Modifiable Co-Morbidities Trends During Hospital Admissions for Obesity in France (2009-2014)

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Abstract- Obesity is a growing public health problem in France, but modifiable co-morbidities in obese patients during their hospital admissions excluding bariatric surgery are lacking. Data were extracted from the French national hospital discharge database. Data on patient admissions, age, gender, and length of stay were extracted by selecting any stay coded primary as obesity. Obesity was defined as body mass index (BMI) between 30-39 kg/m², and morbid obesity as BMI≥40 kg/m². Only modifiable co-morbidities frequently diagnosed during the 6-year period with a rate≥3% were chosen. The admission rate for obesity decreased by 27.2% (P<0.001) with more females than males (71.9% *vs.* 28.1 %; P<0.001). The main modifiable co-morbidities were hypertension (22.72%), sleep apnea (13.64%), diabetes (12.34%), vitamin D deficiency (7.09%), hyperlipidemia (6.9%), hypercholesterolemia (4.98%), and nonalcoholic steatohepatitis (4.94%). Significant decreases were observed for hypertension (14.5%), diabetes (20%), hypercholesterolemia (30%) with steeper increase for vitamin D deficiency (830.7%) and nonalcoholic steatohepatitis (165.2%). Considering obesity class, admission for obesity (BMI: 30-40 kg/m²) and morbid obesity (BMI≥40 kg/m²) increased (P<0.001) by 6% and 7% respectively. Taking into account severity in proportion, stay>3 days significantly increased by 29.2% (P<0.001). The increase in the proportion of morbid obesity, vitamin D deficiency, and nonalcoholic steatohepatitis adds further evidence on the likely adverse health consequences of modifiable obesity-related comorbidities. There is a need for Health Authorities to promoting healthy lifestyle.

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Keywords: Arterial hypertension; Diabetes; Hypercholesterolaemia; Hyperlipidaemia; Nonalcoholic steatohepatitis; Vitamin D deficiency

Introduction

Obesity is a major public health problem in developed and developing countries (1-5).

In 2014, there were about 641 million obese in the world with 184 million severely obese (1). Of note, age-standardized prevalence of obesity increased from 3·2% in 1975 to 10·8% in 2014 in men, and from 6·4% to 14·9% in women. If these trends continue, by 2025, global obesity prevalence will reach 18% in men and surpass 21% in women; severe obesity (Body mass index, BMI 35-40 kg/m²) will surpass 6% in men and 9% of women (1).

The effect of the obesity epidemic on health care use and expenditure is of particular concern. Primarily due to the increased risk factor for many chronic diseases and conditions, including but not limited to diabetes, hypertension, dyslipidemia, sleep apnea, cardiovascular diseases, nonalcoholic steatohepatitis (NASH) and, vitamin D deficiency (6,7). Of note, NASH is considered to be a hepatic manifestation of metabolic syndrome and its incidence is rapidly increasing worldwide (8). NASH can progress to liver cirrhosis and hepatocellular carcinoma. Secondly, obesity has been linked to excess use of hospital and other health services, and consequently excess health care costs, in several countries (9).

For the year 2013 in France, obesity prevalence was 18.36% (10) with a relative increase of 76% between 1997 and 2012 (11). In 2002, the annual cost of obesity in France was estimated to range from 2.1 to 6.2 billion € (12).

Hospital admission rates for obesity and related co-morbid conditions have increased more than four-fold

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over the past decade in young adults in England (7). In France, where access to healthcare is freely accessible, trends in co-morbid conditions linked to the growing epidemic of obesity have not yet been estimated during hospital admissions for non-bariatric surgery. The objective of this study was to determine major co-morbidities' trends during hospital admissions for obesity in France over a 6-year period, excluding bariatric surgery.

Materials and Methods

Data were extracted from the French national hospital discharge database (PMSI_MCO) from 2009 to 2014. The PMSI is an exhaustive national hospital discharge database based on Diagnosis Related Groups (DRG), including patients treated in medical, surgical, and obstetric units. The database includes all hospital admission in French public and private institutions. Since there are no unique identifiers available, multiple discharges are possible for one person.

Data on patient admissions, age, gender, and length of stay (LOS) were extracted by selecting any stay coded with 10M09, 10M09T, 10M091, 10M092, 10M093, and10M094.

Admissions for obesity were those where the primary diagnosis was for management of obesity. Obesity admissions were identified using ICD-10 codes E66, E65 (localized adiposity), and R635 (abnormal weight gain).

As there were up to 2734 associated diagnosis, only co-morbidities (or associated diagnosis) modifiable by lifestyle factors such as physical activity (13-15) and nutrition (16) with diagnosis rate≥3% during the 6-year period were chosen.

So, seven co-morbidities meet the inclusion criteria: arterial hypertension, diabetes, hyperlipidemia, hypercholesterolemia, sleep apnea, vitamin D deficiency, and NASH.

Other variables included age, gender, obesity class and LOS.

Obesity was defined as body mass index (BMI) between 30-39 kg/m², and morbid obesity as BMI≥40 kg/m² for further comparison (17). An obese but not morbidly obese condition is referred to as "obesity" hereafter.

LOS was used to characterize the severity level. Thus, LOS was classified into 3 levels: LoS0 (less than 1-day stay), LoS1 (stay between 1 and 3 days) and, LoS2 (more than 3 days stay).

This non-interventional study does not fall under the scope of the law and does not require any ethics committee submission (Law 88-1138 relative to Biomedical Research of December 20, 1988, modified on August 9, 2004). The ATIH (*Agence Technique de l'Information sur l'Hospitalisation*) is responsible for managing the finalized database each year under approval by the CNIL (National commission for data processing and civil liberties).

The admission rate for obesity as principal diagnosis for any given period was calculated as follows:

(Total number of admissions for obesity/ Total number of hospital admissions) *10,000 admissions.

Obesity admission, modifiable co-morbidities, gender, BMI class, and severity level were presented as proportions with *Chi*-squared tests to assessing differences.

For multiple comparisons, Chi-squared tests with Marascuillo procedure was used. $P \leq 0.05$ was considered significant.

Results

The main findings are presented in Table 1. Median age at hospital admission for obesity as the principal diagnosis was 41 years.

The overall admission rate for obesity was more common in females than males (71.9% *vs.* 28.1 %; $P<0.001$).

Nearly 40% of hospital admissions were for counseling. Although their proportion increased significantly by 4.7% ($P<0.001$) during the 6-year period, the admission rate for counseling declined significantly ($P<0.001$) by 12.74 % between 2012 and 2014.

The main modifiable co-morbidities were hypertension (22.72%), sleep apnea (13.64%), diabetes (12.34%), vitamin D deficiency (7.09%), hyperlipidemia (6.9%), hypercholesterolemia (4.98%), and nonalcoholic steatohepatitis (4.94%).

Percentage of comorbidities, severity level (representing LOS), and BMI evolutions are presented in Figures 1, 2, and 3 respectively.

Severity level in percentage decreased by 11.9% in LoS1 (stay of 1 to 3 days) but increased by 29.2% in LoS2 (stay>3 days) both significantly ($P<0.001$).

Considering obesity class, "obesity" (BMI≥30 but <40 kg/m²) increased by 6% whereas morbid obesity (BMI≥40 kg/m²) progressed to 7% ($P<0.001$). There were 14,720 (9%) unknown data for BMI.

Table 1. Characteristics of hospital admissions (%) for obesity in France (2009/2014)

		2009	2014	Variation 2009/2014 (%)
Admission rate (/10,000)		11	8	-27.2***
Gender	**Male**	28	27.70	-3.1
	Female	71.30	72.20	+1.26
Obesity class	**Obese (BMI 30-49 kg/m²)**	53.00	49.80	6***
	Morbid obesity (BMI ≥ 40 kg/m²)	46.80	50.10	7***
Severity level	**LoS0**	55.2	55.1	-0.1
	LoS1	31.8	28	-11.9***
	LoS2	13	16.8	+29.2***
Modifiable co-morbidities	**Hypertension**	22.47	19.20	14.5***
	Apnea	13.00	12.81	-1.46
	Diabetes	12.88	10.3	-20***
	Hyperlipidaemia	6.39	6.2	-2.97
	Hypercholesterolaemia	5	3.5	-30***
	Vitamin D deficiency	1.3	12.1	+830.7***
	NASH	2.3	6.1	+165.2***

****P*<0.001; LOS: Length of stay; 0: less than 1 day of stay; 1: between 1 and 3 days of stay; 2: >3 days of stay; NASH: nonalcoholic steatohepatitis; BMI: Body mass index

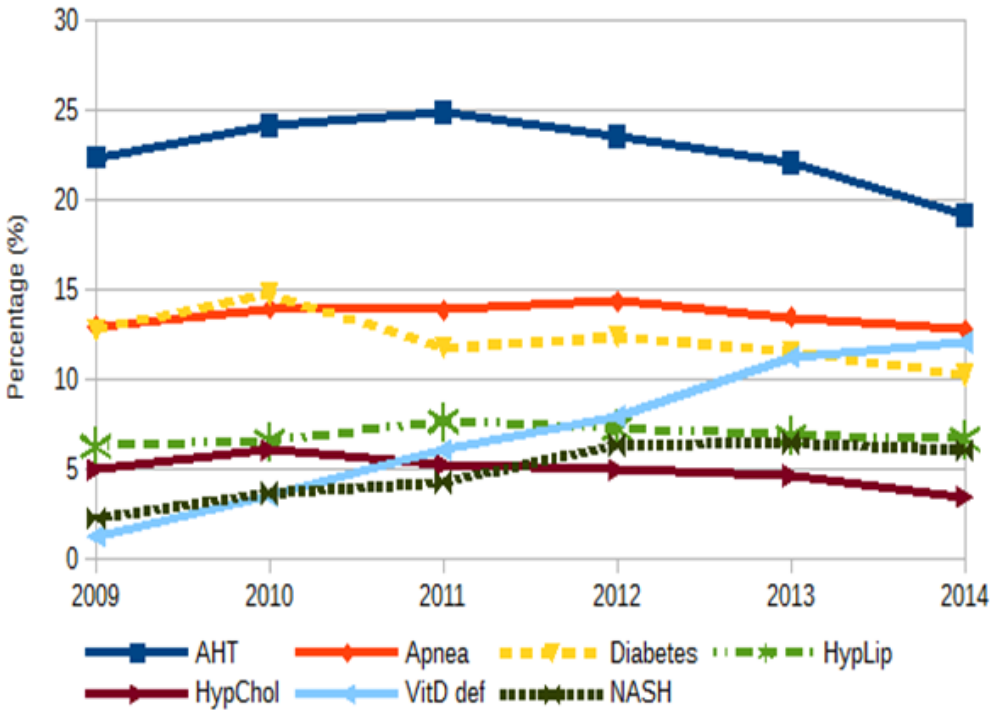

Figure 1. Modifiable co-morbidities evolution (%) during hospital admissions for obesity in France (2009/2014)
AHT: Arterial hypertension; HypLip: hyperlipidaemia; HypChol: hypercholesterolaemia NASH: Nonalcoholic steatohepatitis

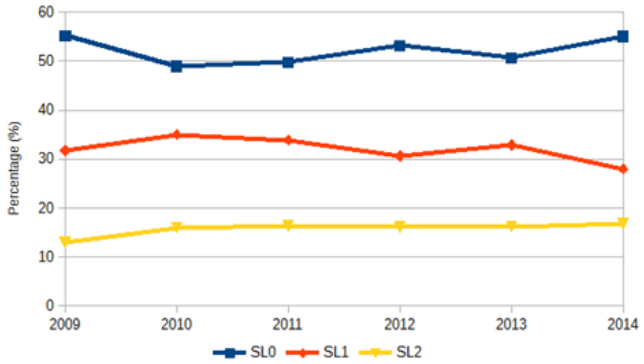

Figure 2. Severity level (%) evolution during hospital admissions for obesity in France (2009/2014), SL: Severity level; 0: less than 1 day of stay; 1: between 1 and 3 days of stay; 2: >3 days of stay

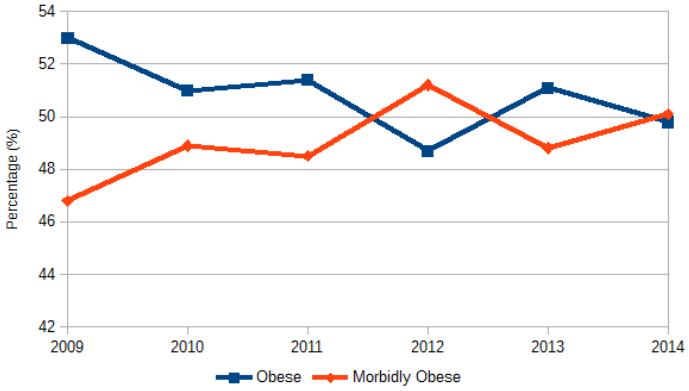

Figure 3. Obesity class evolution (%) during hospital admissions for obesity in France (2009/2014), Obese: Body mass index (BMI) between 30-39 kg/m²; Morbid obesity: BMI≥40 kg/m²

Discussion

During the 6-year period, hospital admission rate for obesity (excluding surgical procedures) and some major comorbidities in relation with obesity decreased significantly.

But, there is a paradox. Hospital admission for obesity is decreasing Meanwhile the obesity prevalence in the general population is increasing. There may be at least three explanations. Firstly, attitude toward obesity is changing with more non-stereotypical, positive media portrayals of obese individuals helping weight stigma reduction (18).

Secondly, obesity can be a choice linked to a culture or not. For example, a qualitative research showed that overweight is considered as a normal and healthy body size in the *Bamiléké* an ethnic group in Cameroon (19) and in *Punjabi* housewives belonging to upper socioeconomic strata (2).

Thirdly, an inadequate management may not only result in a failure but may increase obesity because obese patients with past weight-loss attempts failure are prone to miss controls (20). Also, some health professionals can set weight loss objectives more demanding than guidelines call for (21), and that could increase program failure. Of note, 40% of patients were seeking to counsel. Although their proportion increased by 4.7% during the 6-year period, a significant decline of 12.74 % for counseling was observed between 2012 and 2014. These findings have important public health implications for the prevention and treatments of obesity.

Hypertension, diabetes, sleep apnea, hyperlipidemia, hypercholesterolemia, NASH, and vitamin D deficiency are common conditions associated with obesity (6,7). The prevalence obtained in this study for hypertension, sleep apnea, diabetes are similar to previously reports of 28% for hypertension (22), 11.7% for sleep apnea (23), and 12% for diabetes (17). But these values are very low compared to those reported in other studies for hypertension (38.3%) (23), sleep apnea (56%) (24), diabetes (29%) (25), and vitamin D deficiency (96%) (26). However, in these latest studies, their results were obtained in morbidly obese patients (BMI≥40 kg/m²).

These differences, relying only on methodological considerations, should not hide the fact that obese patients can have two or more co-morbidities which substantially increase with increasing BMI.

In this study, NASH prevalence (2.3-6.5%) was close to 7.3% reported by Wilmot *et al.*, or 10% by Xanthakos *et al.*, but lower compared to 66% obtained in obese adolescents (7-18 yrs) (28). Nevertheless, obesity may be a risk factor for nonalcoholic fatty liver disease (NAFLD) (27) and approximately 10%-25% of patients with NAFLD develop NASH, and 5%-8% of those will develop liver cirrhosis within 5 years (29). Of note, low concentrations of vitamin D are associated with NASH (30). In this study, vitamin D deficiency, which increased by 830.7%, could explain the increase of 165.2% in NASH observed during hospital admission. So, early identification of vitamin D deficiency may help improve outcomes in obesity.

The strength of the study is that data extracted from this database is exhaustive (all public and private hospitals in France are included, and no sampling is done), of high quality, with limited coding errors, and over a 6-year period. So it was possible to account for co-morbidities objectively and not by self-report subjected to error. However, there are limitations to be recognized. First, children and adults' hospital admissions for obesity were not analyzed separately. Second, comorbidities were not stratified by BMI class, gender or adjusted for confounding variables. Thirdly, as there were no unique identifiers available, multiple discharges were possible for one person. Nevertheless, the study captured well trends in modifiable co-morbidities related to hospital admission for obesity and highlighted the increase of morbid obesity, vitamin D deficiency and NASH.

In conclusion, this study adds further evidence on the likely adverse metabolic health consequences of obesity, in particular for those admitted to hospital for the non-surgical procedure.

Obesity-related conditions are expensive to treat. There is a need for Health authorities to promoting healthy lifestyle, eating behavior mainly to reduce inactivity, tobacco use, and the proliferation of junk foods consumption. Such promotion can be further supported by producing a compelling body of evidence on the adverse health impact of inactivity and food consumption.

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