Obesity Facts
The European Journal of Obesity

Obes Facts 2014;7:120–129
DOI: 10.1159/000362343
Received: January 22, 2013
Accepted: January 14, 2014
Published online: April 23, 2014

1662–4033/14/0072–0120$39.50/0
www.karger.com/ofa

Original Article

Food Insecurity, a Determinant of Obesity? – an Analysis from a Population-Based Survey in the Paris Metropolitan Area, 2010

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Abstract

Objective The relationship between food insecurity and obesity is discussed in the literature. The objective of this study was to determine whether food insecurity and obesity were associated in the Paris metropolitan area. ***Methods***: We used data from third wave of the Health, Inequalities and Social Ruptures (SIRS) cohort study, a longitudinal population-based, representative health and socioepidemiological survey of the general population in the Paris metropolitan area. The participants' BMI (calculated using self-reported height and weight) was analyzed as a continuous variable, and a dichotomous variable (BMI < 30 kg/m^2/BMI ≥ 30 kg/m^2) was constructed. Food insecurity was estimated using the Household Food Security Scale Module (HFSSM) and was treated as a trichotomous variable (food security / low food security / very low food security). Multilevel models were estimated for men and women separately. ***Results:*** Obesity (BMI ≥ 30 kg/m^2) prevalence was 10.2%. The determinant of obesity differs according to gender. After adjustment for age, income and the sociooccupational group, very low food security was associated with obesity in women (OR = 2.01, 95%CI 1.05–3.82), and women with very low food security had a higher BMI (Coef. = 1.78, 95% CI 0.24–3.31). This association, however, was not significant for men (OR = 1.84, 95%CI 0.64–5.30). ***Conclusion:*** In times of economic crisis, it is increasingly essential to explore and understand the pathway through which very low food security is linked to obesity.

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Introduction

Obesity is a major worldwide public health problem, and many countries are trying to tackle it. In France, 32.3% of the adult population were pre-obese (25 ≤ BMI < 30) and 15.0% was obese (BMI ≥ 30 kg/m^2) [1] in 2012, while in 1997 these prevalence rates were 29.8% and 8.5%, respectively. While research has led to a better knowledge of the determinants of obesity and guided public health interventions, new factors for obesity still need to be elucidated in order to accurately identify the target of public policies [2]. While the obesity epidemic is a consequence of the dramatic decrease in the need for physical activity and of major increases in the food supply in many countries over the last 40 years, there is another well-known determinant of this condition, namely, people's socioeconomic status (SES) [3], and increasing attention is now being given to food insecurity (FI). Food security (FS) is defined as the situation where people have, at all times, physical, social and financial access to sufficient, safe and nutritious food that meets their dietary needs for an active and healthy life [4]. FI is therefore the situation where, because of financial reasons, people's access to healthy, nutritional and 'socially acceptable' food is limited, inadequate, or uncertain. A quite paradoxical link seems to exist between FI and weight profile. Indeed, FI is a complex phenomenon that can lead not only to undernutrition and recurring hunger but also to overnutrition, which can lead to overweight and obesity [5]. Research on FI and weight status has yielded varied and somewhat contradictory results. Some studies have found an association between FI and obesity [6–10], while others have not [11–14]. When such an association has been found, it is usually among women, but not among men [8–10]. Several mechanisms have been proposed by which FI could cause obesity. First, food-insecure individuals may be overweight because they can only afford cheaper food, which tends to be calorie-dense and which could result in excessive energy intake and weight gain [15, 16]. Second, periods without sufficient food can cause people to overeat during when there is sufficient food, which results in increased overall energy intake and, consequently, weight gain [17, 18]. Since FI was identified and described in the Paris metropolitan area in previous papers [19, 20], the objective of this study was to determine whether FI and obesity were associated in a representative, population-based sample of the adult population in the Paris metropolitan area.

Material and Methods

Study Design and Sample

This study was based on a cross-sectional analysis of data collected in 2010 in the Health, Inequalities and Social Ruptures (SIRS) cohort study among a representative sample of French-speaking adults in the Paris metropolitan area (Paris and its suburbs, a region with a population of 6.5 million). At inclusion, in 2005, a 3-level random sample was constituted. First, 50 census blocks called 'IRISs' (a French acronym for blocks for incorporating statistical information, which constitute the smallest census unit areas in France whose aggregate data can be used on a routine basis, with about 2,000 inhabitants each) were randomly selected using a stratification based on their socioeconomic type and their being labelled or not labelled as 'underprivileged areas' in public (government) policies. Next, 60 households were randomly chosen from a complete list of households within each selected IRIS. Lastly, one adult was randomly selected from each household by the birthday method. Further details on the SIRS cohort methodology were published previously [21]. In 2010, 47% of the respondents were re-interviewed (2.6% were deceased, 1.8% were too sick to answer our questions, 2.7% were absent during the survey period, 13.9% had moved out of the 50 surveyed IRISs, 18.4% declined to participate, and 13.4% were lost to follow-up). Their sex ratio and mean age were similar to those who were not re-interviewed. The individuals lost to follow-up were younger and wealthier than the others, but neither their health status nor the type of IRIS of residence was different. Those absent during the survey period had a lower SES and were mostly immigrants. The individuals in each IRIS who were not re-interviewed in 2010 were replaced by a random procedure similar to the one used in 2005, up to a final sample size of 60 adults interviewed per IRIS. The refusal rate among the newly contacted people was 29% (the same as in 2005).

In 2010, 3,006 adults were interviewed, and for 39 of them either weight data or height data were missing. Our study is therefore based on a sample of 2,967 individuals.

Outcome

We used the BMI, defined as weight/height^2, as a proxy of overall fat mass and used the usual cut-off point [22]. The BMI was calculated using self-reported weight and height and was studied in two distinct ways. First, it was analyzed as a continuous variable in multilevel linear regression models. Second, interviewees were considered obese when their BMI was ≥ 30 kg/m^2 at the time of the survey, and they were compared with those who had a lower BMI.

Covariate

FS was measured by the Household Food Security Scale Module (HFSSM), a scale created by the US Department of Agriculture (USDA) [23]. Its translation into French for the purpose of this study was modeled after the French translation used in Quebec for the 2004 cycle of the Canadian Community Health Survey [24]. Originally, the USDA questionnaire comprised 18 items: 10 adult-referenced and 8 child-referenced, with 2 screening questions. To shorten interview time, we chose to reduce the instrument to 13 questions by deleting the last 5 child-referenced questions (which were asked only in households with children under 18 years of age that had experienced the severest degree of FI). In other words, we kept all the adult-referenced questions and only 3 of the child-referenced questions. Such a reduction did not affect the measure of FI at the household level, since all the household-related questions were kept in the order determined by the USDA [25]. A single score for each household based on the 10 remaining adult-referenced questions was calculated, as has been done in other studies [12, 24, 25]. Ranging from 0 to 10, this score was divided into three categories: FS, low FS and very low FS) defined by the usual thresholds (<3, 3–5 and ≥6, respectively) [25, 26]. We used this classification for the logistic regressions.

Adjustment Variables

Four characteristics were taken into account as adjustment variables. Age was grouped into four categories (18–29, 30–44, 45–59, and 60 years or older). The other three characteristics were the individual's SES, education level (tertiary, secondary, none or primary), monthly household income (calculated in EUR per consummation unit and categorized into quartiles), and sociooccupational group (based on the French National Bureau of Statistics' classification, which distinguishes between workers, employees, tradespeople/shopkeepers, intermediate occupations, executives/managers, and never having been employed, with retired or unemployed people classified according to their last job).

Statistical Analysis

All proportions presented in this paper were weighted to account for the complex sample design (specifically, the design effect associated with cluster sampling and the stratification that overrepresented the poorest neighborhoods) and for the poststratification adjustment for age and gender according to the general population census data (using the svy command in Stata11). The differences between the weighted proportions and those between the weighted means were tested by the Pearson's chi-square test.

Multilevel linear regression models and multilevel logistic regression models were fitted to study the multivariate associations between our covariate and our outcomes when adjusting for age and SES, and to estimate the coefficients and odds ratios (ORs), respectively, as well as their 95% confidence intervals (95% CI), using the xtreg and the xtmelogit commands in Stata11, specifying that the collected data were clustered by census block. All analyses were performed for men and women separately, since the literature usually reports gender differences for factors associated with obesity [27]. We tested interaction and colinearity, but neither was statistically significant. A p value < 0.05 was considered significant for all statistical analyses presented.

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Table 1. Characteristics of the survey population and prevalence of obesity, Paris metropolitan area, France, 2010

	% of weighted sample		Weighted obesity prevalence			
	men	women	men		women	
			%	p	%	p
Age, years						
60 or older	22.6	26.5	12.0	0.01	11.6	0.002
45–59	23.9	23.9	14.0		15.1	
30–44	32.3	30.9	8.1		10.8	
18–29	21.2	18.7	3.9		4.6	
Income / consumption units, EUR						
>4,500	25.5	24.6	10.4	0.81	5.1	<0.001
3,000–4,500	26.0	24.6	10.4		10.6	
1,865–3,000	24.1	25.3	8.8		11.0	
≤1,865	24.4	25.5	8.2		16.4	
Education level						
Tertiary	56.4	56.6	4.9	<0.001	7.0	<0.001
Secondary	36.0	36.3	15.1		14.5	
None or primary	7.6	7.1	16.7		23.3	
Socio-occupational						
Upper white collar	35.5	25.8	8.5	0.12	5.5	<0.001
Never work	5.0	10.7	0.0		11.9	
Tradespeople, shopkeepers	7.1	3.4	20.0		20.5	
Intermediate white-collar	12.0	15.4	7.1		6.5	
Lower white-collar	27.5	42.3	10.0		13.8	
Blue-collar	12.9	2.5	11.8		31.7	
Food security status						
Food security	93.6	93.8	9.5	0.12	10.4	0.001
Low food security	4.2	3.6	4.7		11.9	
Very low food security	2.2	2.7	19.0		26.3	

Results

Univariate Analysis

We estimated that 10.2% (95% CI 8.7–12.0%) of the adult, French-speaking population in the Paris metropolitan area was obese in 2010, specifically, 9.5% (95% CI 7.5–11.9%) of men and 10.9% (95% CI 9.2–12.9%) of women. As expected, the prevalence of obesity increased with age (table 1), the highest prevalence being among 45- to 59-year-old men (14.0%) and women (15.1%). Income was associated with obesity, but was completely different between men and women. Indeed, the prevalence of obesity in men increased with monthly household income, while the prevalence of obesity in women in the wealthiest households was about 3 times less (5.1%) than that in women from households with a monthly income of less than EUR 1,865.00 (16.4%). In addition, there was a significant gradient according to the education level ($p < 0.001$) among both men and women, the highest prevalence being among those with the lowest education level. Men and women had a different weight profile according to their socioocupational group. Regarding obesity, among men, the most prevalent group were the craftsmen and shopkeepers (20.0%), the least prevalent

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Table 2. Factors associated with obesity in multilevel analysis, Paris metropolitan area, France, 2010

	Men								Women							
	n*	BMI kg/m² (n = 1,184)				BMI ≥30 kg/m² (n = 1,184)			n*	BMI kg/m² (n = 1,783)				BMI≥30 kg/m² (n,=,1,783)		
		mean	coef.	95% CI	p	ORa	95% CI	p		mean	coef.	95% CI	*p*	ORa	95% CI	p
Age, years																
60 or older	409	26.30	–	–	*Ref.*	–	–	*Ref.*	576	25.12	–	–	*Ref.*	–	–	*Ref.*
45–59	331	25.85	0.04	−0.78–0.86	0.93	0.86	0.55–1.36	0.53	499	25.25	−0.23	−0.94–0.48	0.52	1.13	0.78–1.63	0.52
30–44	306	24.89	−1.19	−2.06–0.33	0.007	0.57	0.33–0.96	0.03	555	24.44	−1.06	−1.79–0.33	0.00	0.87	0.59–1.30	0.50
18–29	141	23.62	−1.92	−3.12–0.72	0.002	0.48	0.21–1.09	0.08	189	23.06	−2.79	−3.85–1.73	0.00	0.35	0.18–0.70	0.00
Income /consumption units, EUR																
>4,500	304	25.67	–	–	*Ref.*	–	–	*Ref.*	370	23.08	–	–	*Ref.*	–	–	*Ref.*
3,000–4,500	290	25.61	−0.24	−1.16–0.69	0.62	1.52	0.87–2.68	0.14	424	24.45	1.34	0.51–2.17	0.00	1.64	0.96–2.83	0.07
1,865–3,000	276	25.42	−0.99	−2.04–0.07	0.07	1.25	0.66–2.36	0.50	485	24.95	0.92	0.03–1.81	0.04	1.52	0.87–2.67	0.14
≤1,865	317	25.28	−1.17	−2.28–0.05	0.04	0.98	0.50–1.94	0.96	540	25.90	1.26	0.29–2.23	0.01	1.65	0.93–2.94	0.09
Education level																
Tertiary	862	24.77	–	–	*Ref.*	–	–	*Ref.*	581	23.39	–	–	*Ref.*	–	–	*Ref.*
Secondary	785	26.13	1.27	0.48–2.06	0.002	2.77	1.70–4.52	<0.001	462	25.56	0.74	0.06–1.43	0.03	1.24	0.85–1.81	0.26
None or primary	172	26.36	1.20	−0.04–2.44	0.057	2.38	1.17–4.83	0.02	144	27.78	2.32	1.18–3.46	0.00	2.06	1.21–3.49	0.01
Socio-occupational																
Upper white collar	402	25.52	–	–	*Ref.*	–	–	*Ref.*	414	23.37	–	–	*Ref.*	–	–	*Ref.*
Never work	35	22.56	−1.45	−3.57–0.67	0.18	N.C.	–	–	136	25.36	1.23	−0.04–2.51	0.06	2.94	1.47–5.87	0.00
Tradespeople, shopkeepers	89	26.58	0.96	−0.34–2.26	0.15	1.63	0.82–3.25	0.17	57	24.31	0.10	−1.51–1.71	0.90	2.51	1.09–5.77	0.03
Intermediate white-collar	138	25.14	−0.50	−1.61–0.61	0.38	0.67	0.33–1.35	0.26	286	23.92	−0.19	−1.09–0.71	0.68	1.18	0.65–2.14	0.59
Lower white-collar	334	25.77	0.42	−0.62–1.46	0.43	0.83	0.44–1.56	0.56	850	25.51	0.74	−0.12–1.59	0.09	1.84	1.08–3.14	0.03
Blue-collar	180	26.01	0.17	−1.06–1.40	0.78	0.83	0.41–1.68	0.61	64	27.93	1.88	0.18–3.58	0.03	3.25	1.48–7.14	0.00
Food security status																
Food security	1,106	25.51	–	–	*Ref.*	–	–	*Ref.*	1675	24.56	–	–	*Ref.*	–	–	*Ref.*
Low food security	52	24.97	−0.25	−1.78–1.29	0.75	0.63	0.21–1.88	0.41	85	26.40	0.96	−0.31–2.23	0.14	1.07	0.59–1.97	0.82
Very low food security	29	25.76	0.37	−1.66–2.39	0.72	1.84	0.64–5.30	0.26	59	27.30	1.78	0.24–3.31	0.02	2.01	1.05–3.82	0.03

N/C = Not calculable.
*Calculated from the entire sample.

(0.0%) those who had never worked ($p = 0.12$). In women, the most prevalent group were the blue-collar workers (31.7%), the least prevalent the upper white-collar workers (5.5%), and 11.9% of the women who had never worked were obese ($p < 0.001$). Lastly, obesity was more frequent among individuals with very low FS. In women, the prevalence of obesity increased with the level of FI, up to a rate of 26.3% for those with very low FS ($p = 0.001$). We did not observe a similar pattern among men, although 19.0% of men with very low FS were obese compared to 4.7% of those with low FS ($p = 0.12$).

Multilevel Analysis

In multivariate analysis (table 2), age remained strongly associated with a higher BMI and obesity in both genders. Income appeared to be associated with obesity differently in men and women (although none of the associations were significant for either gender). In men, the BMI tended to decrease as the monthly household income decreased, while women in households with a monthly income > EUR 4,500.00 had a lower BMI.

Education level was the most important and significant characteristic associated with obesity among men (OR = 2.38, 95% CI 1.17–4.83 for those with a low education level and OR = 2.77, 95% CI 1.70–4.52 for those with a secondary education level, compared to those with a tertiary level of education, which was used as reference value). Among women, the BMI increased as the level of education decreased, and those with the lowest level of education were twice as likely to be obese than the best-educated ones (OR = 2.06, 95% CI 1.21–3.49).

As for the sociooccupational groups, with the upper white-collar group as the reference, never having worked increased the risk of obesity among women (OR = 2.94, 95% CI 1.47–5.87), while it appeared that men who had never worked had a lower BMI (although not significant). It is worth mentioning that the men who had never worked were mainly students (73.5%), while women in the same category were mainly homemakers (43.0%). Blue-collar women were 3.25 times more likely to be obese, while blue-collar men were not at higher risk. Generally speaking, in women, all sociooccupational groups (except intermediary white-collar workers) were significantly at higher risk for obesity than the reference group, while in men no significant association was found between the sociooccupational groups and obesity.

After adjustment for age and SES, very low FS tended to remain associated with obesity. This association was significant in women (OR = 2.01, 95% CI 1.05–3.82). Women also appeared to have a higher BMI (Coef. = 1.78, 95% CI 0.24–3.31). Among men, the association was not statistically significant, even if the punctual estimate was in the same direction (OR = 1.84, 95% CI 0.64–5.30 and Coef. = 0.37, 95% CI –1.66 to 2.39). On the other hand, we observed that low FS was not associated with a higher risk of obesity either in men (OR = 0.63, 95% CI 0.21–1.88) or women (OR = 1.07, 95% CI 0.59–1.97).

Discussion

We observed an association between very low FS and obesity among women, which persisted after several socioeconomic adjustments. This association is the very first significant one found in a representative, population-based survey in France.

Our results have some limitations. First, the accuracy of self-reported weight and height can be a problem, even if, , this problem was avoided to some degree in the SIRS survey by conducting the interviews face-to-face. A previous French study showed that such self-reporting can lead to significant underestimations of BMI (0.29 and 0.44 kg/m^2 for men and women, respectively) [28]. However, considering the strength of the estimated associations, we think it rather doubtful that such bias could account for them completely. Of course, one other potential bias may be due to the shame attached to FI, which would consequently have been underreported by the interviewees. This may have led to an underestimation of the prevalence of FI. Potential bias may have resulted from the co-occurrence of these two underestimations. Although we cannot confirm or invalidate this assumption, we are still confident about the strength of the observed associations. A last limitation of this study is its sample size, which may have led to a lack of statistical power in our analysis.

Like most of the studies that have found a positive association between FI and obesity, our study had a cross-sectional design and is therefore required to specifying the direction of causality between these two situations. Actually, only a few studies have examined this relationship longitudinally [12, 29–32], and they showed mixed results for the association and the causal link between obesity and FI. For some of them, FI was not associated with weight gain or change [31, 32], and one study has even suggested that obesity can lead to FI rather than the other way around [30]. Others suggest that the link between FI and obesity might be mediated by socioeconomic variables [33], physical activity [32], or marital status [8]. Our results show that SES cannot fully explain this association in the Paris metropolitan area population. The potential impact of physical activity, parental nationality, and marital status was tested in separate models (not shown). The results showed no evidence of any modifying effect.

Such an association between FI and obesity remains a heated point of debate, particularly in the USA [34]. Although our results do not establish a causal link between FI and obesity, they do confirm that very low FS is a specific situation regarding obesity. Like other authors, we assume that very low FS may have a particular impact on nutrition (habits or consumption) [16, 35]. Also, obesity may be linked to specific eating habits and/or with very special importance being attached to food, both of which can lead to a feeling of lacking food and, subsequently, to a situation of perceived FI. Although a previous study sought to test the latter hypothesis and failed to reach a conclusion [6], we think that it remains an interesting theory for explaining such an association.

Among women, we found an association between very low FS and obesity and that very low food-secure women had a higher BMI, which is consistent with the literature [8–10, 29, 36–38]. Our results for men are also consistent with those of other studies, which did not show any significant results in men either [9, 10, 38]. Only two studies found that men who experienced FI tended to have a higher BMI than those who were food-secure [8, 29].

It should be specified that we found no significant association between pre-obesity and FI in either women or men. In women, in a model adjusted on the same co-variables than those for BMI and obesity, the punctual estimates of the association between low FI or very low FI and pre-obesity were 1.62 (95% C 1.00–2.61) or 1.25 (95% C 0.68–2.62). In the literature, most of the studies have found stronger, more significant and consistent associations between FI and obesity than between FI and overweight, even if there is an overall correlation between BMI and FI [39]. A few studies gave details for pre-obese people [40] and found, as we did, that the association is weaker than for obese people. The fact that the overall relationship between BMI and FI is stronger in the higher values of BMI distribution is perhaps not surprising since pre-obesity may encompass a huge variety of situations and causes when obesity seems to be a condition more specifically linked with FI.

Among women, after adjustment for various sociodemographic characteristics, the association between very low FS and obesity remained strong and significant, but there was no association between low FS and obesity (OR close to 1). We must therefore focus on what is meant by low FS and very low FS. These terms refer to various household situations as described in previous works [25, 26, 41]. According to the authors of theses studies, low FS is the situation where 'food insecurity is evident in household members' concerns about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping patterns … In this situation … little or no reduction in members' food intake is reported' [25]. On the other hand, very low FI is the situation where 'food intake of household members was reduced and their normal eating patterns were disrupted because the household lacked money and other resources for food' [41]. This situation (which is the one associated with obesity) is special because of the reduction in food intake and the change in the usual eating pattern. Therefore, in light of our results, some theories about the pathway that links FI to obesity made more sense than others. Indeed, we can hypothesize that in our study, food limitation (which occurs in situations of very low FS) is more likely to be a pathway to obesity than lower-quality food. This said, our results for women may also be due to the fact that when there is a lack of money, women are known to be the first members of the household to modify their food intake in order to protect the other family members [42]. If such restrictions explain part of the observed association, then the subsequent coping strategies leading to obesity cited in the introduction (food cycling) may be a more tenable hypothesis for our population.

Even though the relationship between FI and obesity remains complex, our study for the first time presents some evidence of the existence of such an association in France. These results are instructive because of the paucity of studies of FI in the French context and because of the findings regarding less food-secure individuals, which are quite alarming. Our work argues for more systematic studies of FI and obesity in France, especially at the present time, when the global economic crisis impacts the most vulnerable more severely.

Acknowledgements

This research was funded by the French National Research Agency (ANR) within the framework of the Programme National de Recherche en Alimentation et Nutrition, the French Institute for Public Health Research (IRESP) and the French Interministerial Committee for Urban Affairs. It also received support from Mutualité Française. J. Martin-Fernandez received a PhD grant from the Île-de-France region for this research.

J. Martin-Fernandez: substantial contribution to conception and design, acquisition of data, analysis and interpretation of data and drafting the article, revising it critically for important intellectual content.

F. Caillavet: revising draft critically for important intellectual content.

A. Lhuissier: revising draft critically for important intellectual content.

P. Chauvin: interpretation of data, revising draft critically for important intellectual content

Disclosure Statement

The authors declare that they have no conflict of interest.

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