Public Health (2007) **121**, 497–509

ELSEVIER

PUBLIC HEALTH
JOURNAL OF THE ROYAL INSTITUTE OF PUBLIC HEALTH
www.elsevierhealth.com/journals/pubh

Original Research

Obesity and health in Europeans aged 50 years and older

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Received 19 April 2006; received in revised form 16 September 2006; accepted 16 November 2006

KEYWORDS
Body Mass Index;
International comparisons;
SHARE

Summary *Background:* Obesity is increasing globally across all population groups. Limited data are available on how obesity patterns differ across countries.
Objective: To document the prevalence of obesity and related health conditions for Europeans aged 50 years and older, and to estimate the association between obesity and health outcomes across 10 European countries.
Methods: Data were obtained from the 2004 Survey of Health, Ageing and Retirement in Europe, a cross-national survey of 22 777 Continental Europeans over the age of 50 years. The health outcomes included self-reported health, disability, doctor-diagnosed chronic health conditions and depression. Multivariate regression analysis was used to predict health outcomes across weight classes (defined by body mass index [BMI] from self-reported weight and height) in the pooled sample and individually in each country.
Results: The prevalence of obesity (BMI $\geqslant$ 30) ranged from 12.8% in Sweden to 20.2% in Spain for men and from 12.3% in Switzerland to 25.6% in Spain for women. Adjusting for compositional differences across countries changed little in the observed large heterogeneity in obesity rates throughout Europe. Compared with normal weight individuals, men and women with greater BMI had significantly higher risks for all chronic health conditions examined except heart disease in overweight men. Depression was linked to obesity in women only. Particularly pronounced risks of impaired health and chronic health conditions were found among severely obese people. The effects of obesity on health did not vary significantly across countries.
Conclusions: Cross-country differences in the prevalence of obesity in older Europeans are substantial and exceed socio-demographic differentials in excessive body weight. Obesity is associated with significantly poorer health outcomes among Europeans aged 50 years and over, with effects similar across countries. Large

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doi:10.1016/j.puhe.2006.11.016

heterogeneity in obesity throughout Europe should be investigated further to identify areas for effective public policy.

Introduction

Over the past several decades, obesity has been increasing worldwide in virtually all population groups.[1–6] The growth in the population fraction with unhealthy body weight was particularly high in the USA, although it has also reached worrisome proportions in other developed and developing countries.[7] About two-thirds of US adults aged 20 years and older are now either overweight or obese (defined as having a body mass index [BMI] of 25 kg/m^2 and above) and about 30% are obese (BMI $\geqslant$ 30 kg/m^2).[2] On a global scale, more than 1 billion adults are estimated to be overweight, with at least 300 million of them qualifying as obese.[7] High prevalence of overweight among children is another disturbing trend in countries throughout the world.[5,8–11]

In this study, we examined the relationship between obesity, general health, disability and chronic health conditions in older Europeans. The link between excessive body weight and health is an important concern for public health policy because obesity has considerable implications for morbidity and quality of life of obese individuals, and an attendant increase in healthcare costs. Obesity is an established risk factor for many highly prevalent, mortality-driving and costly diseases, such as cardiovascular disease, diabetes and some types of cancer.[7,12–14] Through poorer health and disability, it increases the financial burden of public transfer programmes and private health plans. The costs are large. At the individual level, obesity is related to healthcare expenditures that are, on average, about one-third above medical costs of otherwise similar individuals with normal weight.[15,16] This exceeds the effect of smoking or problem drinking on healthcare costs.[15] At the aggregate level, obesity accounts for about 6–10% of national healthcare spending in the USA[16–18] and 2.0–3.5% in other developed countries.[19–22] The rising trends in obesity can explain 27% of the growth in real healthcare spending over 1987–2001.[23]

The focus of this research is on adults aged 50 years and older. For a number of reasons, including the biology of aging, age-related changes in physical activity and calorie consumption, the health effects of obesity probably vary over the life cycle. For example, they are more likely to develop in middle age.[14] Therefore, generalizations from the overall population may be inaccurate for predicting health consequences of obesity in older adults. At the same time, understanding the effects of obesity on health and related outcomes among middle-age individuals and elderly people is important because this population will be a long-time beneficiary of public programmes that already pay for around half of medical expenditures attributable to overweight and obesity in the USA.[16] The available data on obesity implications for mortality and morbidity among older adults are inconclusive, particularly for longevity among obese elderly people.[24–27] This study can help to more accurately predict the health risks of obesity at older ages that would be of interest to public and private health plans.

This analysis is one of few to apply a cross-national perspective to the study of obesity risks, and the first to do so for older adults. Despite the potential of comparative analysis to learn from institutional, cultural and socio-demographic differences across nations, multinational comparisons of obesity remain scarce. The best-known cross-national estimates of obesity to date are studies among children,[8–11] and data from the World Health Organization (WHO) MONICA (Multinational monitoring of trends and determinants in cardiovascular disease) project in 21 countries for adults aged 25–64 years.[28–31] Recent additions to empirical research on obesity in Europe are cross-national comparisons of obesity in adults aged 15–75 years using data from the European Community Household Panel for nine European Union member states[32] and estimates for the adult population (age 15 years and over) in 15 European Union countries.[33]

In this study, we used data from the 2004 Survey of Health, Ageing and Retirement in Europe (SHARE) to document the prevalence of obesity and related chronic health conditions in the population among people aged 50 years and over in 10 European countries. We examined the association between obesity, major chronic illnesses, self-reported health and disability, and studied whether it varied across the SHARE countries. We evaluated whether differences in the socio-demographic composition of the countries could explain large heterogeneity in the prevalence of obesity among older Europeans.

Data and methods

Data were obtained from SHARE, which collected information on nationally representative samples of the community-based population aged 50 years and older in Continental Europe. The baseline 2004 SHARE study included data on 11 countries that featured a balanced representation of the different European regions from Scandinavia (Denmark and Sweden) through Central Europe (Austria, France, Germany, Switzerland, Belgium, The Netherlands) to the Mediterranean (Spain, Italy and Greece). This study used data from the 2004 SHARE sample (Release 1 of April 28th, 2005), which included all participating countries, with the exception of Belgium.

The key advantage of this cross-national data is that it provides nationally comparable information on Europeans over the age of 50 years and their spouses that was collected in all countries following a standard protocol and research design. SHARE also contains detailed information on many different aspects of older individuals' lives that few other large data sets have. These include health (e.g. self-reported health, grip strength, physical and cognitive functioning, health behaviours and healthcare use), psychological conditions (e.g. mental health, well-being and life satisfaction), socio-economic status (e.g. work activity, job characteristics, wealth and consumption, housing, and education), and social support (e.g. social networks and volunteer activities). Designed on the basis of the US Health and Retirement Study and the English Longitudinal Study of Ageing, SHARE will be collecting data on older individuals over time. This study uses data from the first wave in 2004. The longitudinal aspect of SHARE will be valuable for research as more waves become available.

The survey used computer-assisted personal interviewing methods in autumn 2004 among participants drawn from probability samples in all participating countries. The sampling plan followed a complex probabilistic multistage design to produce estimates representative of the non-institutionalized population aged 50 years and over in each country. The study also interviewed spouses younger than 50 years. The response rate varied by country but, on average, was 61.8% for households and 86% for individuals within participating households.[34,35] A detailed description of the SHARE data and methodology was published elsewhere.[35] The data are available to registered users from the SHARE website (http://www.share-project.org).

The 2004 SHARE Release I sample included 22 777 respondents from 10 European countries. We imposed several sample restrictions. First, we excluded individuals younger than the age of 50 years (759 observations or 3.3% of the original sample). The second exclusion (1009 observations or 4.4% of the original sample) was for data with missing responses on predictors and key outcomes. Owing to these selections, 21 009 individuals remained eligible for the analysis (9652 men and 11 357 women).

We compared the estimates of obesity in older adults in SHARE with attendant statistics for the general population from the WHO and the International Obesity TaskForce. Although collected for a different age group than in SHARE, the data seem to accord well across sources, particularly for men. The correlation between average BMI per country in SHARE and estimates from the national surveys presented in the World Health Organization Global InfoBase (IOTF) is 0.68 ($P<0.05$) for men and 0.43 for women. The correlation for obesity prevalence is 0.63 ($P<0.05$) for men and 0.52 for women in the WHO-SHARE comparisons, and correspondingly 0.61 ($P<0.05$) and 0.59 for the IOTF-SHARE. Perhaps reflecting cohort effects, obesity rates in older adults are notably above the general population prevalence in some countries (e.g. Spain: 23% vs 15%). Nevertheless, the top five countries with high obesity rates in SHARE and IOTF are the same countries for women and three out of five for men.

Outcomes

Health outcomes

The vector of health outcomes is three-fold and includes self-assessment of general health status and daily functioning, chronic health conditions and emotional health. The measure of overall health is based on subjective evaluation of health by respondents, which they reveal in answering the survey question 'Would you say your health is excellent, very good, good, fair, or poor?' By collapsing responses, we were able to construct an indicator for fair or poor self-reported general health vis-à-vis better health. Disability evaluation was based on responses regarding limitations with activities of daily living (ADL), with at least one limitation indicating disability.

Among the reported health ailments, we examined five chronic health conditions that have links with obesity in the literature. These are doctor-diagnosed chronic diseases, which are self-reported in the survey question: 'Has a doctor ever told you that you have any of these conditions…' such as: (1) diabetes or high blood sugar (the type of

diabetes was not assessed); (2) cardiovascular disease (a heart attack, including myocardial infarction, coronary thrombosis or any other heart problem, including congestive heart failure); (3) high blood pressure or hypertension; (4) high blood cholesterol; and (5) arthritis, including osteoarthritis or rheumatism. We constructed five indicators for these chronic illnesses.

Finally, we used the depression scale EURO-D to evaluate how obesity is related to emotional health or depression. The EURO-D depression scale, validated in an earlier cross-European study,[36,37] was based on categorical responses about individual experiences of emotional problems in the month before the interview. The 12 feelings included sadness or depression, pessimism, suicidality, guilt, sleep trouble, interest, concentration, appetite, irritability, fatigue, enjoyment and tearfulness. The threshold for depression was scoring 4 and above on the EURO-D depression scale.

Explanatory variables

Obesity

The variable of primary interest was a measure of relative body weight. Individuals were classified into weight categories based on their BMI (weight in kilograms divided by the square of height in metres) calculated from self-reported weight and height. This measurement approach is based on the clinical guidelines for the classification of overweight and obesity in adults, published by the National Heart, Lung and Blood Institute of the National Institutes of Health.[38] According to these guidelines, individuals are stratified into six weight classes depending solely on their BMI: underweight (BMI $<$ 18.5); normal weight (BMI 18.5–24.9); overweight (BMI 25.0–29.9); moderate obesity (BMI 30.0–34.9); severe obesity (BMI 35.0–40.0), and extreme obesity (BMI 40.0+). Much of the empirical work on obesity focuses on the aggregate group of adults with a BMI of 30 and above, which is a likely result of the paucity of data on very high BMI or the convenience of generalizing results for all obese people. We separated the obesity group (BMI $\geqslant$ 30) into moderate (BMI 30–34.9) and severe obesity (BMI $\geqslant$ 35) to account for non-linear effects of obesity on health. Previous research showed that severe obesity is associated with more chronic health problems than moderate obesity, and its onset is at earlier ages.[39] As a result, there are large differences across the obesity groups in healthcare utilization and costs.[40] The sample size of people with BMI $\geqslant$ 40 was too small to enable meaningful estimation.

Socio-demographic covariates

A variety of individual level variables were included as controls in the estimation. Socio-demographic covariates were presented by educational achievement (secondary and tertiary education, primary or no education is a reference group), marital status (married and living together with a spouse or registered partnership), household income (an inverse of a hyperbolic sine of annual household income before taxation), and age (5-year increment age groups up to the age of 85 years and over). Current and past smoking was controlled in all models. We included country fixed effects in the estimation on the pooled sample of all countries. Interactions between weight classes and country dummies were tested to compare the gradient of obesity and health across countries.

The means for independent variables by BMI group and gender are shown in Table 1.

Analytic procedure

We pooled the SHARE data across all countries and conducted all analyses separately for men and women. To account for the complex sampling design and obtain nationally representative estimates, we used individual sample weights when presenting sample statistics but not in regression analysis. The Huber–White non-parametric correction produced robust standard errors. We conducted statistical testing of differences between the national means and the sample average for all prevalence statistics. We used logistic regression to generate the odds ratio (ORs) for the association between weight classes and health outcomes. We replicated all regression analyses in the pooled sample and separately by country. We tested whether the observed cross-country differences in obesity were generated by socio-demographic variation across countries comparing the non-adjusted ORs (based on descriptive statistics) and adjusted ORs (based on results from multivariate logistic regression) for obesity across countries and population groups. We checked robustness of our results to the inclusion of physical activity. This exercise evaluated the effect of excessive body weight on health independent of physical activity.

Results

Patterns in obesity and related health outcomes

The prevalence of overweight and obesity in Europeans older than 50 years is high, particularly

Table 1 Socio-demographic characteristics of the sample by body mass index group.

	Sample size	Underweight BMI < 18.5	Normal weight BMI 18.5–24.9	Overweight BMI 25–29.9	Moderately obese BMI 30–34.9	Severely obese BMI 35+
Men ($n = 9652$)						
Age (years)						
50–64	5180	0.2	32.4	50.9	13.3	3.1
⩾65	4472	0.9	34.6	48.6	13.3	2.7
Highest education						
Primary or lower	4370	0.6	31.1	49.1	15.5	3.7
Secondary	3150	0.6	32.9	50.9	12.9	2.7
Tertiary	2132	0.0	39.1	49.7	9.5	1.6
Marital status						
Married/partnered	7879	0.3	32.7	50.5	13.8	2.7
Single/divorced	1773	0.9	35.6	47.8	11.9	3.7
Smoking status						
Current	2304	0.6	37.8	47.4	11.1	3.1
Past	3913	0.5	29.3	51.9	15.0	3.3
Never	3435	0.4	35.0	49.3	12.9	2.4
Total	9652	0.5	33.4	49.8	13.3	2.9
Women ($n = 11\,357$)						
Age (years)						
50–64	6088	1.5	45.3	35.2	13.2	4.8
⩾65	5269	2.3	43.1	36.9	13.8	3.9
Highest education						
Primary or less	6485	1.8	39.8	37.9	15.5	4.9
Secondary	3143	1.9	45.8	35.8	12.7	3.8
Tertiary	1729	2.5	58.8	28.9	6.8	2.9
Marital status						
Married/partnered	7290	1.4	43.5	37.3	13.7	4.1
Single/divorced	4067	2.5	44.8	34.7	13.4	4.6
Smoking status						
Current	1831	4.1	51.9	31.9	9.6	2.6
Past	1997	2.2	44.8	35.1	13.1	4.8
Never	7529	1.5	42.6	37.0	14.3	4.5
Total	11 357	1.9	44.1	36.1	13.5	4.3

Data are presented as percentages. The reported estimates are weighted.
BMI: body mass index.

in some countries. On average, only one-third of men (33.4%) qualify as normal weight, whereas more women (44.1%) are normal weight based on the standard BMI criteria. Among men with weight above normal, 13.3% are moderately obese and almost 3% are severely obese. For women, the prevalence rate is similar for moderate obesity (13.5%) and slightly higher than in men for severe obesity (4.3%). The socio-demographic profile of the BMI distribution is comparable to the patterns established in earlier studies and in the US data, such as higher obesity rates among less educated people and lower prevalence of obesity among current smokers (Table 1).

The rates of unhealthy body weight vary substantially across European countries (Table 2). Spain has the highest prevalence of obesity among men (20.2%) and women (25.6%), and almost twice the rate of severe obesity among women than the sample average (7.5% vs 4.3%, $P < 0.01$). Men are least likely to qualify as moderately or severely obese in Sweden (12.8%) whereas, for women, this is true of Switzerland (12.3%, less than half of the obesity rate in Spain). When the prevalence of normal weight men are compared, the Nordic countries (Denmark and Sweden), the Netherlands and Switzerland have rates above the average ($P < 0.01$). Normal weight women are more likely to live in the Nordic countries, Switzerland, France and less likely in Southern Europe ($P < 0.01$).

We tested whether the observed cross-country differences in the prevalence of obesity were driven by socio-demographic differences in the composition of the nations. Adjusting for age,

Table 2 Distribution of body mass index groups by country.

	Sample size	Underweight BMI < 18.5	Normal weight BMI 18.5–24.9	Overweight BMI 25–29.9	Moderately obese BMI 30–34.9	Severely obese BMI 35+
Men ($n = 9652$)						
Austria	798	0.3	29.8[a]	51.9	14.5	3.4
Denmark	735	0.6	40.1[b]	45.3[a]	11.8	2.2
France	734	0.6	36.0	48.3	12.3	2.8
Germany	1352	0.4	31.7	50.9	14.0	2.9
Greece	877	0.1[a]	28.6[b]	54.5[a]	14.5	2.3
Italy	1106	0.6	34.1	50.1	12.4	2.8
Netherlands	1314	0.3	38.1[b]	48.5	11.1[a]	1.9[a]
Spain	937	0.6	29.2[b]	49.9	16.2[a]	4.0
Sweden	1368	0.6	39.5[b]	47.1	10.4[b]	2.4
Switzerland	431	0.4	39.9[b]	46.6	11.1	1.9
Total	9652	0.5	33.4	49.8	13.3	2.9
Women ($n = 11\,357$)						
Austria	1069	1.5	43.4	35.4	15.9[a]	3.8
Denmark	834	4.2[b]	51.5[b]	31.0[b]	10.9[a]	2.4[b]
France	891	3.6[b]	51.2[b]	30.1[b]	11.2[a]	3.9
Germany	1539	1.2[a]	43.6	37.8	13.2	4.2
Greece	1033	0.9[a]	35.2[b]	41.9[b]	16.9[b]	5.0
Italy	1347	2.3	44.3	36.4	13.7	3.4
Netherlands	1436	1.4	46.1	36.0	12.1	4.4
Spain	1218	0.5[b]	32.4[b]	41.5[b]	18.1[b]	7.5[b]
Sweden	1524	2.2	49.5[b]	33.8	11.6[a]	2.8[b]
Switzerland	466	3.4	55.3[b]	29.1[b]	9.4[b]	2.9
Total	11 357	1.9	44.1	36.1	13.5	4.3

Data are presented as percentages. The reported estimates are weighted.
[a]Significantly different from the sample mean at the 5% level.
[b]Significantly different from the sample mean at the 1% level.

education, marital status and smoking (based on a logistic regression for obesity defined by BMI $\geqslant$ 30) did not reduce the magnitudes notably (results not presented). The largest change after the compositional adjustment was for obesity in Spain relative to Switzerland. The unadjusted OR for men was 1.71, which the adjustment for socio-demographic covariates reduced to 1.43 ($P<0.01$). Similarly, the unadjusted OR for women in Spain relative to Switzerland was 2.57, which was reduced to 2.22 ($P<0.01$) after adjusting for socio-demographics. The unadjusted OR for women with the least education relative to the highest educational level was 2.19, which, after adjusting for other individual characteristics and the country of residence grew to 2.21 ($P = 0.73$). The OR for the comparison of the least educated and the most educated men was 1.99 in the non-adjusted statistics and 2.31 in the regression framework ($P<0.01$).[a]

Cross-country differences in the prevalence of major chronic health conditions are also substantial (Table 3).[b] Some of them may be related to cross-country variation in obesity. For example, the prevalence of diabetes in Spain, the country with the highest obesity rates, is 14.3% for men and 13.1% for women. These rates are twice lower in Switzerland (7.2% men; 4.1% women), which is the country with the lowest obesity rates. The link to obesity is less apparent for some other chronic health conditions. Cholesterol levels are often high in France, but the prevalence of obesity is relatively low. Heart disease is most often reported in Sweden where obesity is not a prevalent condition. Cross-country differences in other risk factors and the socio-demographic composition of the population may account for the observed

[a]We tested the null hypothesis that the odds ratio was the same before and after adjusting for socio-demographic covariates. This was done using a minimum distance test comparing

(*footnote continued*)
the difference between the two estimates (Hausman J. Specification tests in econometrics. *Econometrica* 1978;**46**:125–171).

[b]See Ref.[41] for a SHARE-based analysis of the prevalence of health conditions and socio-economic status.

Table 3 Prevalence of obesity-related health outcomes by country.

	Poor/fair self-reported health	Percent with any ADL limitation	Diabetes	High cholesterol	Hypertension	Arthritis	Heart disease	Depression
Men ($n = 9652$)								
Austria	27.7[a]	8.1	9.9	16.9	27.0[b]	7.9[b]	11.5	12.4[b]
Denmark	24.0[b]	9.5	8.1[b]	17.4	30.7	19.4[b]	9.7[b]	13.9[b]
France	31.1	12.8[b]	10.8	23.2[b]	26.9[b]	23.5[b]	17.0[b]	21.9[b]
Germany	37.1[b]	8.3	11.0	18.1	33.5[b]	9.1[b]	13.5	12.6[b]
Greece	25.2[b]	6.4[b]	8.6[b]	19.5	32.2	9.6[b]	14.9	12.8[b]
Italy	32.3	9.7	12.6	17.3	36.6[b]	18.8[b]	11.4	23.4[b]
Netherlands	25.4[b]	6.3[b]	7.8[b]	16.3[b]	22.5[b]	5.5[b]	13.4	15.8
Spain	34.4	9.2	14.3[b]	22.9[b]	26.7[b]	18.8[b]	11.4	20.9[b]
Sweden	10.6[b]	7.8	9.8	16.4[b]	27.6[b]	5.9[b]	20.1[b]	12.7[b]
Switzerland	13.8[b]	4.4[b]	7.2[b]	15.7[b]	28.7	7.1[b]	8.5[b]	11.2[b]
Total	31.7	9.3	11.3	19.4	30.9	14.9	13.5	17.8
Women ($n = 11\,357$)								
Austria	30.7[b]	11.5	8.1[b]	15.6[b]	34.3	13.4[b]	7.9	26.0[b]
Denmark	25.3[b]	10.1	6.7[b]	13.7[b]	28.4[b]	32.5[b]	7.4[b]	21.6[b]
France	35.4[b]	12.5	7.9[b]	25.9[b]	33.3	38.1[b]	10.5	42.5[b]
Germany	42.4[b]	12.1	12.9[b]	18.8	38.2[b]	14.4[b]	10.1	27.4[b]
Greece	36.6	11.5	8.9	22.1	41.1[b]	25.1	9.9	34.8
Italy	45.6[b]	12.5	11.1	19.7	36.2	36.6[b]	8.0	40.5[b]
Netherlands	28.6[b]	9.5[b]	8.7[b]	13.3[b]	27.6[b]	13.5[b]	8.1	25.4[b]
Spain	47.6[b]	13.2	13.1[b]	25.0[b]	37.6	35.0[b]	10.6	46.1[b]
Sweden	15.4[b]	11.7	7.8[b]	16.4[b]	29.4[b]	13.8[b]	14.6[b]	27.3[b]
Switzerland	17.8[b]	8.3[b]	4.1[b]	9.8[b]	23.2[b]	14.8[b]	5.2[b]	23.1[b]
Total	39.6	12.1	10.7	20.5	35.5	26.8	9.6	35.4

Data are presented as percentages. The reported estimates are weighted. ADL: activities of daily living.
[a]Significantly different from the sample mean at the 5% level.
[b]Significantly different from the sample mean at the 1% level.

disparities in the rate of obesity and some chronic health conditions. For example, high rates of heart disease in Sweden most likely reflect an older sample in the country: the proportion aged 75+ and 80+ Swedes is the highest in SHARE, and aging is a known factor of heart disease.

Relationship between obesity and health outcomes

Regression analysis confirms descriptive results on obesity and health. Compared with normal weight people, men and women with BMI of 30 and above are significantly more likely to have adverse health outcomes, such as ADL-disability, major chronic health conditions and poor general health (Table 4). Severely obese women report poor or fair health status almost twice as often as women of normal weight (90%, $P<0.01$), which accords with estimates from earlier studies and the US data.[13,42] Among men, the most prevalent adverse self-reports of health are predicted in the underweight group (106% vs normal weight, $P<0.01$). The estimates for ADL-disability reveal a similar pattern of the least healthy men among underweight people and the least healthy women among severely obese people. Another gender-related difference in the effect of excessive body weight on health is that overweight men report poor health as often as normal weight men (30.2% vs 30.1%), whereas overweight is a significant risk factor for poor self-reported health in women (38.8% vs 33.8%, $P<0.01$).

Both overweight and obesity are associated with chronic health conditions, such as diabetes, high blood cholesterol, hypertension and arthritis in men and women (Table 4). Compared with older women of normal weight, women with BMI of between 30 and 34.9 are three times more likely to have diabetes and almost twice as likely to report hypertension. The effects for men are somewhat smaller, yet still substantial; for example, about 140% higher rates of diabetes and 96% of hypertension among moderately obese vs normal weight men. Similar to earlier studies, this analysis reveals

Table 4 Health risks of obesity in men and women aged 50 years and over.

	Underweight BMI<18.5	Normal weight BMI 18.5–24.9	Overweight BMI 25–29.9	Moderately obese BMI 30–34.9	Severely obese BMI 35+
Men ($n=9652$)					
Poor or fair self-reported health	4.41 (3.66)	1.00	0.99 (−0.09)	1.61 (6.14)	2.49 (6.29)
Percent with any ADL limitation	5.03 (3.92)	1.00	1.06 (0.67)	1.69 (4.42)	2.91 (5.48)
Diabetes	2.15 (1.72)	1.00	1.56 (5.18)	2.74 (9.66)	4.19 (8.52)
High cholesterol	0.56 (−0.93)	1.00	1.42 (5.62)	1.55 (5.09)	1.90 (4.15)
Hypertension	0.59 (−1.12)	1.00	1.70 (9.88)	2.82 (13.87)	4.04 (9.79)
Arthritis	1.22 (0.42)	1.00	1.21 (2.63)	1.57 (4.49)	1.82 (3.19)
Heart disease	0.87 (−0.30)	1.00	1.12 (1.70)	1.57 (4.69)	1.56 (2.35)
Depression	4.19 (3.89)	1.00	0.88 (−1.96)	1.08 (0.79)	1.48 (2.40)
Number of observations	37	3270	4847	1245	253
Women ($n=11\,357$)					
Poor or fair self-reported health	2.25 (5.18)	1.00	1.28 (4.93)	2.19 (11.85)	4.09 (13.42)
Percent with any ADL limitation	2.26 (4.08)	1.00	1.32 (3.49)	2.09 (7.54)	4.20 (10.64)
Diabetes	0.62 (−1.21)	1.00	1.92 (7.54)	3.59 (12.80)	6.02 (13.54)
High cholesterol	0.50 (−2.68)	1.00	1.25 (3.95)	1.41 (4.56)	1.43 (3.06)
Hypertension	0.56 (−3.02)	1.00	1.82 (12.52)	2.71 (15.76)	4.65 (14.63)
Arthritis	0.74 (−1.52)	1.00	1.22 (3.59)	1.69 (7.58)	2.34 (7.73)
Heart disease	1.11 (0.43)	1.00	1.24 (2.68)	1.75 (5.63)	2.01 (4.48)
Depression	1.39 (2.13)	1.00	1.07 (1.47)	1.37 (4.82)	1.99 (6.71)
Number of observations	205	4965	4147	1562	478

Data are presented as fully adjusted odds ratio with z-statistic in parentheses from multivariate logistic regression (age, education, household income, marital status, smoking status, and country dummies included). ADL: activities of daily living.

considerable differences in health risks related to excessive body weight by degree of obesity.[13,14,40,42] Individuals with BMI $\geqslant$ 35 kg/m^2 have notably higher odds than obese people with BMI of 30–34.9 kg/m^2 for all examined chronic conditions except for heart disease in men, poor health and ADL-disability. The interactions between country indicators and weight groups (in different specifications that we tried) were not statistically significant for all health measures.

The results on the effects of obesity on health are robust to the inclusion of physical activity measures in estimations. Obesity is associated with significantly higher risks of poor health, disability and chronic health diseases independent of physical inactivity, although obesity-related differences in adverse health outcomes decrease slightly in models that include physical activity controls. For example, an increase in the probability of poor health between normal weight and obese men is 19 percentage points, which declines by 2 percentage points with adjustment for vigorous and moderate activity. The same 1–3 percentage point reduction in the estimates of obesity holds for other health outcomes. Hence, the association of obesity with poor health does not seem to reflect the effect of physical inactivity but rather has a health effect independent of whether an obese individual engages in regular physical activity.

Discussion

Obesity is a significant problem in older Europeans that already affects every eighth Swiss, every sixth German man, and every fourth woman in Spain. The compositional differences of the nations with rather distinct socio-demographic characteristics do not explain the observed large variation in obesity rates throughout Europe. In contrast, differences related to diet culture, physical activity and other lifestyle behaviours may be at play. Large differences in obesity prevalence across European countries should be investigated further, as they are likely to suggest areas for effective public health policy.

Similar to studies in the general population, this analysis suggests that obesity is strongly associated with major health risks for older adults. The odds of disability, poor self-reported health and chronic health conditions are multi-fold for obese men and women compared with normal weight people, and hold independently of the effects of physical inactivity on health. Particularly, high risks of disability and impaired health are related to severe obesity in older people, especially women.

The differences in how obesity is related to health outcomes across countries are not statistically significant in the interactions analysis. At the same time, the associated magnitudes with obesity and their variation for some conditions in the by-country analysis suggest the need for further exploration in this domain. Table 5 (for men) and Table 6 (for women) present results (adjusted odds ratio) from separate multivariate logistic models for the SHARE countries explaining the association between obesity and selected health outcomes. For example, Swiss men in poor health are about four times more likely to be obese than otherwise similar Swiss men. In Greece, the ratio is only 1.35 and the difference between the obesity rate for otherwise similar men who are and are not in poor health is not significant.

Furthermore, we found a significant link between obesity and heart disease among men in four out of the 10 countries examined, with no apparent explanation of the differences related to the sample size of the countries or other obvious reasons (results not presented). The association between obesity and high cholesterol levels was not significant in countries such as France, which have traditionally cholesterol-rich diet and high estimates of cholesterol blood levels. Obesity affected depression among women only in several countries (with no clear geographic or cultural pattern). Differences in the gradient between obesity and health across countries and their relation to institutional characteristics of the nations deserve further research.

The current study has several limitations that may be overcome by future data collection. First, we only have self-reported height and weight. Several US studies show that individuals with excessive body weight tend to underreport their weight (with an increasing extent among more obese people). In addition, respondents often overestimate height, particularly in older population groups.[43–45] The estimates, based on subjective assessment of body weight and height, are likely to underestimate the actual prevalence of obesity in the participating SHARE countries. If the tendency to systematically under- or over-report varies across countries, this could hamper our cross-country comparison. To test this hypothesis, we would need objective measurements in the SHARE countries. Second, undiagnosed chronic diseases could not be counted. Given the differences in healthcare systems across the SHARE countries, the prevalence of specific chronic health conditions might be underestimated more in some countries than in others. Third, we have relatively small samples and low response rates in some countries, particularly Switzerland. Finally, the survey does not cover the institutionalized population.

Table 5 Cross-country effects of obesity on health among men aged 50 years and over.

	Poor self-reported health		Percent with any ADL limitation		Diabetes	
	BMI 30–35	BMI 35+	BMI 30–35	BMI 35+	BMI 30–35	BMI 35+
Austria	1.79[a]	1.90	1.48	2.89	3.10[b]	5.47[b]
	(0.45)	(0.83)	(0.61)	(1.79)	(1.11)	(2.94)
Denmark	2.03[a]	3.85[a]	1.93	10.35[b]	3.22[b]	4.14[c]
	(0.59)	(2.14)	(0.83)	(6.34)	(1.42)	(3.09)
France	2.26[b]	2.84[a]	2.82[b]	6.07[b]	3.91[b]	10.17[b]
	(0.61)	(1.47)	(1.06)	(3.88)	(1.59)	(6.50)
Germany	1.58[a]	3.10[b]	0.88	2.05	3.61[b]	5.76[b]
	(0.30)	(1.10)	(0.29)	(1.04)	(0.95)	(2.29)
Greece	0.91	1.35	2.43[a]	4.42[a]	2.30[a]	2.65
	(0.25)	(0.76)	(1.05)	(3.28)	(0.89)	(1.88)
Italy	1.49[c]	3.05[b]	1.92[c]	6.01[b]	2.41[b]	1.74
	(0.33)	(1.17)	(0.70)	(3.03)	(0.70)	(0.92)
Netherlands	1.79[b]	2.29[c]	1.36	0.86	1.52	8.04[b]
	(0.38)	(1.01)	(0.54)	(0.91)	(0.53)	(3.93)
Spain	1.69[a]	1.62	1.11	0.23	1.57	3.67
	(0.37)	(0.63)	(0.36)	(0.24)	(0.47)	(1.63)
Sweden	1.21	4.08[b]	2.90[b]	4.09[b]	4.27[b]	3.59[a]
	(0.39)	(1.86)	(0.99)	(2.23)	(1.24)	(1.83)
Switzerland	2.02	4.46[c]	1.99	6.64[c]	3.36[a]	1.98
	(0.98)	(3.73)	(1.44)	(6.79)	(1.94)	(2.38)
Total	1.61[b]	2.49[b]	1.69[b]	2.91[b]	2.74[b]	4.19[b]
	(0.11)	(0.29)	(0.23)	(0.87)	(0.37)	(0.64)

Results from by-country analyses: adjusted odds ratio for obesity groups. Presented results are odds ratio from multivariate regression logistic models estimated for each country individually. Standard errors are in parentheses.
[a]Significantly different from normal weight in the country at 5% level.
[b]Significantly different from normal weight in the country at 1% level.
[c]Significantly different from normal weight in the country at 10% level.

Nevertheless, the study provides evidence that obesity has significant implications for increased morbidity of older adults observed across all population groups and countries examined. Public and private health plans are recommended to consider the risks of excessive body weight for their beneficiaries that are likely to persist well into old age. Prevention of weight gain is critical to older adults as well as in the general population, particularly as effective obesity treatment has been a challenge thus far. Lack of success with long-term efficacy of many treatment therapies for obesity attests that the best long-term approach to the problem of obesity is prevention.[7,46–49]

Critical to obesity prevention is improving diet through reduced intakes of fat and added sugar and increasing physical activity levels, so that interventions focus on dietary behaviour, physical activity or their combination. For older adults, preventive strategies, such as regular participation in physical activity of at least moderate intensity could be the first step in changing the energy balance. Moderate physical activity, such as walking, is available to older adults even with some health constraints, whereas even a small change in calorie expenditure due to increased physical activity is likely to help prevent weight gain in addition to overall health benefits of regular exercise.

Overall, a number of preventive strategies could be initiated, although further research is necessary to understand the effectiveness and cost-effectiveness of different policies. For example, the initiatives to improve nutritional choices among consumers could include the provision of low-calorie or zero-calorie drink choices and a wider array of beverage sizes, reasonable meal portions, and flexible pricing mechanisms for low-calorie food and beverage options. The mandatory provision of food labelling in away-from-home food establishments has been discussed in many countries. Medical professionals could influence individual diet and physical activity choices through regular advice, such as advocating reduced consumption of high fat, energy-dense food and sugary drinks and increased levels of physical activity, especially among people susceptible to weight gain.

Table 6 Cross-country effects of obesity on health among women aged 50 years and over.

	Poor self-reported health		Percent with any ADL limitation		Diabetes	
	BMI 30–35	BMI 35+	BMI 30–35	BMI 35+	BMI 30–35	BMI 35+
Austria	2.16[a]	5.34[a]	2.08	3.68[a]	3.58[a]	5.19[a]
	(0.44)	(1.91)	(0.59)	(1.71)	(1.15)	(2.47)
Germany	2.87[a]	7.37[a]	2.11[a]	4.79[a]	4.45[a]	7.15[a]
	(0.52)	(2.24)	(0.59)	(1.76)	(1.08)	(2.39)
Sweden	3.12[a]	5.45[a]	1.81[a]	3.46[c]	4.36[a]	6.32[a]
	(0.69)	(2.06)	(0.56)	(1.74)	(1.36)	(3.04)
Netherlands	2.01[a]	2.71[a]	1.84[b]	4.74[a]	3.60[a]	7.66[a]
	(0.38)	(0.76)	(0.59)	(1.86)	(1.06)	(2.76)
Spain	1.89[a]	2.99[a]	2.47[a]	4.07[a]	2.19[a]	3.52[a]
	(0.34)	(0.77)	(0.66)	(1.36)	(0.56)	(1.09)
Italy	2.02[a]	3.58[a]	1.68[b]	4.61[a]	4.11[a]	5.36[a]
	(0.36)	(1.10)	(0.46)	(1.69)	(1.09)	(2.01)
France	1.93[a]	6.36[a]	2.91[a]	5.53[a]	6.71[a]	16.63[a]
	(0.46)	(2.49)	(0.99)	(2.64)	(2.59)	(7.83)
Denmark	1.69[c]	5.01[a]	2.66[c]	4.30[c]	3.31[a]	4.92[a]
	(0.46)	(2.27)	(1.03)	(2.61)	(1.34)	(3.05)
Greece	2.49[a]	4.93[a]	1.34	7.14[a]	2.82[a]	8.40[a]
	(0.54)	(1.71)	(0.47)	(3.12)	(1.11)	(3.95)
Switzerland	1.95	3.77[c]	3.88[c]		4.82[c]	10.72[c]
	(0.79)	(2.56)	(2.04)		(3.14)	(10.26)
All sample	2.19[a]	4.09	2.09[a]	4.20[a]	3.59[a]	6.02[a]
	(0.12)	(0.50)	(0.13)	(0.28)	(0.34)	(0.77)

Results from by-country analyses: adjusted odds ratio for obesity groups. Presented results are odds ratio from multivariate regression logistic models estimated for each country individually. Standard errors are in parentheses.
[a]Significantly different from normal weight in the country at 1% level.
[b]Significantly different from normal weight in the country at 10% level.
[c]Significantly different from normal weight in the country at 5% level.

The case for counteracting obesity is overwhelming, as demonstrated in this paper. Still, the obesity problem has yet to generate sufficient policy attention to enable changes in European countries, including those of particular need for reform. The rapid growth in obesity over the past decades, and large differences in the prevalence of obesity across countries with similar populations, indicate that trends in obesity are environmentally based, and the key causes for obesity spread are societal. Identifying programmes that address these societal contributors to the epidemic of obesity should be public health priorities in European countries.

Acknowledgements

This paper benefited from comments by Arie Kapteyn, PhD. The data are from Release 1 of SHARE 2004. The SHARE data collection has been primarily funded by the European Commission through the fifth framework program (Project QLK6-CT-2001-00360 in the thematic program Quality of Life). Additional funding came from the US National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Data collection in Austria (through the Austrian Science Fund, FWF), Belgium (through the Belgian Science Policy Office) and Switzerland (through BBW/OFES/UFES) was nationally funded.

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