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Certification of obesity as a cause of death in England 1979–2006

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Background: There is increasing recognition of the importance of obesity as a cause of death but it is uncommon for obesity to be certified on death certificates. We considered it useful to study what doctors actually do in respect of certification of obesity and to study trends, if any, in certification practice. **Methods:** Analysis of two datasets that include all certified causes of death ('mentions'), not just the underlying cause—the Oxford record linkage study 1979–2006 and English national mortality data 1995–2006. **Results:** Underlying-cause mortality identified only a quarter (26% in Oxford, 25% in England) of all deaths with obesity as a certified cause. The longstanding Oxford dataset showed that there were significant changes over time in the percentage of certificates, with mention of obesity, that were coded with obesity as the underlying cause. Changes coincided with times of national change in selection and coding rules for underlying cause mortality. In the recent English dataset from 1995–2006, mention-based death rates rose by an average annual rate of 7.5% [95% confidence intervals (CI) 6.1–8.8] for men and by 4.0% (2.3–5.7) for women. Analysis of mortality based on underlying cause alone would have missed this rise. We report on diseases commonly certified alongside obesity on death certificates in England. **Conclusion:** There is an emerging trend of increased certification of obesity as a cause of death in England. The use of underlying-cause mortality statistics alone fails to capture the majority of obesity deaths.

Keywords: obesity, mortality, trends, death certificate, England

Introduction

Obesity was first included as a codable condition in the International Classification of Diseases (ICD) in 1948, at a time when the ICD was intended predominantly for classification and coding of mortality rather than morbidity. Since then, the importance of obesity has become well-recognized globally. In 2007, it was estimated that 22-million children under 5 years were overweight, with more than 75% of such children living in low and middle income countries, particularly in urban settings.[1]

The prevalence of obesity in Great Britain has almost trebled over the last quarter of a century.[2] Figures from the Health Survey for England 2007 show that 24% of men and 25% of women were classified as obese.[3] The prevalence of obesity in childhood is reported to have increased in the UK from 1.5% of children in 1984 to 6.3% in 2003.[4] Both for adults and children, increases in obesity are more marked in lower social classes.

Health risks from obesity arise from the increase in mass of fat tissue (e.g. psychosocial distress, obstructive sleep apnoea, osteoarthritis) and from products produced by the increased number and size of fat cells (e.g. diabetes, gallstones, hypertension, liver disease, coronary artery disease, cerebrovascular disease, certain cancers and infertility).[5] Obesity increases overall mortality. Recent calculations suggest that obesity and overweight are responsible for 7% of morbidity and mortality in the UK with the direct cost to the NHS estimated at 3.23-billion.[6]

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Although the contribution of obesity to mortality is increasingly well-recognized, obesity itself is rarely certified by doctors as a cause of death. The certification of obesity as a cause of death is likely to be a poor indication of the true absolute toll of obesity-attributable death. Nonetheless, we considered it important to study what doctors actually do in respect of certification of obesity and to study trends, if any, in certification practice. We used two large datasets that include not only the underlying cause of death but also all certified causes on each death certificate.

Methods

In the first analysis, we used data from the former Oxford National Health Service region of England. The resident population is ~2.5-million people. This dataset, collected as part of the Oxford record linkage study, includes all causes of death, contributing causes as well as the underlying cause, from 1979–2007. All certified causes are conventionally called 'mentions'. The Oxford dataset is thought to be the longest continuous run of systematic, ready-to-analyse, coding of all mentions on death certificates in a large defined population in England. Analysis of this dataset can be used not only to analyse trends but also to identify artefactual shifts in cause-specific mortality resulting from coding rule changes.[7] We analysed the regional data in four main time periods defined by changes to national coding rules, 1979–83, 1984–92, 1993–2000 and from 2001.[8–10] The data had been coded according to the English national conventions at the time of certification of each death.

In the second analysis, we used national data for England with all mentions from 1995–2007 (national coding of all mentions was undertaken routinely from 1993 but we only have access to the data from 1995). In both datasets, deaths were coded to the ninth revision of the ICD (ICD9)[11] for the years prior to 2001 and to ICD10 for 2001–07.[12] The mortality data in each set were available by year of registration and, to allow for deaths that were registered after the end of the year of

occurrence, we restricted the results of our analyses to deaths that occurred in each year up to the end of 2006.

The datasets were searched for mentions of obesity (ICD9 278.0; ICD10 E66). Age-specific mortality rates in 5-year age-groups were used to calculate age-standardized mortality rates within broader age groups and overall, with 95% CI, for each time period. We also calculated age-standardized rates for each individual calendar year. We standardized, using the direct method, by applying the age-specific rates in each 5-year age-group in each calendar year to the European standard population. We calculated the average annual percentage change across the whole period for mortality rates based on mentions, using data for each individual calendar year, by fitting linear regression models to the logarithms of the death rates. Changes in the proportion of underlying cause to mention deaths, between subsequent and previous time periods, were tested for significance using chi-squared tests. We also analysed the records that mentioned obesity to establish the profile of other causes of death certified alongside obesity.

Results

In the Oxford region from 1979–2006 (table 1), obesity was a certified cause of death in 1002 deaths out of a total of 656 443 (0.15%); and it was coded as the underlying cause of death in 26% (259/1002) of the deaths with mentions. The percentage of mentions coded as underlying cause was 22.2% in 1979–83, 36.4% in 1984–92, 25.8% in 1993–2000 and 17.4% in 2001–06 (table 1). The increase between the first two periods, and the decrease between periods two and three, was statistically significant and coincided with coding rule changes.

In England from 1995–2006 (table 2), obesity was a certified cause of death in 8450 deaths out of a total of 6 054 897 (0.14%); and it was coded as the underlying cause of death in 24.8% (2096/8450). Considering individual years, the percentage of all deaths in England with obesity on the certificate doubled from 0.11% in 1995 to 0.23% in 2006. Certified death rates for obesity were substantially higher in women than men (tables 1 and 2).

Table 1 Number of deaths certified as obesity in the Oxford region 1979–2006: all ages rates[a] per million population; underlying cause deaths as a percentage of all mentions;average annual percentage change based on mentions

		Rates per million														
	N^b	Underlying cause (UC)				Mentions (M)				UC/M%				Average annual percent change	95%CI	
	1979–2006	1979–83	1984–92	1993–00	2001–06	1979–83	1984–92	1993–00	2001–06	1979–83	1984–92	1993–2000	2001–06			
Males	332	2.7	2.3	2.0	1.6	11.3	8.4	9.7	11.8	23.5	27.8	20.8	12.9	0.4	−1.2	1.9
Females	670	3.5	5.9	5.1	3.7	17.1	15.2	18.3	16.8	21.5	40.0**	28.1*	20.4	0.1	−0.8	1.0
Total	1002	3.1	4.4	3.7	2.6	14.3	12.5	14.3	14.4	22.2	36.4**	25.8**	17.4*	0.1	−0.7	0.9

a: Rates are age standardized, overall and within each broad age stratum, in five year groups
b: Number of deaths with a mention of obesity
*Significant change between percentage of mention coded as underlying cause in the asterisked period, compared with the previous period, at $^*P<0.05$, $^{**}P<0.01$

Table 2 Number of deaths certified as obesity in England 1995–2006: rates[a] per million population; underlying cause deaths as a percentage of all mentions; average annual percenatage change based on mentions

	N^b	Rates per million					
		Underlying cause (UC)	Mentions (M)	UC/M%	Average annual percent change	95%CI	
Males							
<35	148	0.5	1.0	45.9	5.9†	0.4	11.7
35–44	402	3.0	9.4	31.8	7.0†	4.7	9.3
45–54	766	5.2	20.1	25.7	7.2†	4.4	10.1
55–64	878	5.6	28.1	19.9	8.7†	6.8	10.8
65–74	703	4.4	30.3	14.7	7.2†	3.8	10.6
75+	318	2.8	19.0	15.1	6.0†	1.9	10.4
All ages	3215	2.5	11.1	22.4	7.5†	6.1	8.8
Females							
<35	182	0.5	1.2	37.9	3.8†	0.1	7.6
35–44	366	2.9	8.5	34.2	5.2†	0.9	9.7
45–54	733	6.2	19.0	32.7	4.8†	2.3	7.4
55–64	1223	10.0	38.0	26.2	4.4†	2.5	6.4
65–74	1487	12.5	55.8	22.4	4.9†	2.1	7.9
75+	1244	10.4	45.9	23.1	−0.3	−4.8	4.4
All ages	5235	4.5	17.3	26.3	4.0†	2.3	5.7
Total	8450	3.5	14.3	24.8	5.2†	3.7	6.7

a: Rates are age standardized, overall and within each broad age stratum, in five year groups
b: Number of deaths with a mention of obesity
†Statistically significant change

Trends in death rates: Oxford 1979–2006

Measured as mentions, all-ages rates showed non-significant, average annual changes of 0.4% (95% CI −1.2–1.9) for men (table 1) and 0.1% (−0.8–1.0) for women. Examination of the detail shows a significant increase of 10.3% (CI 3.5–17.5), for young women under age 35 years, a borderline significant increase for men aged 35–54 (5.6%; CI −0.5, 12.0), and a significant decrease for women 75 years and over (7.8%; CI 2.3, 13.0) (figure 1).

Trends in death rates: England 1995–2006

Underlying-cause mortality showed a slight increase over time; but mortality based on mentions showed a substantial increase, particularly from ∼2002 (figure 1). Mention-based mortality rose in men by an average annual rate of 7.5% (95% CI 6.1–8.8) per year; and rose in women by 4.0% (2.3–5.7). Death rates in England for individual years rose in men from 6.8 (6.4–7.2) in 1995 to 16.2 (15.8–16.6 in 2006, and in women from 13.1 (12.7–13.5) in 1995 to 18.5 (18.2–18.9) in 2006.

Other certified causes of death

When obesity was coded as the underlying cause of death, the most common other conditions mentioned were heart failure, pulmonary embolism, diabetes mellitus and pneumonia. When obesity was coded as a condition contributing to death, but not as the underlying cause, the most common underlying certified causes were chronic ischaemic heart disease, acute myocardial infarction, chronic obstructive pulmonary disease and diabetes mellitus (table 3).

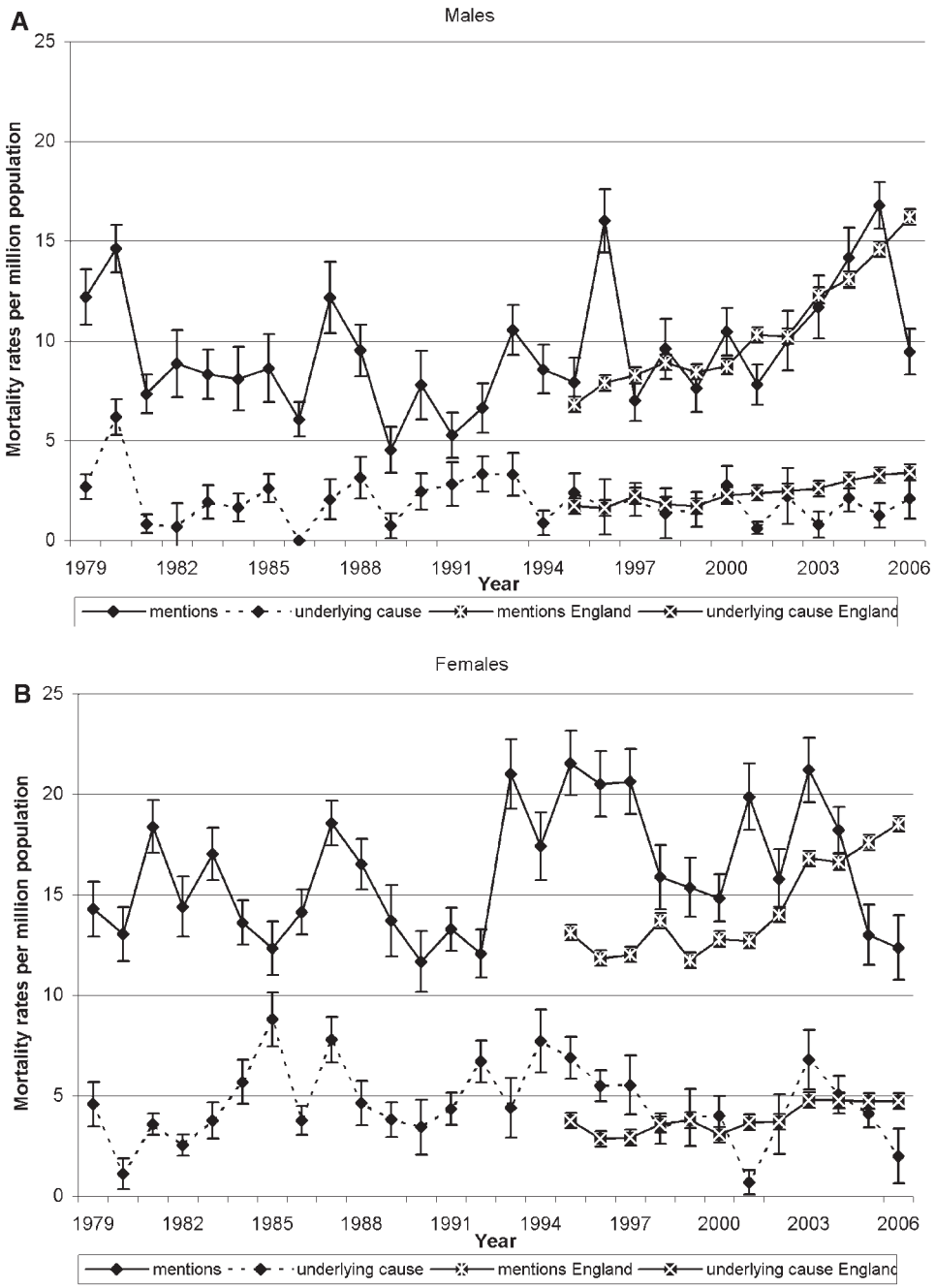

Figure 1 All-ages mortality rates for obesity in the Oxford region 1979–2006 and England 1995–2006, comparing underlying cause and mentions

Table 3 The 10 most common conditions associated with obesity on death certificates in England 1995–2006 and in the Oxford region 1979–2006

ICD code	Condition	England (N^a)	Oxford (N^b)
Obesity as underlying cause			
428, 150	Heart failure	531	58
415, 126	Pulmonary embolism	469	69
250, E10–E14	Diabetes mellitus	227	21
485, 486, J12–J18	Pneumonia unspecified	221	35
799, R09, R64, R99	Other ill defined and unknown causes of morbidity and mortality	215	16
414, 125	Chronic ischaemic heart disease	196	34
451, 180	Phlebitis and thrombophlebitis	177	21
401–404, I10–I13	Essential hypertension	167	18
490–492, 496, J44	COPD	155	11
429, I51	Complications and ill defined descriptions of heart disease	136	24
Obesity as contributing cause			
414, I25	Chronic ischaemic heart disease	1086	106
410, I21	Acute myocardial infarction	704	146
490–492, 496, J44	COPD	503	43
250, E10–E14	Diabetes mellitus	359	32
485, 486, J12–J18	Pneumonia unspecified	334	31
415, I26	Pulmonary embolism	281	29
451, I80	Phlebitis and thrombophiebitis	279	26
401–404, I10–I13	Hypertensive heart disease	264	30
428, I50	Heart failure	167	19
129, I51	Complications and ill-defined descriptions of heart disease	118	17

a: The total number of deaths in England where obesity was given as the underlying cause was 2152; there was a total of 6364 deaths where obesity was given as a contributing cause
b: The total number of deaths in the Oxford region where obesity was given as the underling cause was 267; there was a total of 760 deaths where obesity was given as the underlying cause

Discussion

Mortality statistics based on underlying cause alone substantially underestimate deaths with obesity on the death certificate: they capture only about a quarter of such deaths. This may of course itself still be a considerable underestimate of those deaths in which obesity was an important underlying cause. As measured by mentions, there has been a very substantial recent increase in mortality ascribed to obesity in the national data. This was not paralleled by a consistent increase, even in the same period, in the Oxford data. We cannot tell whether this represents geographical variation in the contribution of obesity to mortality, in certification practice, or both.

Although obesity mortality is higher for women than men, obesity deaths are rising more steeply in men than women. The sharper rise in men than women may reflect sex differences in recent trends in the prevalence of obesity. Findings from the Health Survey for England 2007 showed that, in the same range of years, the percentage of obese men, as assessed by BMI, rose from 15.3 (1995) to 27.4% (2006) compared with a slightly smaller increase in women from 17.5% to 24.2%.

A number of factors may influence a rise in the certification of obesity (Box 1). It seems likely that the increase in our study reflects the increase in the prevalence of obesity; but other factors, such as increased clinical awareness of, and willingness to certify, obesity may have played a role too.

Until recently in England and many other countries, only one underlying cause of death from each death certificate has been selected for routine coding and analysis in national systems. As well as omitting data on contributory causes, this can be problematic because the procedures for selecting the underlying cause of death change over time. Such changes occurred in England in 1984, 1993 and 2001.[7–9] The changes—changes to the application of 'rule 3' in the selection of the underlying cause of death when more than one disease is on the certificate—had a significant impact on the coding of obesity. There are important limitations in using death certification data for monitoring long-term trends over time in mortality as the most serious adverse consequences of obesity. Nonetheless, mortality statistics are an available resource for monitoring; and, at least in the near future, it seems unlikely that there will be alternatives to routine mortality statistics based on death certification for identifying trends in mortality ascribed directly to obesity. When used, analysis of mortality data should be based on mentions as well as underlying cause. When compared, over time or for international comparisons between countries, analyses should

Box 1: Factors that may increase certified mortality rates for obesity[a]

- An increase in the prevalence of obesity
- An increase in the degree of obesity, and therefore an increase in the prevalence at death of obesity considered serious enough to be certified as a cause of death
- When obesity is present at death, an increase in the percentage of cases of obesity in which the certifying doctor considered that obesity had contributed to death
- An increase in willingness to certify obesity, when considered to be a cause of death, as a contributing cause
- Increased clinical awareness of obesity as a condition that may contribute to death
- Diagnostic substitution: deaths that in previous times would have been certified as other disorders (e.g. ischaemic heart disease, diabetes) now being certified as obesity
- Trends in doctors' practice towards certifying more causes of death per decedent generally, incidentally resulting in more certificates that include obesity as a contributing cause
- Changes to rules for certification, selection, classification, or coding of causes of death

a: Modified from Goldacre *et al.*[13]

be interpreted in the knowledge of possible differences over time and between countries in the rules used for selecting and coding the underlying cause of death.

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Conflicts of interest: None declared.

Key points

- Obesity may contribute to death but is uncommonly certified on death certificates as a cause of death. When certified, it is usually selected as a contributing cause rather than as the underlying cause.
- There is an emerging trend over time of increased certification of obesity as a cause of death in England.
- Analysis of mortality based on underlying cause alone would have missed this rise.
- In using mortality statistics to monitor trends in deaths ascribed to obesity, public health practitioners should consider the importance of using all certified causes of death and not just the underlying cause.

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