs. A proportion of individuals isolated or in institutions, probably with the most severe conditions, were excluded from the observations, which might explain the absence of difference in inpatient costs.

Conclusions

This cost of illness study raises some methodological questions with regard to the usual top-down approach used to calculate the cost of a pathology or risk factor like obesity. A simple analysis based on an attributable fraction for obesity-related diseases might overestimate costs of this pathology because of interactions between obesity-related diseases and because of potentially lower health resource consumption among the obese population for other pathologies. The extra cost of obesity itself and associated diseases is in the range 0.7–1.5% of total French health direct expenditure.

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