

Relationship between body mass index and length of hospital stay for gallbladder disease

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ABSTRACT

Background Obesity increases the risk of hospital admission for gallbladder disease but its impact on the length of hospital stay is largely unknown.

Methods Prospective population-based study of 1.3 million women aged 56 years on average, recruited from 1996 to 2001 in England and Scotland and followed-up through NHS hospital admission record databases for gallbladder disease (cholelithiasis, cholecystitis, cholecystectomy) over a total of 7.8 million person-years.

Results During follow-up, 24 953 women were admitted with gallbladder disease, 87% who had a cholecystectomy. After adjusting for age, socioeconomic status and other factors, women with higher BMI at recruitment to the study were more likely to be admitted and spend more days in hospital. For 1000 person-years of follow-up, women in BMI categories of 18.5–24.9, 25–29.9, 30–39.9, 40+ kg/m² spent, respectively, 16.5[16.0–17.0], 28.6[28.3–28.8], 44.0[43.4–44.5] and 49.4[45.7–53.0] days in hospital for gallbladder disease.

Conclusion On the basis of these estimates, over a quarter of all the days in hospital for gallbladder disease in middle-aged women can be attributed to obesity.

Keywords body mass index, cholecystectomy, gallbladder diseases, 'length of stay', obesity

Background

Gallbladder disease is one of the most common causes of hospital admission in middle-aged women in developed countries^{1,2} resulting in a substantial cost to health systems.³ Although increased body mass index (BMI) is well recognized as a risk factor for gallstones and subsequent cholecystectomy,^{4,5} there is little information on what direct impact overweight and obesity have on the length of hospital stay for gallbladder disease. Given the increasing rates of overweight and obesity in the community, and the large number of hospital admissions for gallbladder disease, we report on the effect of BMI on length of hospital stay using routinely collected hospital admission records in a cohort of middle-aged women.

Methods

Study population and definitions

The Million Women Study is a prospective study that recruited 1.3 million women, mean age 56 years, from

National Health Service (NHS) breast screening clinics in England and Scotland through 1996–2001. At recruitment women provided information on their height, weight, reproductive history, use of exogenous hormones and medical history (see www.millionwomenstudy.org for questionnaires).

Study participants are followed for deaths and emigrations⁶ and linked to databases of NHS hospital admissions (the Hospital Episode Statistics for England⁷ and Scottish Morbidity Records⁸) using their NHS number (a unique personal identifier for NHS health care records), date of birth and sex in England and their NHS number, date of birth, sex and other personal details in Scotland. For linkage purposes, these databases contain a record of all NHS hospital admissions including day surgery, since 1 January 1981 in Scotland and 1 April 1997 in England. For each record,

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there is a primary reason for admission (coded using the WHO International Classification of Diseases 10th revision, ICD-10⁹), up to 12 procedures (coded using the Office of Population Censuses and Surveys Classification of Surgical Operations and Procedures, 4th revision, OPCS-4¹⁰) and the admission and discharge dates.

Women were identified as having a hospital admission for gallbladder disease if they had a hospital record where the primary diagnosis was cholelithiasis or cholecystitis (ICD-10 codes K80–K81) or where any procedure code indicated a cholecystectomy (OPCS-4 codes J18). As data were originally organized as episodes of care rather than individual hospital admissions, the episodes were combined into individual admissions (based on an identifier provided in the data). Hospital data from England contained a variable with a pre-calculated length of hospital stay (equivalent to the discharge date minus the admission date), whereas we calculated this variable in the hospital data from Scotland by subtracting the admission date from the discharge date. We added one to the length of hospital stay for each admission for gallbladder disease to account for day stay admissions. The Million Women Study has been approved by the Eastern Multi-centre Research Ethics Committee and all participants provided written consent for follow-up through their medical records. Acquisition of linked hospital records was approved by the Information Centre for Health and Social Care in England and the Information and Statistics Division Scotland.

Statistical analysis

Women were excluded if their BMI or length of hospital stay was unknown ($N = 71\ 169$ and 9 , respectively) or if they had a hospital admission for gallbladder disease before recruitment ($N = 9667$). Person-years were calculated from the date of recruitment to the date of discharge for a cholecystectomy (as a woman could not be admitted for gallbladder disease following a cholecystectomy), date of death, emigration or the end of follow-up, whichever came first. For women recruited in England and Scotland, the last date of follow-up was 31 March 2005 and 31 December 2003, respectively, corresponding to the dates when hospital records were complete at the time of record linkage. As there were a small proportion of women recruited in England (5%) before the linked hospital admission data were available, for these women person-years were calculated from 1 April 1997 (the date at which hospital data were available) instead of the date of recruitment.

BMI was calculated using self-reported height and weight collected at recruitment and participants were categorized according to the following BMI categories: <18.5 , 18.5 –

24.9 , 25 – 29.9 , 30 – 39.9 and $40+$ kg/m^2 . The relative risk of first hospital admission for gallbladder disease was estimated using Cox-regression. Then, within each BMI category, the total length of hospital stay for all admissions for gallbladder disease and for cholecystectomy alone was calculated and presented as the total length of hospital stay per 1000 person-years of follow-up. Analyses were adjusted or standardized for age at recruitment (in 2-year-age categories), socioeconomic status (in tertiles defined previously¹¹), region of recruitment (10 regions), smoking (never, past, current), alcohol use (never, <1 unit per week, ≥ 1 unit per week), parity (nulliparous, parous), use of hormone replacement therapy (never, past, current) and history of medical illness (high blood pressure, heart disease, stroke, thrombosis, diabetes or cancer, classified as never/ever).

As the length of hospital stay for gallbladder disease was not normally distributed, among the women admitted for gallbladder disease, the relationship between BMI and the length of hospital stay was also assessed using a non-parametric test for trend.¹² Using published rates of BMI in middle-aged women in England,¹³ UK population data¹⁴ and the length of hospital stay calculated in the study, we estimated the contribution that obesity makes to hospital stay for gallbladder disease in the UK. Analyses were conducted using STATA 9.2 statistical software and in the text, 95% confidence intervals are represented in square brackets.

Results

A total of 1 282 547 women followed for an average of 6.1 years were included in the analyses. During follow-up, 24 953 had at least one admission for gallbladder disease, 21 656 (87%) also having a cholecystectomy. Admissions for gallbladder disease occurred a mean of 3.3 years following recruitment. Table 1 shows, according to BMI category, the total women, person-years of follow-up, number of participants with an admission for gallbladder disease and for cholecystectomy, and the lengths of stay. Comparing the BMI categories, the largest proportion of women (45%) were in a healthy weight range (BMI 18.5 – 24.9 kg/m^2), whereas 36% were overweight (BMI 25 – 29.9 kg/m^2) and 18% obese (BMI ≥ 30 kg/m^2). The mean person-years of follow-up were similar in all groups. In women with a BMI ≥ 18.5 kg/m^2 , the mean total length of hospital stay for all gallbladder disease admissions and the mean length of stay for admissions for cholecystectomy increased with BMI group but the median lengths of stay remained the same except in women with a BMI ≥ 40 kg/m^2 .

Fig. 1 shows the adjusted relative risk of first hospital admission for gallbladder disease by BMI at recruitment.

Table 1 No. of participants, person-years of follow-up and events of interest according to BMI group

BMI group (kg/m ²)	N (% of total ^a)	Mean person-years of follow-up (SD)	No. women with admission for gallbladder disease	No. women with admission for cholecystectomy	Mean total length of hospital stay in women admitted for gallbladder disease in days (median)	Mean length of hospital admission for women who had a cholecystectomy in days (median)
<18.5	13 010 (1.0)	6.0 (1.4)	123	93	10.7 (4)	6.4 (3)
18.5–24.9	582 671 (45.4)	6.2 (1.2)	7105	6159	7.3 (4)	4.8 (3)
25–29.9	458 060 (35.7)	6.1 (1.3)	10 286	9023	7.7 (4)	4.7 (3)
30–39.9	210 977 (16.4)	6.0 (1.3)	6856	5959	8.3 (4)	5.1 (3)
40+	17 829 (1.4)	5.9 (1.4)	583	422	10.7 (6)	5.9 (4)
Total	1 282 547 (100)	6.1 (1.3)	24 953	21 656	7.8 (4)	4.9 (3)

^aPercentages do not add to total due to rounding.

The relative risks were 0.76[0.64–0.91], 1.81[1.75–1.86], 2.56[2.48–2.65] and 2.58[2.37–2.81] in women with BMI <18.5, 25–29.9, 30–39.9 and 40+ kg/m², respectively, compared to healthy weight women (BMI 18.5–24.9 kg/m²). Overall, the relative risks increased as BMI increased although there was a little difference between obese and morbidly obese women.

Fig. 2 shows the number of inpatient hospital days for gallbladder disease and for cholecystectomy per 1000 person-years of follow-up by BMI, standardized for age, socioeconomic status and the other factors. Women who were overweight (BMI 25–29.9 kg/m²), obese (BMI 30–39.9 kg/m²) or morbidly obese (BMI 40+ kg/m²) had significantly higher rates of hospital inpatient days for gallbladder disease per 1000 person-years than women with a healthy BMI (18.5–24.9 kg/m²): rates were 28.6[28.3–28.8],

44.0[43.4–44.5] and 49.4[45.7–53.0] per 1000 person-years, respectively, compared to 16.5[16.0–17.0]. Women who were underweight (BMI <18.5 kg/m²) also had a higher rate of hospital inpatient days compared to women with a healthy BMI (20.9[14.4–27.3] per 1000 person-years). The pattern was similar for cholecystectomy. Excluding underweight women, in the 24 953 women who were admitted for gallbladder disease there was a significant trend of increasing length of hospital stay with increasing BMI ($P < 0.0001$).

Applying the rates from Fig. 2 to the estimated number of women in the UK in each BMI category (using figures from the Health Survey for England¹³ and national census data¹⁴), the total annual number of inpatient hospital days for gallbladder disease in women aged 55–64 years was 99 722. If all these women had been in a healthy BMI range, the estimated inpatient days would be 56 533. As it was, obesity (BMI ≥ 30 kg/m²) accounted for 26 886 of the additional days of hospital stay.

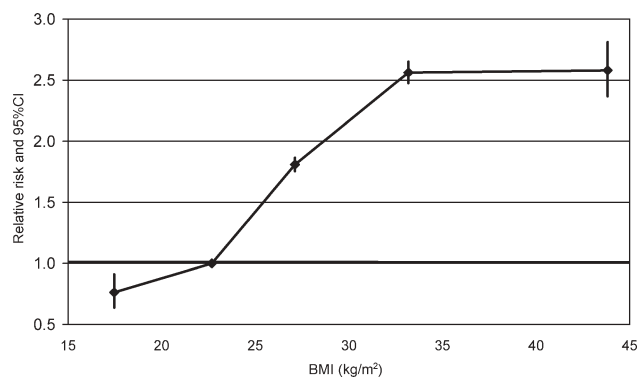


Fig. 1 Relative risk of hospital admission for gallbladder disease according to BMI at recruitment. Relative risk are plotted against the mean in each BMI category and adjusted for age, socioeconomic status, region, smoking, alcohol use, parity, use of hormone replacement therapy, history of heart disease, stroke, thrombosis, diabetes or previous cancer.

Discussion

Main findings

This study provides an estimate of the substantial additional cost that overweight and obesity contribute to the UK health system with respect to its effects on hospital stay for gallbladder disease. The results suggest that in middle-aged women obesity accounts for more than a quarter of the total inpatient hospital days for gallbladder disease in this population.

What is already known on this topic

Gallbladder disease is common in the UK and it has been identified as one of eight health resource groups in England

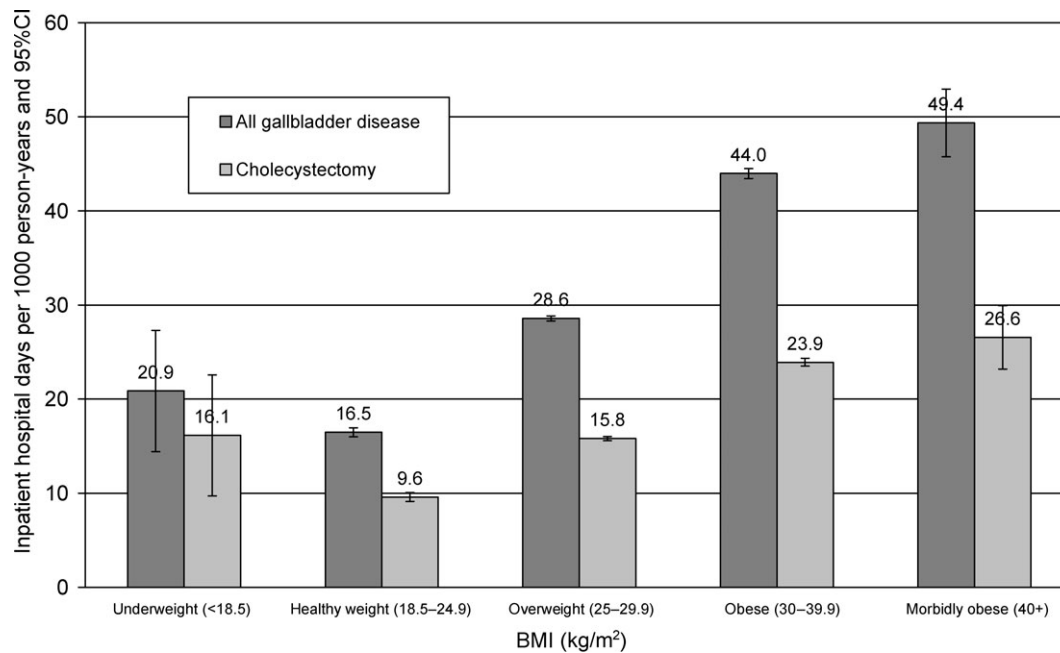


Fig. 2 Number of inpatient hospital days for gallbladder disease and cholecystectomy per 1000 person-years according to BMI at recruitment. Rates are standardized for age, socioeconomic status, region, smoking, alcohol use, parity, use of hormone replacement therapy, history of heart disease, stroke, thrombosis, diabetes or previous cancer.

that contribute to a large proportion of National Health Service resources.³ Rates of disease are highest in middle-aged women.² Previous studies have demonstrated that BMI is strongly positively associated with gallbladder disease and cholecystectomy^{5,15} but have not examined the effect on the length of hospital stay. Other studies have shown that obese patients have a longer length of hospital stay for all types of hospital admissions than healthy weight patients but these studies have not looked at the effects according to specific reasons for admission and nor were they able to adjust their estimates for such a wide range of possible confounding factors such as smoking, socioeconomic status as well as other co-morbidities.^{16,17}

What this study adds

We found the relationships between BMI and risk of hospital admission for gallbladder disease, and BMI and length of hospital stay differed. Increasing BMI was associated with an increase in the risk of hospital admission although the risks were similar for obese and morbidly obese women. With respect to hospital stay, except for underweight women, increasing BMI was associated with a consistent increase in the rate of hospital stay so that morbidly obese women had a significantly higher rate of hospital stay than obese women. Underweight women, however, appeared to have a higher rate of hospital stay than healthy weight

women although the large confidence intervals for underweight women make it difficult to draw firm conclusions.

These results indicate that while BMI may be a risk factor for developing gallbladder disease, other factors related to BMI, independent of the likelihood of hospital admission, affect the total length of hospital stay. The significant trend test for BMI and length of hospital stay in women admitted for gallbladder disease also supports this. Possible explanations for the differences in hospital stay with BMI include the fact that obesity is known to complicate cholecystectomy surgery¹⁸ and treatment decisions for patients such as laparoscopic versus open surgery or conservative versus immediate operative management may differ depending on their weight. Furthermore, obesity is known to increase the risk of other conditions such as cardiovascular diseases or thromboembolic disease that may prolong hospitalization.

Studies examining the length of hospital stay for all types of hospital admissions have found that underweight adults appear to have an overall longer length of hospital stay^{16,17} and our findings for admissions for gallbladder disease were similar. We postulate that this may be because these women have an underlying chronic debilitating disease (such as pancreatitis or cancer).

Limitations of this study

Limitations that may affect the precision of our estimates include that weight and height were self-reported, we were

unable to link to non-NHS funded admissions and we were also unable to exclude all women who had had a cholecystectomy before recruitment as we did not have hospital data in England before 1997. However, it is unlikely that overall these issues would substantially alter our findings. Studies have shown that self-reported height and weight correlate well with measured values¹⁹ and non-NHS hospitalizations only account for a small proportion of hospital admissions in the UK.²⁰ The effect of not excluding all women with a cholecystectomy before recruitment will have resulted in an overall underestimation of inpatient hospital stay attributable to gallbladder disease although given the size of the study cohort this is likely to be small. It is conceivable that overweight women would be more likely to have had a previous cholecystectomy before recruitment. However, if this was the case, then our calculated rates of hospital stay should be higher in the more overweight women, suggesting that our estimated number of hospital days attributable to obesity are in fact conservative.

It is possible that participants' BMI and other exposures such as smoking status and pre-existing illnesses may have changed since recruitment. However, as admissions for gallbladder disease occurred a mean of 3.3 years following recruitment, we would not expect substantial changes to these factors over this period of time and hence this is unlikely to greatly affect our estimates. Finally, this study population has been shown to be similar to the UK population, albeit of marginally higher socioeconomic group,²¹ hence it is likely that the population estimates provided here are generalizable.

Public health implications

A recent publication from the National Health Service in England estimated that each additional hospital bed day for gallbladder disease costs about £225.³ Our findings suggest a considerable reduction in hospital stay and hence health service costs could be achieved through public health measures that reduce obesity in the community. These contributions need to be considered in the context of the other benefits to health systems that come from addressing obesity in the population.

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