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Multimorbidity and weight loss in obese primary care patients: longitudinal study based on electronic healthcare records

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ABSTRACT

Objective: To analyse the association between cardiovascular and mental comorbidities of obesity and weight loss registered in the electronic primary healthcare records.

Design and setting: Longitudinal study of a cohort of adult patients assigned to any of the public primary care centres in Aragon, Spain, during 2010 and 2011.

Participants: Adult obese patients for whom data on their weight were available for 2010 (n=62 901), and for both 2010 and 2011 (n=42 428).

Outcomes: Weight loss (yes/no) was calculated based on the weight difference between the first value registered in 2010 and the last value registered in 2011. Multivariate logistic regression models were adjusted for individuals' age, sex, total number of chronic comorbidities, type of obesity and length of time between both weight measurements.

Results: According to the recorded clinical information, 9 of 10 obese patients showed at least one chronic comorbidity. After adjusting for covariates, weight loss seemed to be more likely among obese patients with a diagnosis of diabetes and/or dementia and less likely among those with hypertension, anxiety and/or substance use problems ($p<0.05$). The probability of weight loss was also significantly higher in male patients with more severe obesity and older age.

Conclusions: An increased probability of weight loss over 1 year was observed in older obese male patients, especially among those already manifesting high levels of obesity and severe comorbidities such as diabetes and/or dementia. Yet patients with certain psychological problems showed lower rates of weight reduction. Future research should clarify if these differences persist beyond potential selective weight documentation in primary care, to better understand the trends in weight reduction among obese patients and the underlying role of general practitioners regarding such trends.

Strengths and limitations of this study

- Primary care databases offer great potential for capturing the constellation of comorbidities affecting people in the community.
- Such data are more informative of the real-life evolution of patients' health characteristics (such as their weight) compared to strictly designed clinical trials, offering broader opportunities to move towards patient-centred comparative effectiveness research.
- Nevertheless, the accuracy and completeness of diagnostic coding in primary care electronic health records rely on general practitioners' efforts and capacity that are often limited, especially regarding body mass index registration. This could derive in a potential selection bias which may limit the external validity of the present study.

BACKGROUND

While the positive association between severe obesity and premature death is clearly established,[1] the relationship of the former with coexisting comorbidities has been studied to a lesser extent. In a systematic review of multimorbidity indices, only 5 of the 39 studies included obesity.[2] However, a recent review of multimorbidity patterns found obesity to be associated with cardiometabolic, mental health and musculoskeletal disorders.[3] Indeed, obesity is an important independent predictor of disease clustering,[4] and has been previously described as being the entrance port to multimorbidity.[5] As the body mass index (BMI) increases, so does the probability of suffering multiple chronic conditions.[6] A study of the interactions between obesity and other primary care registered chronic conditions revealed unexpected associations beyond those related to the well-known metabolic syndrome.[3]

There is certainly a case for studying obesity from the perspective of its concomitant health problems. A study about obesity and functional impairment reported that the

relationship between both phenomena was primarily due to medical comorbid conditions.[7] Moreover, a large impact of obesity is derived from the psychosocial burden, a type of comorbidity that may affect adherence to medical care.[8] Nevertheless, the presence of weight-related comorbidity has been found to positively influence weight management in primary care.[9 10]

Despite its acknowledged impact on individuals' health, the documentation of BMI and obesity is generally poor in primary care.[6 11] Yet primary care registries are the preferred data source when studying population-level occurrence of multimorbidity, because large numbers of diverse patients are included.[12]

The aim of this study was to describe the association between cardiovascular and mental comorbidities of obesity and weight loss registered in electronic primary healthcare records.

METHODS

Longitudinal study of a population-based prospective cohort: The study population was conformed by all adult patients assigned to any of the public primary care centres in Aragon during 2010 and 2011, for whom data on their weight and height were available in 2010 (n=185 645; figure 1). With the aim of avoiding potentially erroneous data, we excluded those patients with weight or height values outside the ranges of 40–150 kg and 1.48–2 m, respectively.[13] The BMI was calculated for each individual, and subsequently grouped according to the categories established by the WHO: underweight (BMI <18.5); normal weight (BMI 18.5–24.9); overweight (BMI 25–29.9); obesity type I (BMI 30–34.9); obesity type II (BMI 35–39.9) and obesity type III (BMI ≥40).[14] For the present study, the first two categories, ie, underweight and normal weight, were collapsed.

Information on individuals' sex, age, comorbidities (coded according to the International Classification of Primary Care (ICPC)),[15] weight and height were extracted from the electronic medical records for 2010. To facilitate management of diagnostic information, diseases were grouped according to the Expanded Diagnostic Clusters (EDC) of the ACG system. This system groups ICPC codes into 260 EDCs based on the clinical, diagnostic and therapeutic similarities of diseases. The selection of chronic EDCs was based on a previously validated list containing 114 EDCs.[16] From the list of all prevalent and/or incident chronic EDCs occurring during 2010, only cardiovascular and mental health problems were selected because of (1) the high frequency of most of these comorbidities among the obese population and (2) their acknowledged impact on the clinical approach to obesity, according to the

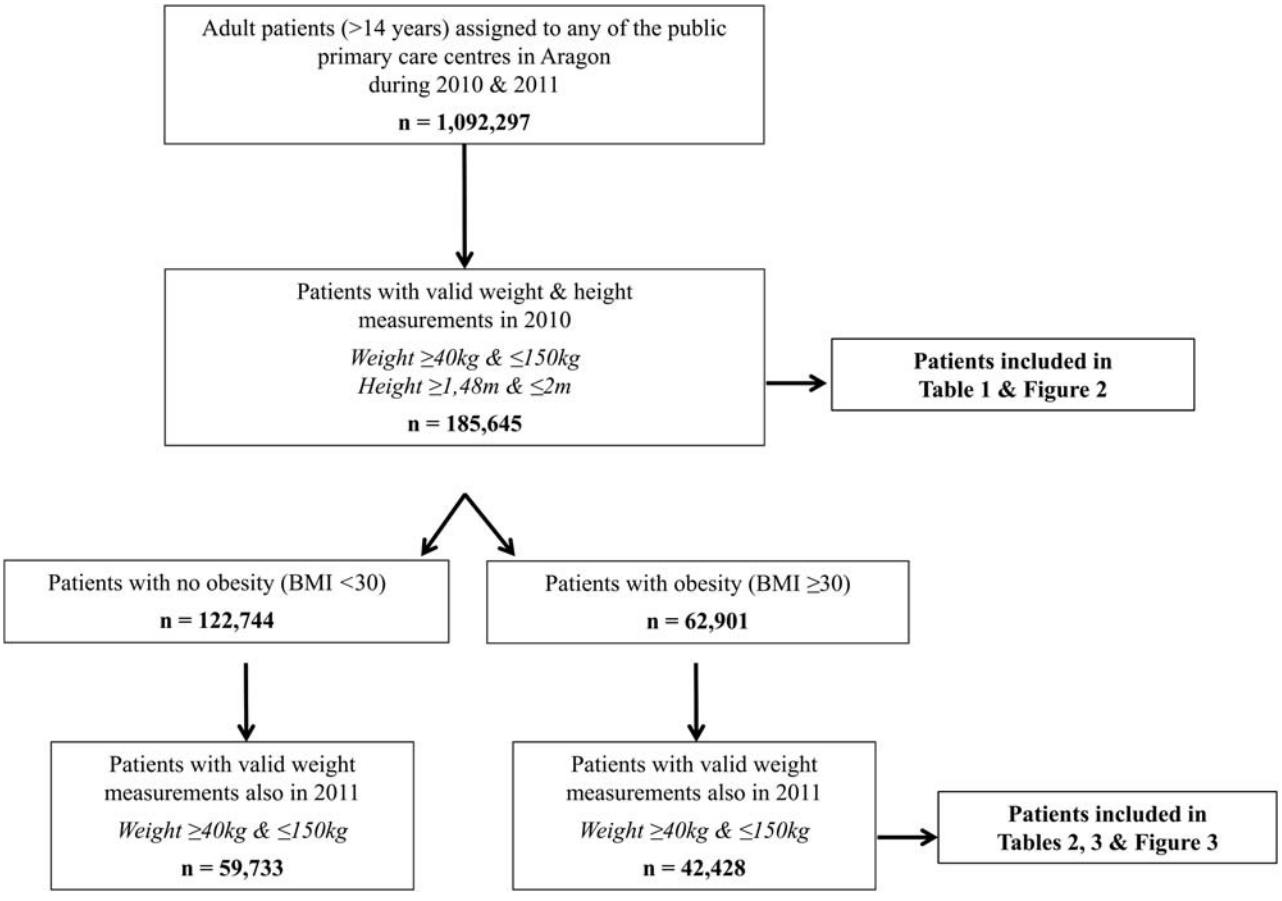

Figure 1 Flow chart for the study population (BMI, body mass index).

Table 1 Distribution of body mass index in the population according to demographic variables and number of comorbidities

	Normal weight (%)	Overweight (%)	Obesity type I (%)	Obesity type II (%)	Obesity type III (%)
n	49 902	72 842	44 619	13 738	4544
Sex					
Men	32.40	52.61	50.83	40.00	29.01
Women	67.60	47.39	49.17	60.00	70.99
Age group (years)					
15–44	48.00	18.07	12.81	15.42	19.54
45–64	27.20	33.47	34.07	37.22	42.56
≥65	24.80	48.47	53.12	47.36	37.90
Number of chronic comorbidities					
0	29.61	12.78	7.77	6.92	7.86
1	25.62	19.39	15.27	13.82	12.87
2	17	19.75	19.27	18	16.97
3	11.24	16.84	18.51	17.6	16.64
4	7.13	12.55	14.81	15.4	15.29
≥5	9.39	18.69	24.36	28.24	30.37
Mean (SD)	1.79 (1.87)	2.74 (2.08)	3.19 (2.13)	3.40 (2.20)	3.50 (2.31)

Number of observations=185 645 (patients for whom data on weight and height were available in 2010).

literature and a previous exploratory analysis performed by the research group (data not shown).

The outcome variable, weight loss (yes/no), was obtained only for those patients who suffered obesity in 2010 and for whom data on their weight were available for the following year (n=42 428; figure 1). It was calculated based on the weight difference between the first value registered in 2010 and the last value registered in 2011. No specific weight management interventions were being developed in primary care at the time of the study. Consequently, the results of this study are framed in the context of routine general practice.

The statistical analysis was carried out using STATA/IC V.12. Results were expressed as relative and absolute frequencies, and the association between comorbidity and the outcome variable was studied by means of a multivariate logistic regression model, adjusting for age, sex, total number of chronic comorbidities, type of obesity and length of time (in days) between both weight measurements. ORs and 95% CIs were calculated, and statistical significance was set at p<0.05.

RESULTS

More than half of the individuals for whom BMI data were available in 2010 were women (55%) and 43% were over 64 years. Women were over-represented among patients with obesity types II (60%) and III (71%). With regard to age, patients with overweight or obesity were mainly over 44 years, and those with normal weight were mainly under 45 years of age (table 1).

The percentage of patients with five or more chronic comorbidities became higher with increasing values of BMI. Nine of 10 obese patients showed at least one comorbidity. This proportion was still as high as 68% among those under 45 years of age. Almost two thirds of obese patients were diagnosed with hypertension (61%), 37% with dyslipidemia and 24% with diabetes (figure 2). These numbers were even higher among older individuals (77%, 41% and 29%, respectively), and as high as 57%, 23% and 18% among middle-aged individuals.

Over half of the obese patients (55%) lost weight between 2010 and 2011, with an average weight loss at least twice as high among patients with obesity type III (8 kg), as compared to those with type I (4 kg) and type II obesity (5 kg; table 2).

Weight loss was more frequently reported among obese patients with a diagnosis of diabetes (OR=1.14, p<0.05) and/or dementia (OR=1.31, p<0.05) after adjusting for sex, age, rest of the comorbidities, type of obesity and time between weight measurements. Yet, the likelihood for losing weight seemed to be between 12% and 3% lower in obese patients with hypertension (p<0.05). Mental health conditions, such as anxiety (OR=0.87, p<0.05) and substance abuse (OR=0.83, p<0.05), were also negatively associated with weight loss. The probability of weight loss was also significantly higher in older male patients, with more severe obesity and longer length of time between both weight measurements, according to BMI data recorded in the electronic medical records. The total number of chronic comorbidities was no longer significant after adjusting for the rest of the covariates (table 3).

Regarding patients with diabetes, those who had been diagnosed with diabetes in 2010 were more likely to reduce weight compared to those who had been diagnosed before 2010 (63% vs 57%, p<0.05). When stratifying the analysis by type of obesity, these differences were statistically significant for patients with diabetes with obesity types I (61% vs 55%, p<0.05) and II (65% vs 58%, p<0.05; figure 3).

DISCUSSION

In this study, 92% of obese patients attended to in primary care had associated comorbidity. The probability of weight loss among patients with hypertension,

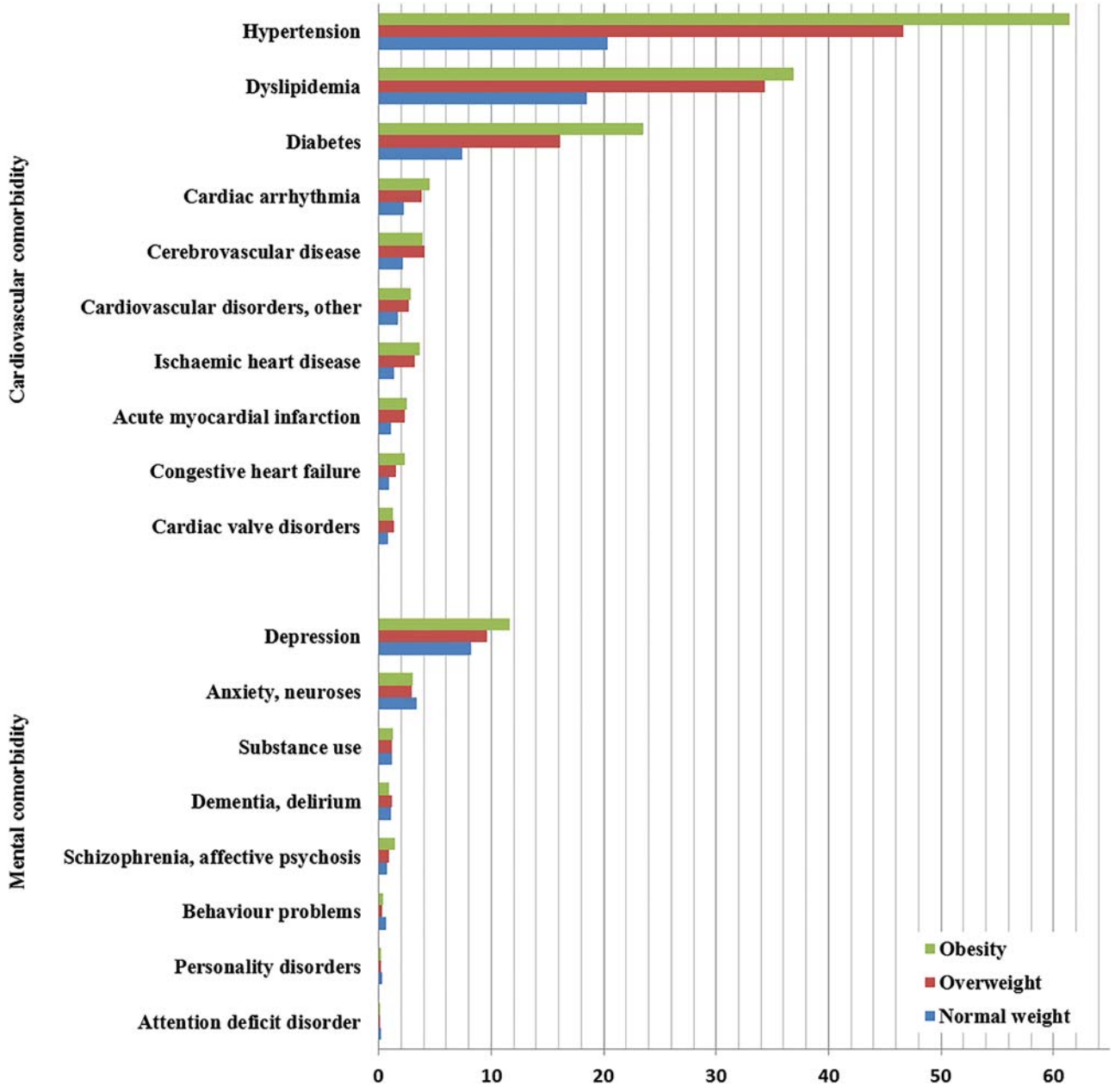

Figure 2 Prevalence (%) of cardiovascular and mental chronic comorbidities in patients with normal weight, overweight and obesity. Hypertension=hypertension with and without complications. Diabetes=diabetes types I and II with and without complications.

anxiety and/or substance use problems was 8%, 13% and 17% lower, respectively, compared to patients not presenting with such comorbidities. In contrast, obese patients with dementia and/or diabetes seemed to be more likely to lose weight from one year to another, especially if the latter had been diagnosed in the previous year. In addition, male sex, higher age, more severe obesity and longer time-length between weight measurements were all independently associated with weight loss according to the information recorded in the electronic medical records.

Primary care databases offer great potential for capturing the constellation of morbidities affecting people in the community.[17] Moreover, such data are more informative of the real-life evolution of patients' health characteristics (such as their weight) compared to strictly designed clinical trials, offering broader opportunities to move towards patient-centred comparative effectiveness research.[18] Nevertheless, the accuracy and completeness of diagnostic coding in primary care electronic health records rely on general practitioners' (GPs) efforts and capacity that are often limited, especially regarding BMI registration.[19] We could not address waist circumference, which is an important complementary parameter to assess metabolic health, given that it discriminates body fat from fat-free mass. It was not possible to include drug

Table 2 Weight differences between 2010 and 2011 in obese patients according to type of obesity, age group and main comorbidities

	N	Weight loss (%)	Weight gain (%)	No differences (%)	Average weight loss (kg)*
Type of obesity					
I	30 000	53.36	41.48	5.16	3.50
II	9412	56.57	39.22	4.22	4.81
III	3016	63.00	33.55	3.45	8.34
Age group (years)					
15–44	3018	53.48	41.55	4.97	6.92
45–64	13 635	53.00	42.37	4.63	4.58
≥65	25 775	55.83	39.25	4.92	3.70
No comorbidities	1168	54.21	39.02	6.77	5.81
Cardiovascular comorbidity					
Acute myocardial infarction	1182	54.74	41.20	4.06	4.15
Cardiac arrhythmia	2275	55.43	39.78	4.79	4.49
Cardiac valve disorders	621	55.39	40.42	4.19	4.41
Cardiovascular disorders, other	1357	55.78	38.76	5.45	4.28
Cerebrovascular disease	1938	57.12	38.96	3.92	4.06
Congestive heart failure	1134	56.26	39.15	4.59	5.03
Diabetes	12 012	57.44	38.37	4.19	4.09
Dyslipidemia	16 915	54.46	40.95	4.59	4.02
Hypertension	30 404	54.59	40.90	4.51	3.99
Ischaemic heart disease	1832	54.69	39.74	5.57	4.13
Mental comorbidity					
Anxiety, neuroses	1256	50.80	44.75	4.46	5.34
Attention deficit disorder	17	41.18	52.94	5.88	1.66
Behaviour problems	154	58.44	38.31	3.25	4.46
Dementia, delirium	380	61.58	33.42	5.00	4.60
Depression	5078	54.96	40.82	4.21	4.34
Personality disorders	84	54.76	41.67	3.57	5.23
Schizophrenia, affective psychosis	600	52.83	43.33	3.83	5.21
Substance use	497	50.10	45.07	4.83	4.37

Number of observations=42 428 (patients with obesity in 2010 for whom data on weight were available in 2011).
Hypertension=hypertension with and without complications.
Diabetes=diabetes types I and II with and without complications.
*Calculated exclusively for obese patients who lost weight between 2010 and 2011.

use data to shed light on the role of certain medications such as metformin on weight loss. Although the diagnostic information covered all prevalent and incident chronic conditions during 2010, we did not consider those new diagnoses occurring during 2011.

Obesity rarely appears as an isolated condition. However, the burden of multimorbidity in obese patients varies among studies. In a primary care-based study of adults over 30 years in the UK, between 69% and 79% of obese patients showed at least one additional comorbidity, depending on the type of obesity and sex.[6] In our study, the percentage of obese patients suffering from one or more chronic comorbidities rose to 92%, probably due to differences in the number of baseline chronic diseases considered (114 diseases in our study vs 11 diseases in the UK study). Similar results were reported in a Canadian study of the general adult population of Alberta,[4] which was based on a list of 14 baseline chronic conditions. In this study, a significantly higher mean number of chronic disease was reported in the obese population (1.9 diseases) compared to the non-obese population (1.0 diseases); these numbers were higher in our study (3.3 diseases and 1.8 diseases, respectively). Two recent survey-based studies[5 20] also showed a significant stepwise increase in the prevalence of the majority of chronic conditions, especially of cardiometabolic risk factors, from the lowest to the highest BMI category, although crude prevalences were lower than those obtained in our study. These differences may be related to the existence, in our study, of the so-called BMI recording and/or measurement bias in favour of those obese patients with a greater morbidity burden who see their GP more often.[11 21] Indeed, in a sensitivity analysis carried out comparing obese patients with and without BMI documentation (see online supplementary table S1), we found that the former were much older, suffered from a higher mean number of chronic comorbidities and had a higher prevalence for most of the studied physical conditions.

A loss of weight between both study years was recorded for only half of the obese patients studied. This finding could be in accordance with the debate regarding the inadequate recognition, documentation

Table 3 Multivariate logistic regression

	OR	p Value	95% CI	
Sex	0.95	0.02	0.92	0.99
Age group (years)				
45–64 vs 15–44	0.99	0.75	0.91	1.07
≥65 vs 15–44	1.12	0.01	1.03	1.22
Type of obesity				
II vs I	1.16	0.00	1.10	1.21
III vs I	1.54	0.00	1.42	1.66
Time between weight measurements (days)	1.00	0.00	1.00	1.00
Number of chronic comorbidities	0.99	0.45	0.98	1.01
Cardiovascular comorbidity				
Acute myocardial infarction	0.97	0.63	0.86	1.09
Cardiac arrhythmia	0.99	0.89	0.91	1.09
Cardiac valve disorders	1.01	0.88	0.86	1.19
Cardiovascular disorders, other	1.03	0.63	0.92	1.15
Cerebrovascular disease	1.08	0.11	0.98	1.19
Congestive heart failure	1.00	0.96	0.89	1.14
Diabetes	1.14	0.00	1.09	1.19
Dyslipidemia	0.98	0.31	0.94	1.02
Hypertension	0.92	0.00	0.88	0.97
Ischaemic heart disease	0.96	0.44	0.87	1.06
Mental comorbidity				
Anxiety, neuroses	0.87	0.02	0.77	0.97
Attention deficit disorder	0.58	0.28	0.22	1.54
Behaviour problems	1.16	0.37	0.84	1.60
Dementia, delirium	1.31	0.01	1.06	1.61
Depression	1.01	0.69	0.95	1.08
Personality disorders	1.04	0.88	0.67	1.60
Schizophrenia, affective psychosis	0.91	0.26	0.77	1.07
Substance use	0.83	0.04	0.69	0.99

Outcome variable: weight loss between 2010 and 2011 in obese patients (yes/no).
Number of observations=42 428 (patients with obesity in 2010 for whom data on weight were available in 2011).
Maximum likelihood test p<0.001.
Hypertension=hypertension with and without complications.
Diabetes=diabetes types I and II with and without complications.

and management of obesity by GPs.[10] GPs have a clear opportunity to early diagnose and treat this health problem in most segments of the population, and their expertise is highly regarded by patients.[22] Indeed, there is evidence indicating that patients receiving adequate weight reduction advice in primary care are more likely to reduce weight than those not receiving any counselling.[23]

In our study, older male patients with a higher level of obesity recently diagnosed from diabetes were more frequently reported to reduce weight from one year to another. In a German study about the management of obesity in primary care,[19] the presence of vascular complications associated with hypertension or diabetes seemed to slightly increase the likelihood of using weight reduction interventions. In a similar US study,[9] it was also stated that management of obesity occurred more frequently among patients with weight-related comorbidities such as diabetes, lipid disorders, hypertension or cardiovascular disease. The impact of weight loss regarding remission of diabetic symptoms in obese patients has been widely discussed,[24] and seemed to be a determining factor in our setting, especially if the diagnosis of diabetes was made in the previous year. However, that was not the case for the other cardiovascular comorbidities considered in our analyses. In fact, suffering from hypertension was negatively associated with reduction of weight, after adjusting for potential confounders. This finding requires further investigation. We hypothesised that the association between obesity and hypertension might not be as deep-rooted as thought, neither among physicians nor among patients. GPs may focus more on the pharmacological treatment of this risk factor, while patients could have a lower feeling of ill health compared to those suffering from a well-defined disease such as diabetes. Moreover, in patients with hypertension, nutrition counselling may be based on hyposodic rather than hypocaloric diets.

Dementia is a well-recognised source of weight loss. This may in part be explained by reduced food intake because of impaired autonomy, eating disturbances and reduced appetite.[25] In addition, neurodegenerative processes during the presymptomatic stage of the disease may be responsible for involuntary weight loss.[26]

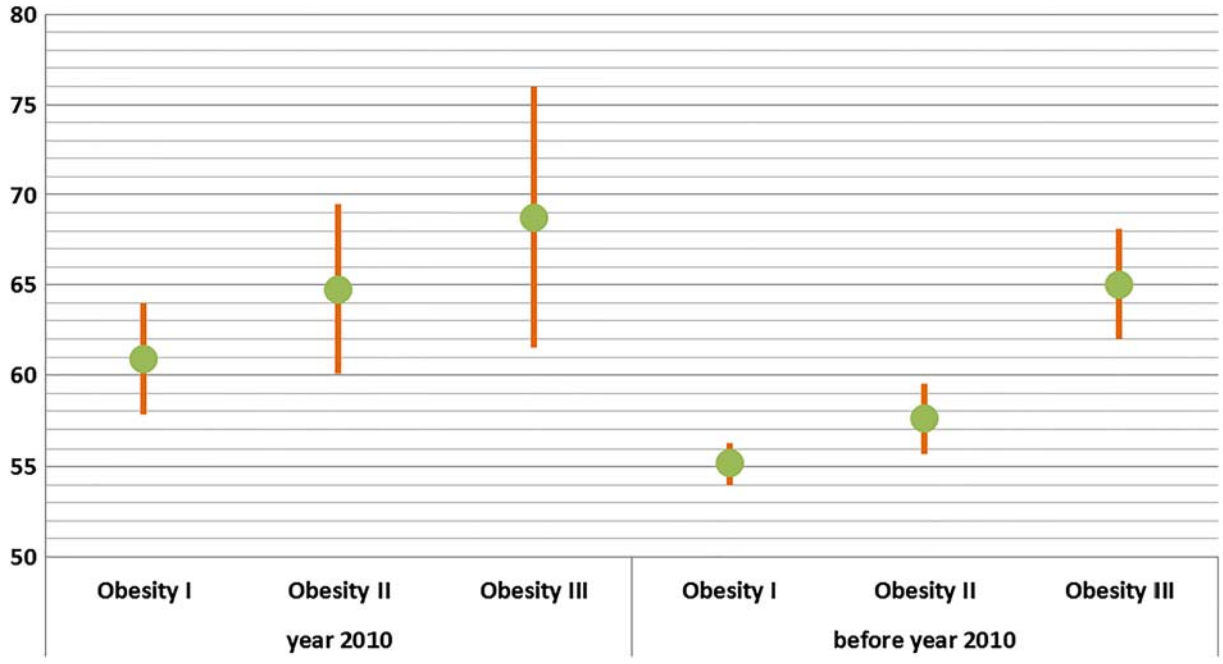

Figure 3 Proportion and 95% CI of obese patients with diabetes who lost weight between 2010 and 2011 according to the year of diagnosis of diabetes and type of obesity. Number of observations=12 012 (patients with obesity and diabetes in 2010 for whom data on weight were available in 2011, and who lost weight between both years).

Involuntary weight loss is also associated with cholinesterase inhibitors in dementia.[27] There is evidence for a higher risk for mental disorders, such as anxiety, in obese individuals.[28] Comorbid anxiety has also been shown to negatively influence the course of weight in treated and untreated patients.[29] Moreover, substance use (ie, drug and alcohol) problems may be associated with the development of other detrimental lifestyles, such as an unhealthy diet and lack of physical activity, which may increase the risk of obesity, especially during youth.[30] This could also be the reason for the poorer weight reduction outcomes among substance users observed in our study.

Presenting with multiple comorbid conditions has been shown to be positively associated with receiving advice to lose weight,[31–33] although only about half of these patients actually received such advice from their physician.[34] In our study, when considering cardiovascular and mental comorbidities of obesity, the total number of comorbidities itself was no longer significantly associated with weight loss. This was probably because we had already included a wide range of chronic conditions in the regression model, neutralising the explanatory power of the synthetic variable, that is, number of total comorbidities.

According to Bramlage *et al*,[19] younger overweight and/or obese patients up to grade I were recognised and diagnosed considerably less frequently than older patients and/or those with more severe obesity, which may explain the lower weight loss rates documented for these population groups in this study. The association of older age with greater weight loss may be related to muscle loss rather than fat loss, especially in the very elderly. Moreover, the larger weight loss among individuals with higher grades of obesity could also be explained by regression to the mean. According to the study aforementioned, although women had a higher probability to be diagnosed as overweight or obese than men, the latter were more likely to use weight reduction measures,[19] which may also elucidate our findings. This could be explained by women's role as informal carers of family members, which may be at the expense of their own health attitudes.

Perspective

Obesity, which is reaching epidemic proportions globally,[35] increases the risk of suffering from numerous chronic comorbidities, many of which are life-limiting at premature ages[36] and responsible for the largest part of the total health costs due to this health problem.[37] Therefore, measurement of BMI and clinical recognition of obesity should be used to identify patients at high risk of multimorbidity in primary care.

The results of our study describe trends in weight loss within the community according to information registered by GPs. For example, we observed an apparently increased probability of weight loss over 1 year in older obese male patients, and particularly those already manifesting high levels of obesity and severe comorbidities such as diabetes or dementia. In contrast, patients with certain psychological problems showed lower rates of weight reduction. Future research should clarify if these differences persist beyond potential selective weight documentation by GPs. Understanding the trends in weight reduction among obese patients, and the role of

GPs underlying these trends, could orientate future primary care strategies.

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Contributors AC-L, FG-R, LAG-F and AP-T generated the research question. BP-P processed the data and PH-O carried out the statistical analyses. AC-L, PH-O, FG-R, LAG-F, BP-P and AP-T participated in the interpretation and discussion of results. AC-L drafted the manuscript which was revised and approved by the rest of the authors.

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Competing interests None.

Ethics approval This study was approved by the Ethics Committee of Clinical Research of Aragon (CEICA, for its initials in Spanish), which waived the need for written patient consent because the study was based on the statistical analysis of anonymous data.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The technical appendix, statistical code and data set are available from the corresponding author on request.

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