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ORIGINAL RESEARCH

Change in the prevalence of obesity and use of health care in Denmark: an observational study

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Purpose: The purpose of this study was to examine the influence of the increasing prevalence of obesity on the development of health care utilization in Denmark in the period 1987–2005.

Patients and methods: From a random sample of adult Danes (19,142 women and 18,335 men) who participated in the Danish Health Interview Surveys in 1987, 1994, 2000, and 2005, self-reported data on type of health care utilization within the previous 3 months and on height and weight were obtained.

Results: Adjusted odds ratios (ORs) showed that an increased use of health care among obese men compared with those of normal weight was pronounced and significant for those aged 45–64 years, whereas it was weaker and borderline significant for those aged 25–44 and 65+ years. Among obese men, there was an increasing use of health care until 2005. Among women, there was also an increased use of health care among the obese women in comparison with the normal weight women. An increase in the use of health care was found among obese women during 1987–2000, followed by a leveling of utilization during 2000–2005.

Conclusions: In conclusion, this study showed that the increase in health care utilization in Denmark could, in part, be attributed to an increase in prevalence of obesity and to an increase in health care utilization among obese men in particular.

Keywords: BMI, health care utilization, health survey, epidemiology

Introduction

In recent years, health care utilization has increased steadily. Data from Statistics Denmark show that the average number of consultations with a general practitioner increased from 7.2/year in 1999 to 8.0/year in 2005 for women and from 4.5/year to 5.3/year for men during the same period.[1] Data from the Danish Hospital Discharge Registry reveal that the annual number of ambulatory contacts doubled for both women and men in the period 1997–2006, from 0.8 to 1.6 million for women and from 0.6 to 1.2 million for men. This increase could partly be attributed to alterations in registration, because people who are hospitalized for <24 h have been registered as outpatients, not as inpatients, since 2002.[2] At the same time, the number of hospitalizations increased from 0.60 to 0.64 million for women and from 0.45 to 0.54 million for men.[2] An increase in health care utilization has also been demonstrated in The Danish Health Interview Surveys (DHIS), which are cross-sectional surveys with the main objective of describing health and morbidity in the Danish population.[3] In 1987–2005, an increase in the number of people who had contact with their general practitioner, an outpatient clinic, or a medical specialist was observed, a development that cannot be attributed to change in age structure of the population alone.[3,4]

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Concurrently, with the increased utilization of health care, the prevalence of obesity among those aged 16–99 years increased from 5.5% in 1987 to 11.4% in 2005 according to the DHIS.[3] This rise in prevalence of obesity is in accordance with findings from other Danish studies[5,6] and with the development seen in other industrialized countries.[7,8]

Considering the higher incidence of somatic and psychological illness among obese people, it is conceivable that some of the increase in utilization of health care might be attributed to the increase in the prevalence of obesity. Studies examining the impact of the rising prevalence of obesity on the development of health care utilization are generally absent in previous literature, but several studies have shown an association between obesity per se and utilization of various types of health care.[9–22] However, first, the results from these studies were not consistent and, second, a potential influence of the rising prevalence of obesity on the increasing use of health care can only be determined by analyzing data from repeated measurements. In order to organize and assure the quality of health care to a progressively larger part of the population, it is essential to examine whether the rising prevalence of obesity contributes to the increasing use of health care, and whether health care utilization among obese people has changed over time.

The purpose of this study was therefore to examine the impact of the rising prevalence of obesity on utilization of health care in Denmark in 1987–2005. The hypothesis was that the prevalence of obesity would be associated with utilization of health care and thus that the rise in utilization could be partly attributed to the rise in the prevalence of obesity. Another purpose was to examine whether the utilization of health care of obese people has changed during the period.

Material and methods

Study design

Data were obtained from the DHIS, which is a series of cross-sectional surveys carried out by the National Institute of Public Health in 1987, 1994, 2000, and 2005. Each survey was based on a random sample from the Danish Civil Registration System of people aged 16 years and above and was initiated by a mailed invitation to take part, followed by a personal interview in the respondent's home. Interviews took place in February, May, and September, except for the survey in 2005, when interviews were carried out continuously from May 2005 until March 2006.[3,23] Samples in the four surveys were not constructed in the same way. In 1987 and 1994, a random sample was drawn from the entire Danish population aged above 16 years.[24,25] In 2000 and 2005, one of the purposes of the survey was to provide data for local health care planning in addition to reinterviewing the sample from the 1994 survey. As a consequence, the sample for the 2000 survey consisted of three subsamples: i) the national sample, ii) the follow-up sample, and iii) the supplementary county sample.[23] The sample for the 2005 survey consisted of two subsamples: i) the follow-up sample and ii) the supplementary regional sample (Danish counties were consolidated into five regions by 2005).[3] Response rates were 79.9%, 78.0%, 74.2%, and 66.7% in the surveys from 1987, 1994, 2000, and 2005, respectively.[3,23–25] Previous analyses have shown that the increase in nonresponse in the period 1994–2005 was most prominent among 16–24-year-old women, followed by 25–44-year-old women, then 16–24-year-old men, and finally 25–44-year-old men.[26]

Overall, there were 40,673 respondents in the four surveys. In this study, respondents with missing or implausible information on height or weight (470 people), as well as respondents with missing information on the utilization of health care (75 people), were excluded. Respondents with missing data on sociodemographic conditions, health behavior, self-rated health, or obesity-related illness were also excluded (2651 people). In all, 7.9% of the respondents were excluded, leaving 37,477 subjects for the study, consisting of 19,142 women and 18,335 men.

Measures

Outcome

Health care utilization was assessed via the question "Have you consulted a physician during the past three months due to discomfort, illness, or injury?" Respondents were asked to answer yes or no to having utilized eight different types of health care: general practitioner, physician from the emergency service, medical specialist, industrial medical officer, emergency ward, outpatient clinic, hospitalization, and other physician.

The eight categories for type of utilization were divided into three categories for analysis: 1) general practitioner, 2) secondary sector (physician from the emergency service, emergency ward, outpatient clinic, and hospitalization), and 3) primary sector/other (medical specialist, industrial medical officer, and other physician). For the logistic regression analysis, the outcome measure was defined as "all types of physician", ie, an overall category for all eight types of health care. Respondents were only included in this category once, even if they had utilized multiple types of health care.

Exposure

The primary exposure was body mass index (BMI), which was assessed by self-report of height in centimeters and weight in kilograms. BMI was calculated as the weight in kilograms divided by the square of the height in meters (kg/m²). Categories were defined according to the definitions of the World Health Organization, ie, underweight = BMI < 18.5, normal weight = BMI 18.5–24.9, overweight = BMI 25.0–29.9, and obesity = BMI ≥ 30.[27]

Sociodemographic measures

Information was collected on age, gender, marital status, educational level, and employment status.

In the analysis, age was treated as both a continuous and a categorical variable. The basis of categorization was an assumption about life phases employed in publications on the DHIS, according to which the age category 16–24 years focuses on education, 25–44 years is focused on family life, 45–64 years is middle age, and 65+ years is the pensionable age. The variable marital status was divided into three categories (married, cohabiting, or single). The variable educational level was divided into three categories (≤ 9, 10–12 or ≥ 13 years) and concerned the total number of years spent from starting school until completion of further education. Employment status was divided into two categories (yes or no).

Smoking

Data were obtained on smoking behavior and divided into five categories: smokes 1–14 cigarettes daily; smokes 15+ cigarettes daily; never smoker; former smoker; and does not smoke cigarettes. The latter category included smokers of cigars, cheroots, and/or a pipe.

Obesity-related illness

Conditions with a well-known relation to obesity, such as diabetes, hypertension, and back problems, were included in this study as intermediate variables, ie, these conditions were regarded as links in the causal chain from obesity to utilization of health care. Including these variables in the analysis was an attempt to determine the extent to which potential associations between obesity and health care utilization could be explained by obesity-related illness. It was intended to include data on angina/myocardial infarction, but these data were not collected in the first session of the survey in 1987, with the implication that 30% of respondents from this survey would have been excluded. Therefore, data on angina/myocardial infarction were not included in the study. Information on diabetes, hypertension, and back problems was originally divided into former and current illness but was merged into one variable for each illness and each divided into one of two categories (yes or no) in this study.

Statistics

Weighting

In the 2000 survey the sample consisted of three subsamples, and in 2005 it consisted of two subsamples. This design was applied in order to obtain at least 1000 respondents in each county in 2000 and at least 3000 respondents in each region in 2005, in order to make the survey representative on a county or regional level. As a consequence, the county or regional distribution in the sample was different from the county or regional distribution in Denmark as a whole. That is, regions with large populations were under-represented in the study, and regions with smaller populations were over-represented.[3,23] In order to have nationally representative estimates, it was necessary to weigh the data. The calculation of weights was performed by the National Institute of Public Health and has been thoroughly described elsewhere.[23,26]

Analyses

All analyses were conducted for men and women separately. Initially, characteristics of the respondents by year of study were presented, and the χ^2 test for trend was used to assess the changes in distribution of BMI over time. The percentages of people who had consulted a physician in the four study years were estimated by BMI group, and the χ^2 test for trend was applied to test for statistical differences over time. Associations between year and utilization and between BMI and utilization were examined via logistic regression analysis. In these analyses, the variable "all types of physician" was the outcome measure. In the regression analyses, age was treated as a continuous variable after examination of scatter plots that showed the relation between age and log odds for utilization to be linear. Scatter plots of the relation between BMI and log odds for utilization were not linear; therefore, BMI was treated as a categorical variable. All other variables included in the regression analyses were categorical.

The applied statistical software did not allow for goodness-of-fit tests of the regression models due to the unequal weighting of the data. As data from the surveys performed in 1987 and 1994 were not weighted in the analyses, goodness-of-fit tests were performed on these data. The Hosmer–Lemeshow goodness-of-fit test showed a good agreement between observed and expected data. Results of the test for women were $P = 0.86$, for men aged 16–24 years $P = 0.37$, for men aged 25–44 years $P = 0.71$, for men aged 45–64 years $P = 0.41$, and for men aged 65+ years $P = 0.65$.

Adjusted odds ratios (ORs) derived from logistic regression were used for figures showing the development of probability of utilization by BMI over time. Estimates for graphs were calculated as: ORutilization (year) × ORutilization (BMI).

The influence of obesity-related illnesses such as diabetes, hypertension, and back problems on the association between obesity and utilization of health care was also estimated. The potential influence of each obesity-related illness was assessed in accordance with the change-in-estimate method,[28] ie, a factor was regarded as important if the crude estimate was changed by at least 10% by adjustment. Analyses were performed using Stata vs 9.2 (StataCorp, TX, USA), and the level of significance was set at 0.05.

Results

Table 1 shows that in the period from 1987 to 2005, the percentage of overweight women increased from 17.2% to 25.6%, and the percentage of obese women increased from 5.5% to 11.1%. A test for trend showed that in 2005 there were

Table 1 Characteristics of women by year of study

Characteristic	Category	1987 n = 2198 % (95% CI)	1994 n = 2207 % (95% CI)	2000 n = 7750 % (95% CI)	2005 n = 6987 % (95% CI)
Age (years)					
	16–24	14.6 (13.1; 16.0)	11.8 (10.5; 13.2)	11.2 (10.5; 12.0)	8.1 (7.4; 8.8)
	25–44	39.1 (37.0; 41.1)	39.2 (37.2; 41.2)	36.8 (35.7; 37.9)	34.3 (33.1; 35.4)
	45–64	27.1 (25.3; 29.0)	30.0 (28.0; 31.9)	33.3 (32.2; 34.4)	36.2 (35.0; 37.4)
	65+	19.2 (17.6; 20.9)	19.0 (17.4; 20.7)	18.7 (17.8; 19.6)	21.4 (20.4; 22.4)
BMI (kg/m^2)					
	Underweight <18.5	7.6 (6.4; 8.7)	5.4 (4.5; 6.4)	4.5 (4.0; 5.0)	3.6 (3.2; 4.1)[1]
	Normal weight 18.5–24.9	69.7 (67.8; 71.6)	66.2 (64.2; 68.2)	60.9 (59.7; 62.0)	59.6 (58.4; 60.8)[1]
	Overweight 25.0–29.9	17.2 (15.7; 18.8)	21.3 (19.6; 23.0)	25.3 (24.3; 26.3)	25.6 (24.6; 26.7)[1]
	Obesity ≥30	5.5 (4.6; 6.5)	7.1 (6.0; 8.1)	9.4 (8.7; 10.1)	11.1 (10.4; 11.9)[1]
Marital status					
	Married	53.9 (51.8; 56.0)	52.2 (50.1; 54.2)	52.4 (51.2; 53.5)	53.8 (52.6; 55.1)
	Cohabiting	15.0 (13.5; 16.5)	16.8 (15.2; 18.3)	16.1 (15.2; 16.9)	15.3 (14.4; 16.1)
	Single (divorced/widowed/never married)	31.1 (29.2; 33.1)	31.1 (29.2; 33.0)	31.6 (30.5; 32.7)	30.9 (29.8; 32.0)
Educational level					
	≤9 years	39.4 (37.4; 41.4)	28.1 (26.2; 29.9)	21.1 (20.2; 22.1)	17.2 (16.3; 18.1)
	10–12 years	27.9 (26.0; 29.8)	27.5 (25.6; 29.3)	26.9 (25.8; 27.9)	23.6 (22.5; 24.6)
	≥13 years	32.7 (30.8; 34.7)	44.5 (42.4; 46.6)	52.0 (50.8; 53.2)	59.2 (58.0; 60.4)
Employment					
	Yes	59.6 (57.5; 61.6)	55.5 (53.4; 57.6)	56.4 (55.3; 57.6)	55.3 (54.1; 56.5)
	No	40.4 (38.4; 42.5)	44.5 (42.4; 46.6)	43.6 (42.4; 44.7)	44.7 (43.5; 45.9)
Smoking status					
	1–14 cigarettes daily	23.3 (21.6; 25.1)	19.7 (18.1; 21.4)	17.4 (16.5; 18.3)	14.2 (13.3; 15.0)
	15+ cigarettes daily	18.1 (16.5; 19.7)	18.3 (16.6; 19.9)	16.4 (15.6; 17.3)	14.8 (13.9; 15.7)
	Never smoker	38.6 (36.5; 40.6)	38.3 (36.3; 40.4)	42.8 (41.6; 43.9)	42.1 (40.9; 43.3)
	Former smoker	16.4 (14.9; 18.0)	21.5 (19.8; 23.2)	22.1 (21.2; 23.1)	24.3 (23.2; 25.3)
	Does not smoke cigarettes[2]	3.5 (2.8; 4.3)	2.2 (1.6; 2.8)	1.3 (1.0; 1.5)	4.6 (4.1; 5.1)
Diabetes					
	Yes	2.5 (1.8; 3.1)	2.6 (1.9; 3.2)	2.8 (2.4; 3.1)	4.1 (3.6; 4.6)
	No	97.5 (96.9; 98.2)	97.4 (96.8; 98.1)	97.2 (96.9; 97.6)	95.9 (95.4; 96.4)
Hypertension					
	Yes	12.1 (10.7; 13.4)	11.2 (9.9; 12.5)	13.7 (12.9; 14.5)	23.2 (22.2; 24.2)
	No	87.9 (86.6; 89.3)	88.8 (87.5; 90.1)	86.3 (85.5; 87.1)	76.8 (75.8; 77.8)
Back problems					
	Yes	17.4 (15.8; 19.0)	16.0 (14.5; 17.6)	16.1 (15.3; 17.0)	22.9 (21.9; 23.9)
	No	82.6 (81.0; 84.2)	84.0 (82.4; 85.5)	83.9 (83.0; 84.7)	77.1 (76.1; 78.1)

Notes: [1]Test for trend: $P = 0.00$; [2]Smokers of cigars, cheroots, and/or pipe tobacco.
Abbreviations: BMI, body mass index; CI, confidence interval.

significantly fewer underweight and normal weight people and significantly more overweight and obese people than in 1987. Concerning the three obesity-related conditions diabetes, hypertension, and back problems, more women were affected by at least one of these in 2005 than in 1987, and the change in percentage of women affected was particularly prominent in the period 2000–2005. Hypertension and back problems were the most common conditions of the three.

Table 2 shows that, among men, the percentage of obese people increased from 5.7% in 1987 to 11.8% in 2005. In addition, the difference between the percentage of normal weight and overweight men was reduced with time, and in 2005 there were 46.2% normal weight and 41.4% overweight men. A test for trend showed a development similar to that for women, ie, with fewer underweight or normal weight and more overweight or obese men in 2005 compared with 1987. The percentage of men affected by obesity-related illness was larger in 2005 than in 1987, and the growth in percentage of affected people was especially large from 2000 to 2005. Hypertension and back problems were the most

Table 2 Characteristics of men by year of study

Characteristic	Category	1987	1994	2000	2005
		n = 2150	**n = 2041**	**n = 7538**	**n = 6606**
		% (95% CI)	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**
Age (years)					
	16–24	15.5 (14.0; 17.0)	13.4 (11.9; 14.9)	11.9 (11.1; 12.7)	8.6 (7.9; 9.3)
	25–44	40.0 (37.9; 42.0)	40.7 (38.5; 42.8)	35.6 (34.5; 36.8)	34.6 (33.4; 35.8)
	45–64	28.0 (26.1; 29.9)	29.3 (27.3; 31.3)	35.6 (34.5; 36.7)	37.3 (36.0; 38.5)
	65+	16.6 (15.0; 18.1)	16.6 (15.0; 18.2)	16.9 (16.0; 17.7)	19.6 (18.6; 20.5)
BMI (kg/m²)					
	Underweight <18.5	1.2 (0.7; 1.6)	0.9 (0.5; 1.3)	0.9 (0.7; 1.1)	0.6 (0.4; 0.8)[1]
	Normal weight 18.5–24.9	57.7 (55.6; 59.8)	53.0 (50.8; 55.1)	48.7 (47.5; 49.9)	46.2 (44.9; 47.5)[1]
	Overweight 25.0–29.9	35.4 (33.4; 37.5)	37.5 (35.4; 39.6)	40.4 (39.2; 41.6)	41.4 (40.1; 42.6)[1]
	Obesity ≥30	5.7 (4.7; 6.7)	8.6 (7.4; 9.8)	10.0 (9.3; 10.8)	11.8 (11.0; 12.6)[1]
Marital status					
	Married	58.3 (56.2; 60.4)	53.7 (51.5; 55.8)	54.5 (53.4; 55.7)	57.9 (56.7; 59.2)
	Cohabiting	14.2 (12.8; 15.7)	17.5 (15.8; 19.1)	16.2 (15.3; 17.0)	15.9 (14.9; 16.8)
	Single (divorced/widowed/ never married)	27.4 (25.6; 29.3)	28.9 (26.9; 30.8)	29.3 (28.2; 30.4)	26.2 (25.1; 27.3)
Educational level					
	≤9 years	27.8 (25.9; 29.7)	20.8 (19.0; 22.5)	16.6 (15.7; 17.5)	12.3 (11.5; 13.1)
	10–12 years	36.2 (34.2; 38.3)	35.5 (33.3; 37.5)	34.4 (33.3; 35.5)	34.2 (33.0; 35.3)
	≥13 years	36.0 (33.9; 38.0)	43.8 (41.6; 45.9)	49.0 (47.8; 50.2)	53.5 (52.3; 54.8)
Employment					
	Yes	72.1 (70.2; 74.0)	67.5 (65.5; 69.5)	66.9 (65.8; 68.0)	64.2 (63.0; 65.5)
	No	27.9 (26.0; 29.8)	32.5 (30.5; 34.5)	33.1 (32.0; 34.2)	35.8 (34.5; 37.0)
Smoking status					
	1–14 cigarettes daily	16.6 (15.0; 18.2)	12.7 (11.2; 14.1)	11.3 (10.5; 12.0)	9.8 (9.1; 10.6)
	15+ cigarettes daily	22.5 (20.7; 24.2)	24.2 (22.3; 26.0)	21.7 (20.8; 22.7)	18.7 (17.8; 19.7)
	Never smoker	27.6 (25.7; 29.5)	31.0 (29.0; 33.0)	34.6 (33.5; 35.7)	36.1 (34.9; 37.3)
	Former smoker	22.2 (20.5; 24.0)	23.7 (21.9; 25.6)	25.8 (24.8; 26.9)	26.1 (25.0; 27.2)
	Does not smoke cigarettes[2]	11.1 (9.8; 12.4)	8.4 (7.2; 9.6)	6.6 (6.0; 7.2)	9.2 (8.5; 9.9)
Diabetes					
	Yes	2.3 (1.6; 2.9)	3.3 (2.5; 4.1)	3.2 (2.8; 3.6)	4.9 (4.3; 5.4)
	No	97.7 (97.1; 98.4)	96.7 (96.0; 97.5)	96.8 (96.4; 97.2)	95.1 (94.6; 95.7)
Hypertension					
	Yes	8.1 (6.9; 9.2)	8.7 (7.5; 9.9)	11.5 (10.7; 12.2)	19.4 (18.4; 20.4)
	No	91.9 (90.8; 93.1)	91.3 (90.1; 92.5)	88.5 (87.8; 89.3)	80.6 (79.6; 81.6)
Back problems					
	Yes	18.9 (17.2; 20.5)	15.7 (14.1; 17.3)	16.7 (15.8; 17.6)	26.6 (25.4; 27.7)
	No	81.1 (79.5; 82.8)	84.3 (82.7; 85.9)	83.3 (82.4; 84.2)	73.4 (72.3; 74.6)

Notes: [1]Test for trend: BMI < 18.5; $P = 0.01$. Other BMI groups: $P = 0.00$; [2]Smokers of cigars, cheroots, and/or pipe tobacco.
Abbreviations: BMI, body mass index; CI, confidence interval.

common conditions. Overall, for both men and women, the largest increase occurred in the percentage with hypertension, followed by the percentage with diabetes.

The percentage of people who had consulted a physician at least once in the previous three months increased over time; among women from 44.8% (95% CI, 42.7–46.8) in 1987 to 52.0% (95% CI, 50.8–53.3) in 2005, and among men from 37.8% (95% CI, 35.7–39.8) in 1987 to 43.8% (95% CI, 42.6–45.1) in 2005. This development was dependent on BMI and, furthermore, different for the two sexes. Among women, only the normal weight had a significant increase in the percentage of individuals who had consulted a physician; hence, the increasing use of health care among women could be largely attributed to the normal weight. Among men, the increase in use of health care was largest among the obese people, but significant increases were also observed among the normal weight and overweight people (data not shown). There were no differences in the types of health care sought by obese women over the years, but a significant increase was found in the percentage of obese men who had consulted a general practitioner, a physician in the secondary sector, or any physician (data not shown).

Table 3 shows that, for women, ORs for health care utilization appeared to be higher for each study year after 1987, but the difference in estimates did not reach significance in the years between 1994 and 2005. Crude estimates showed a significant association between BMI and health care utilization among the underweight, overweight, and obese people compared with the normal weight people. After adjustment, overweight and obesity were still significantly associated with health care utilization, OR = 1.18 (95% CI, 1.09–1.26) and OR = 1.51 (95% CI, 1.36–1.68).

In Figure 1, it can be seen that irrespective of BMI category, ORs for utilization appeared to increase in the years 1987–2000 and then leveled from 2000 to 2005. At all years, the obese person had the largest probability for health care use in comparison with the other BMI groups; however, the difference in estimates by year was not significant (data not shown).

A Wald test for interactions showed that, among men, associations between BMI and utilization varied according to age (BMI*age: $P = 0.00$) and, as a result, regression analyses for men were stratified by age, 16–24, 25–44, 45–64, and 65+ years. No further adjustment for age was done, whereby analyses for men involved fewer regression models than for women.

Table 4 shows that among 16–24-year-old men, the probability of health care utilization tended to be increasingly larger with higher BMI, and the obese people had the highest risk (OR = 1.34; 95% CI, 0.83–2.16), but associations were not significant. Among those aged 25–44 years, the obese people had a higher probability of health care utilization compared with normal weight men (OR = 1.22; 95% CI, 1.01–1.47). Among those aged 45–64 years, ORs for utilization were increasingly larger with higher BMI, and positive associations were found for both overweight (OR = 1.15; 95% CI, 1.02–1.29) and obese men (OR = 1.56; 95% CI, 1.32–1.85). Among men aged 65+ years, the underweight men had an increased probability of utilization compared with the normal weight men. After adjusting for confounders, the probability of health care utilization was almost five times larger among the underweight than among the normal weight (OR = 4.66; 95% CI, 1.46–14.82). A tendency for a positive association between obesity and health care utilization was also found (OR = 1.27; 95% CI, 0.99–1.63).

Figure 2A–D shows, with the exception of those aged 65+ years, that at each year obese men had the highest probability of utilization of health care compared with the other BMI categories. Among those aged 16–24 and 45–64 years,

Table 3 ORs for health care utilization in relation to year and BMI, women

Risk factor	Crude OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Year[1]					
1987	Reference	Reference	Reference	Reference	Reference
1994	1.21 (1.08; 1.37)	1.21 (1.07; 1.36)	1.20 (1.07; 1.35)	1.20 (1.07; 1.35)	1.17 (1.04; 1.32)
2000	1.33 (1.20; 1.46)	1.31 (1.19; 1.44)	1.29 (1.17; 1.42)	1.28 (1.16; 1.41)	1.27 (1.15; 1.40)
2005	1.34 (1.21; 1.48)	1.29 (1.17; 1.42)	1.29 (1.17; 1.42)	1.25 (1.14; 1.38)	1.24 (1.12; 1.38)
BMI[2]					
<18.5	1.20 (1.05; 1.39)		1.22 (1.06; 1.41)	1.22 (1.06; 1.41)	1.11 (0.96; 1.28)
18.5–24.9	Reference		Reference	Reference	Reference
25.0–29.9	1.27 (1.18; 1.36)		1.25 (1.16; 1.34)	1.17 (1.09; 1.26)	1.18 (1.09; 1.26)
≥30	1.64 (1.48; 1.82)		1.61 (1.45; 1.79)	1.53 (1.38; 1.70)	1.51 (1.36; 1.68)

Notes: [1]Year: Model 1: adjusted for age. Model 2: adjusted for BMI. Model 3: adjusted for age and BMI. Model 4: Model 3 + adjusted for marital status, educational level, employment, and smoking status; [2]BMI: Model 2: adjusted for year. Model 3: adjusted for year and age. Model 4: Model 3 + adjusted for marital status, educational level, employment, and smoking status.

Abbreviations: BMI, body mass index; CI, confidence interval; OR, odds ratio.

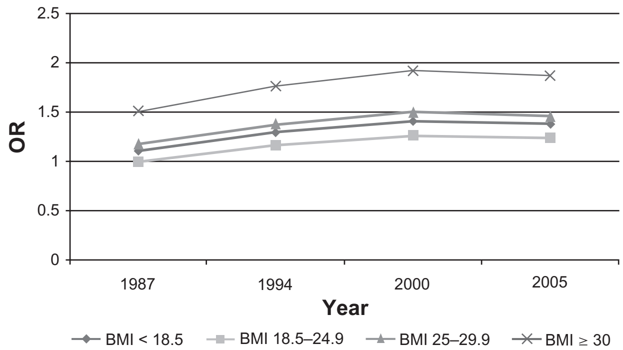

Figure 1 Adjusted* ORs for health care utilization by BMI in four study years, women.
Notes: *Adjusted for age, marital status, educational level, employment, and smoking status.
Abbreviations: BMI, body mass index; OR, odds ratio.

a decline in OR was observed from 1987 to 1994, followed by an increase. Among those aged 25–44 and 65+ years, steadily larger ORs were detected for the entire period. However, the difference in estimates by year did not reach significance for any of the age groups (data not shown). ORs for the normal weight and the overweight men aged 65+ years were almost identical, making it difficult to distinguish the two BMI groups in Figure 2D.

Analyses including variables of obesity-related illness, such as diabetes, hypertension, and back problems, indicated that hypertension mediated part of the associations between obesity and health care utilization for both women and men (data not shown). However, this finding did not apply to men aged 16–24 years for whom the association was, by and large, similar whether adjustment was made for hypertension or not. For women, in general, and men aged 45–64 and 65+, there was also some reduction in ORs when including diabetes. Taking back problems into account altered ORs for utilization of health care for obese men aged 16–24 and 25–44 years. Regardless of adjustment for obesity-related illnesses, associations between obesity and health care utilization were still evident for women, as well as for the men aged 45–64 years.

Discussion

Principal findings

The increase in health care utilization that has occurred in recent years may in part be attributed to a rise in the prevalence of obesity. This increase is particularly seen among obese men. Health care utilization among obese women increased in 1987–2000 only and then leveled from 2000 to 2005. Including variables of obesity-related illness, such as hypertension, diabetes, and back problems, in the analyses suggested a varying significance of these conditions among the subsets of the sample but indicated that they may be at least part of the cause of the increased utilization among obese people. Among men, the association between BMI and health care utilization was dependent on age. Stratification according to age resulted in reduced statistical strength, and results were found to be significant only for those aged 45–64 years and borderline significant for those aged 25–44 and 65+ years. Among men aged 65+, the underweight had the largest probability of health care utilization, as opposed to the other age groups. This finding may be partly attributed to the presence of malignant illness in this group, indicating inverse causality, ie, that illness (and, by implication, need for consultation with a physician) preceded the underweight.

Strengths and limitations

The limitation of this study is that data on BMI were based on self-reported height and weight.[7,29–31] Indeed, the prevalence of obesity may have been underestimated in the present study. It is possible that such underestimation may not be entirely independent of health care utilization but may be more prevalent among obese people with health problems requiring treatment, which would cause associations between obesity and health care utilization to be underestimated. In addition, social and cultural norms related to obesity may have changed between 1987 and 2005 in such a way that being obese is more unacceptable today than it was before. Consequently, it may be that underestimation of weight among respondents in the DHIS has become more pronounced with time, as would associations between obesity and health care utilization. On the other hand, previous studies have found good agreement between self-reported and medical journal data on the number of consultations with a physician for a period of up to 1 year previously.[32–35] Considering that it may be easier to remember if contact with a physician had occurred at all than the actual number of consultations, it is reasonable to conclude that the self-reported data on health care utilization in the present study were valid.

In the DHIS, there was no discrimination between utilization of private and public health care, implying that it was not possible to assess the impact of structural changes in the health care system in the studied period. Traditionally, private hospitals in Denmark struggled to exist, until an amendment to the health legislation was passed in 2002, allowing patients to receive treatment at a private hospital if the public health service cannot offer treatment within 2 months. As a consequence, accessibility of health care may have changed slightly in the period from 2000 to 2005; however, such a

Table 4 ORs for health care utilization in relation to year and BMI, men

Age group	Risk factor	Crude OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
16–24	Year[1]			
	1987	Reference	Reference	Reference
	1994	0.95 (0.67; 1.33)	0.94 (0.67; 1.32)	0.95 (0.67; 1.34)
	2000	0.98 (0.74; 1.28)	0.95 (0.72; 1.25)	0.97 (0.74; 1.29)
	2005	1.06 (0.80; 1.42)	1.03 (0.77; 1.38)	1.07 (0.79; 1.45)
	BMI[2]			
	<18.5	0.57 (0.31; 1.06)	0.57 (0.31; 1.05)	0.56 (0.30; 1.03)
	18.5–24.9	Reference	Reference	Reference
	25.0–29.9	1.25 (0.98; 1.60)	1.24 (0.97; 1.59)	1.23 (0.96; 1.59)
	≥30	1.40 (0.88; 2.24)	1.41 (0.88; 2.25)	1.34 (0.83; 2.16)
25–44	Year[1]			
	1987	Reference	Reference	Reference
	1994	1.07 (0.88; 1.32)	1.07 (0.87; 1.31)	1.03 (0.84; 1.27)
	2000	1.18 (1.00; 1.40)	1.18 (1.00; 1.39)	1.15 (0.97; 1.37)
	2005	1.25 (1.05; 1.48)	1.24 (1.04; 1.47)	1.21 (1.02; 1.44)
	BMI[2]			
	<18.5	0.94 (0.44; 2.00)	0.97 (0.45; 2.08)	0.86 (0.40; 1.85)
	18.5–24.9	Reference	Reference	Reference
	25.0–29.9	0.92 (0.82; 1.03)	0.91 (0.82; 1.02)	0.92 (0.82; 1.04)
	≥30	1.25 (1.04; 1.51)	1.23 (1.02; 1.49)	1.22 (1.01; 1.47)
45–64	Year[1]			
	1987	Reference	Reference	Reference
	1994	0.84 (0.66; 1.06)	0.82 (0.65; 1.03)	0.79 (0.62; 1.00)
	2000	0.97 (0.81; 1.16)	0.93 (0.78; 1.12)	0.92 (0.76; 1.11)
	2005	1.10 (0.92; 1.32)	1.07 (0.89; 1.28)	1.06 (0.88; 1.28)
	BMI[2]			
	<18.5	1.03 (0.48; 2.21)	1.03 (0.48; 2.21)	0.80 (0.37; 1.73)
	18.5–24.9	Reference	Reference	Reference
	25.0–29.9	1.13 (1.01; 1.26)	1.13 (1.01; 1.26)	1.15 (1.02; 1.29)
	≥30	1.61 (1.37; 1.90)	1.62 (1.37; 1.90)	1.56 (1.32; 1.85)
65+	Year[1]			
	1987	Reference	Reference	Reference
	1994	1.06 (0.78; 1.42)	1.04 (0.77; 1.40)	1.04 (0.77; 1.40)
	2000	1.26 (1.00; 1.60)	1.26 (0.99; 1.60)	1.22 (0.96; 1.55)
	2005	1.49 (1.18; 1.90)	1.48 (1.17; 1.88)	1.45 (1.14; 1.85)
	BMI[2]			
	<18.5	3.86 (1.24; 11.99)	4.04 (1.28; 12.76)	4.66 (1.46; 14.82)
	18.5–24.9	Reference	Reference	Reference
	25.0–29.9	1.04 (0.90; 1.22)	1.04 (0.90; 1.22)	1.00 (0.85; 1.17)
	≥30	1.36 (1.06; 1.74)	1.33 (1.04; 1.70)	1.27 (0.99; 1.63)

Notes: [1]Year: Model 1: adjusted for BMI. Model 2: Model 1 + adjusted for marital status, educational level, employment, and smoking; [2]BMI: Model 1: adjusted for year. Model 2: Model 1 + adjusted for marital status, educational level, employment, and smoking.
Abbreviations: BMI, body mass index; CI, confidence interval, OR, odds ratio.

development would presumably be independent of BMI and therefore not lead to any bias.

From 1987 to 2005, nonresponse to the DHIS increased from 20% in 1987 to 33% in 2005, with the largest increase in nonresponse occurring among those aged 16–24 and 25–44 years.[26] Analyses on nonresponse by BMI to the DHIS in 2005 showed that more obese than normal weight people did not participate.[26] This is in line with results from studies performed during the 1980s that indicated a greater nonresponse among obese people.[36,37] These findings imply that, over the years, nonresponse was generally larger among obese people compared with normal weight people, adding to an increasing underestimation of the prevalences of obesity in the study period. In addition, previous analyses on nonresponse in relation to health care utilization in the DHIS 2000 and 2005 have shown a positive association between nonresponse and health care utilization.[26,38] Considering that obese people also have a higher probability

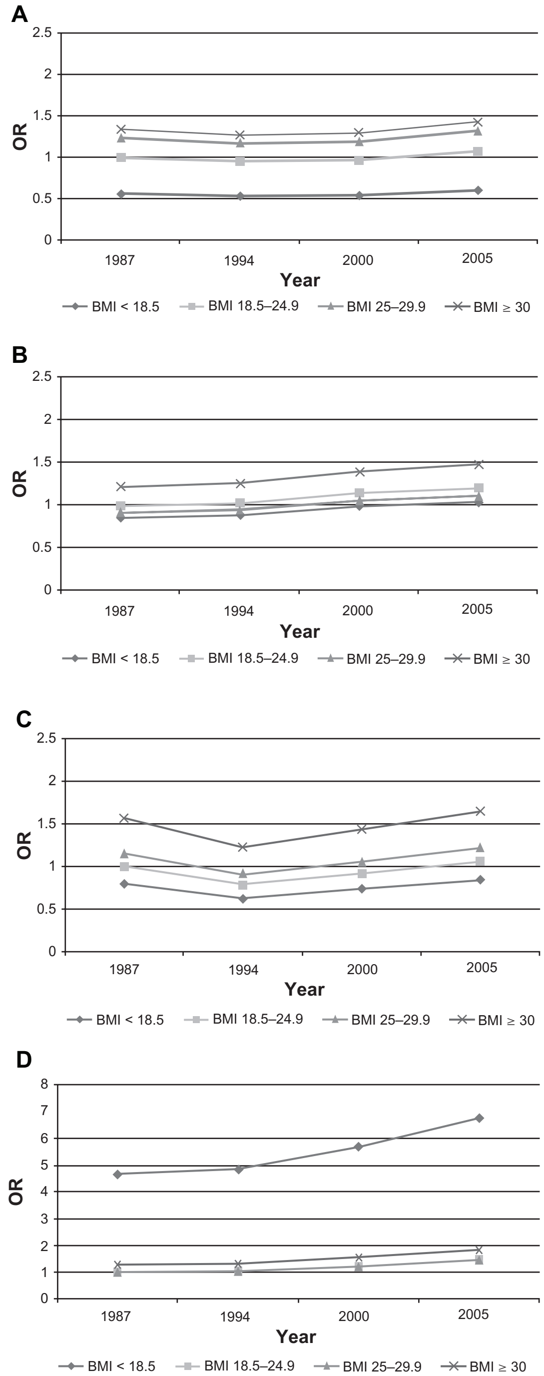

Figure 2 Adjusted* ORs for health care utilization by BMI in four study years: **A**) 16–24-year-old men, **B**) 25–44-year-old men, **C**) 45–64-year-old men, and **D**) 65 + -year-old men.
Notes: *Adjusted for marital status, educational level, employment, and smoking status.
Abbreviations: BMI, body mass index; OR, odds ratio.

of using the health care system than normal weight people, associations between obesity and health care use may have been underestimated, and possibly increasingly so. In the present study, we assessed how associations between current obesity and current health care use have changed with time. Thus, the right temporal association between exposure and outcome cannot be verified; however, it seems unlikely that health care utilization should precede obesity. Technological development of diagnostics and treatment as well as increased general knowledge of health and illness may have changed during the study period and be contributory factors in the observed increase of health care utilization. However, it is reasonable to assume that an increase in utilization, partly caused by such conditions, would be independent of BMI and therefore not lead to any bias in the present study.

Comparison with other studies

To our knowledge, this was the first study to examine the development of health care utilization in relation to the development of obesity. Several studies that have found an association between obesity and consultations with general practitioners,[10,12,14,18–22] consultations at outpatient clinics,[14–18] or consultations with a medical specialist[10,14,22] or an emergency ward[10,18] have been published. Some studies also report an increased probability of hospitalization among the obese, in general,[11,16,17] whereas others find that this applies only to women,[14] or fail to find significant associations.[12,15,18] However, none of the studies examined whether these associations changed over time. In the present study, associations between obesity and health care utilization were found independent of hypertension, diabetes, and back problems; thus, these illnesses did not fully mediate associations. This is in line with previous findings that suggested that associations between obesity and health care utilization can only partly be attributed to obesity-related illness such as heart disease, hypertension, high cholesterol, diabetes, and arthritis.[14] This indicates that treatment of obesity itself also leads to increased health care utilization and is increasingly found among men in recent years.

Explanations and implications

The increased use of health care among obese men may be part of a health-promoting behavior with the objective of protecting, promoting, or maintaining good health.[39] It has been shown that in the period 1987–2005, increasingly more Danish men exercised, ate healthily, ate less, or drank less alcohol in order to maintain their health.[3] Additionally, the increase in the percentage of men who eat healthily or eat less was larger than that among women.[3] These findings point toward an increasing awareness, among men in particular, of the importance of maintaining or promoting health. Still, obesity-related health care use was greater among women than among men. In addition, today, physicians may focus more than they have done earlier on the importance of detection and treatment of obesity and obesity-related illness, which contributes to more health care utilization. Therefore, the increasing health care use among obese people may be caused by a combination of obesity-related illness requiring treatment and an increased awareness of the hazards of obesity, which may lead to consulting a physician as a preventive action.

Conclusion

In summary, previous findings focused on associations between obesity and utilization of certain types of health care, but they have not focused on whether the increase observed in health care use may be attributed to the increased prevalence of obesity. We found that the increased burden on the health care system was partly caused by obesity and a change toward an increase in health care use, particularly among obese men. It is likely that the present findings are underestimated due to a possible underestimation of weight, particularly among obese people with health problems, and potential differential selection caused by nonresponse among obese people with health problems. However, the implications for the organization and quality assurance of health services are serious. Therefore, general practitioners have a particular role as the primary source of medical care for obese people and as gatekeepers to many of the other health services.

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Disclosure

The authors report no conflicts of interest in this work.

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