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Obesity and injury in the National Hospital Morbidity Database

David van der Zwaag, Sophie Pointer & James E Harrison

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Contents

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Abbreviations

ABS	Australian Bureau of Statistics
ACHI	Australian Classification of Health Interventions
ACS	Australian Coding Standards
AIHW	Australian Institute of Health and Welfare
AusDiab	Australian Diabetes, Obesity and Lifestyle study
BMI	body mass index
ICD	International Classification of Diseases
ICD–10–AM	International Classification of Diseases, 10th Revision, Australian Modification
ICD–9–CM	International Classification of Diseases, 9th Revision, Clinical Modification
METeOR	Metadata Online Registry
NCCH	National Centre for Classification in Health
NHMD	National Hospital Morbidity Database
NHS	National Health Survey
VAED	Victorian Admitted Episodes Database
WHO	World Health Organization

Symbols

n	number
n.p.	not publishable because of small numbers, confidentiality or other concerns about the quality of the data

Summary

Obesity and injury are major health burdens on society. A recent literature review on possible relationships between obesity and injury revealed some evidence of an association between obesity and injury, but the nature and extent was unclear (Norton et al. 2011). The review made a number of suggestions for further investigation. One suggestion was to examine the feasibility of using the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (NHMD) to investigate the relationship between obesity and hospitalised injury in Australia, and that is the aim of this report.

Reported obesity in the NHMD

The proportion of Australian hospital separation records for 2008–09 containing an ICD-10-AM obesity code (E66) is much lower than the proportion of people in the Australian population who are obese. About 1% of hospital separation records contain an obesity code. By comparison, the National Health Survey 2007–08 found that about 25% of Australians aged 18 or older were obese.

The low proportion of admitted cases with an obesity code appears to reflect the operation of the Australian Coding Standards (ACS) for admitted patients. If obesity is the main reason for an episode in hospital, then it should be coded as the principal diagnosis. If the presence of obesity is recorded as having affected patient management in certain ways, then it should be coded as an additional diagnosis. Otherwise (with limited exceptions, related to the presence of diabetes), the presence of obesity falls beyond the scope of what should be coded, according to the ACS.

Obesity and hospitalised injury

An examination of the subset of cases with code E66 that also met the definition of injury (ICD-10-AM principal diagnosis in the range S00–T75 or T79) was undertaken. These cases were compared with all other injury separations in the same period. About 1,360 separation records which met the criteria for injury also contained the code E66 *Obesity*. These comprised only 0.3% of injury separations and 2% of all obesity cases. The injury cases with an obesity code were more likely than injury cases with no reported obesity to involve falls (55% compared with 38%), to have occurred from about age 45 (76% compared with 44%) and to have a longer mean length of stay (13 days compared with 4 days).

Conclusions

The NHMD does not currently provide a reliable basis for measuring obesity among admitted patients, nor to assess the characteristics of injury cases with obesity. Importantly, the data do not identify most records in which the patient is obese. The set of cases that can be identified on the basis of having code E66 is likely to misrepresent patterns of healthcare utilisation for obese patients generally and may not be large enough for certain types of analysis. If measurement of obesity among admitted patients is required, then coding and the availability of data need addressing.

1 Introduction

Obesity and injury are major health burdens on society. In a review of the literature possible relationships between obesity and injury occurrence have recently been reported, but their nature and extent have been unclear (Norton et al. 2011). However, obesity has been found to affect outcomes after injury. Average length of stay in hospital was significantly longer for obese injured patients than for their leaner counterparts. Greater requirements for respiratory support have also been shown for injured obese patients relative to the non-obese. Further, obese injured patients are more likely to suffer certain complications during the period of care following injury. Risk of death after serious injury appears to be raised by obesity, though findings are mixed concerning the most severely injured cases.

The literature review posed a number of questions concerning the usefulness of the National Hospital Morbidity Database (NHMD) to investigate the relationship between obesity and hospitalised injury in the absence of routinely recorded height and weight measures (or body mass index, or BMI). These questions included: is the presence of obesity or overweight reflected in the data on hospitalised injury cases in Australia, and are the data likely to reveal cases in which obesity or overweight is an incidental characteristic rather than a primary reason for admission? The latter could occur, for example, when a person with a BMI of, say, 32 is admitted to hospital because of a fracture sustained in a motor vehicle crash.

1.1 Aim

This report examines the feasibility of using the NHMD to investigate the relationship between obesity and hospitalised injury in Australia.

The presence and use of obesity-related diagnosis and procedure codes in the NHMD were examined and ways of identifying obese patients from the data were investigated. Patterns of injury hospitalisation with relation to reported obesity were described to the extent enabled by the data.

1.2 Defining obesity

Obesity is commonly reported in terms of BMI. BMI is calculated as the person's weight (in kilograms) divided by their height (in metres) squared. While BMI has limitations in describing obesity accurately on a case-by-case basis (due to cultural, age and fat tissue distribution issues) it provides an established method of describing obesity and overweight within a population. Obesity can also be defined in other ways, such as that proposed by Bruce-Keller et al.: 'a physiological condition in which excess body fat has accumulated to an extent that it can negatively affect health' (Bruce-Keller et al. 2009).

Table 1.1 illustrates the range of BMI scores and their descriptive terms as recommended by the World Health Organization (WHO). In line with the WHO recommendations, a person is defined as obese in this report where BMI ≥ 30 kg/m^2. In general, health risks are continuous and graded and increase with increasing BMI above a specific, population-specific value (WHO 2000).

Table 1.1: International body size classification by BMI

Classification	BMI (kg/m^2)	Risk of comorbidities
Underweight	< 18.5	Low (risk of other clinical problems increased)
Normal Range	18.5–24.9	Average
Overweight	≥ 25.0	
Pre-obese	25.0–29.9	Increased
Obese	≥ 30.0	
Obese Class I	30.0–34.9	Moderate
Obese Class II	35.0–39.9	Severe
Obese Class III (morbidly obese)	≥ 40.0	Very Severe

Source: WHO 2000.

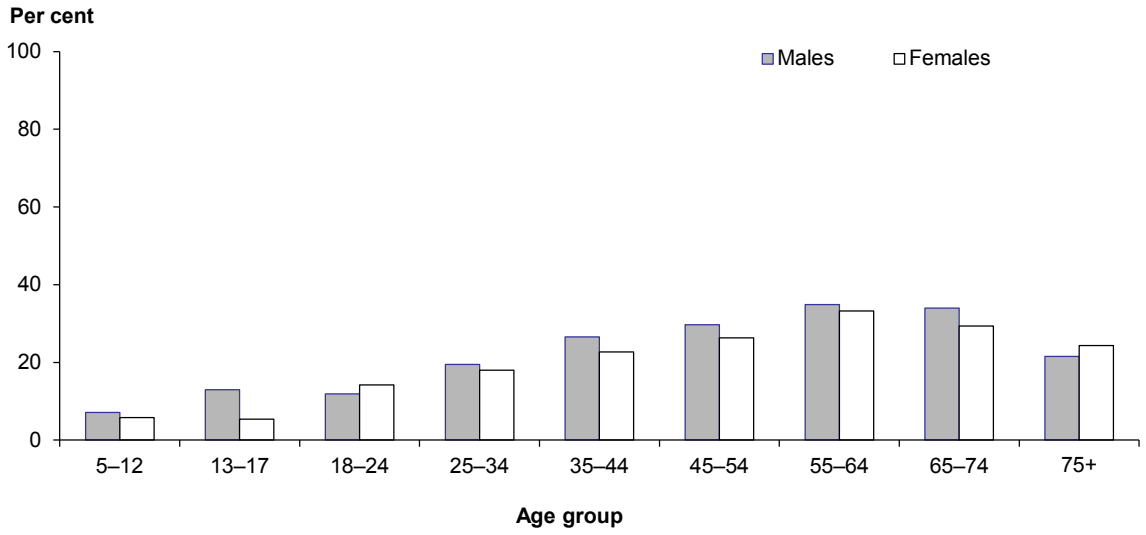
The method employed to calculate BMI in adults is not suitable for children and adolescents because of changes in body proportions and other factors. BMI ranges defining obesity in children and adolescents between the ages of 5 and 18 years are provided in Australia by the Australian Bureau of Statistics (ABS) (ABS 2009b). Where data for children are presented in this report the BMI cut-off points from the ABS were used (ABS 2009b).

1.3 Obesity and injury

Obesity in Australia

Population data on obesity rates in Australia relevant to this report are from the 2007–08 National Health Survey (NHS). The survey gathered self-reported height and weight data and also measured height, weight and girths. Figure 1.1 presents the distribution of obesity prevalence by age in Australia for 2007–08. Excluding those for whom height or weight data were not available, measured BMI showed that 37% of Australians over the age of 18 were overweight but not obese, while 25% were obese (ABS 2009a). Males are more likely to be obese than females at all but two age ranges (18 to 24 and 75 and over). The highest proportion of obesity for both males and females occurred between the ages of 55 and 64.

BMI (based on measurements) was obtained for the NHS conducted in 1995. Between the 1995 NHS and the 2007–08 NHS, the proportion of the Australian population aged 18 and older with BMI in the obese range (30 kg/m^2 and above) rose from 19% to 25%.



Note: Obesity in the 5–12 and 13–17 age groups is defined by a range of child BMI cut-off points defined by the ABS (ABS 2009b) not by the adult cut-off point of BMI ≥ 30 kg/m^2.

Source: ABS 2009a.

Figure 1.1: Australian obesity prevalence 2007–08

The relationship between obesity and injury

The findings from the recent literature review (Norton et al. 2011) on the relationship between obesity and injury are mixed, but evidence suggests that obesity may well increase the risk of injury, alter the pattern of injury and complicate recovery. Some findings from a number of the studies reviewed are as follows:

- The probability of falls, trips or stumbles, and resulting musculoskeletal injury, tends to rise with obesity, in the general population, in sport and in the workplace.
- Sleep apnoea, which increases risk of road-crash injury, is strongly associated with obesity.
- Workers' obesity has been found to be associated with elevated risk of workplace injury.
- Obesity affects outcomes after injury. Average length of stay in hospital is significantly longer for obese injured patients and they tend to have greater requirements for respiratory support.
- Obese injured patients are more likely to suffer certain complications during the period of care following injury.

A recent addition to the Australian literature on this topic is a study of BMI as a risk factor for admission to hospital (Korda et al. 2012). The study is based on the 45 and Up Study, a prospective cohort of about 10 per cent of New South Wales residents who were aged 45 or older when the study began. Korda et al (2012) derived BMI from height and weight as self-reported by participants in the baseline survey. At baseline, 40% of participants were overweight and another 22% were obese.

Overall, BMI in the overweight and obese ranges was associated with higher risk of hospitalisation than BMI in the normal range. This was also found for nearly all of the types of condition reported. The main exception was fractures, for which adjusted relative risks were lower for participants who were overweight or obese at entry into the study than for those who were in the normal BMI range. The results as reported do not allow assessment of whether this characteristic of overweight and obese participants was because they were less exposed to risk of falling (for example, less physical activity), had lower propensity to fall, had lower risk of fracture when a fall occurred, or was due to a combination of factors.

2 Identification of obesity in the NHMD

To study the relationship between obesity and injury, it is necessary to identify obese individuals in a data source that also identifies those with injury. This chapter describes the ways in which obese patients might possibly be identified in routinely collected data, focusing on the Australian Institute of Health and Welfare (AIHW) NHMD. It also provides a review of the few studies that have attempted to validate the use of International Classification of Diseases (ICD) codes to identify obese patients within hospital-based data.

2.1 Obesity coding in Australia

The NHMD is the main source of data used to describe hospitalised injury morbidity in Australia. It is a whole-population data source containing records of hospital separations in Australia. A separation is defined as '[a] formal, or statistical, process by which an episode of care for an admitted patient ceases' (AIHW 2008a). Nearly all admitted patients separating from public and private hospitals in Australia are included in the NHMD.

Data provided in the NHMD include codes for the principal diagnosis, additional diagnoses, external causes of injury and procedures undertaken, coded according to the International Classification of Diseases and Related Problems, 10th Revision, Australian Modification (ICD-10-AM) (NCCH 2006). The ICD-10-AM codes are assigned by professional coders on the basis of the patient's hospital file and, when necessary, advice from attending clinicians.

A range of demographic and other information is also recorded, describing factors such as sex, age and place of usual residence. There is no data element in the NHMD for height, weight or BMI.

Recording BMI in hospital records

Weight, height and/or BMI are sometimes noted in hospital records. Obesity may be noted in a patient file because of concern about risks related to some types of treatment, such as surgery (Hauck & Hollingsworth 2008), because required doses of some medications vary with weight, due to clinical concern with or patient growth or nutritional status. Mention of obesity in patient records may also alert hospital staff to the need for extra precautions in lifting or manoeuvring a patient and serve as an identifier of patients who require specialised bariatric beds and other equipment. Thus, the presence of data in records that would allow calculation of BMI may vary according to the patient's condition and type of care.

The extent to which Australian hospital records contain information sufficient to enable the presence of obesity to be coded needs further investigation.

ICD-10-AM obesity codes

ICD-10-AM codes for obesity and obesity-related conditions are in the ICD-10-AM code-block E65–E68 *Obesity and other hyperalimentation* (Table 2.1) (NCCH 2006). E66 *Obesity* is the main diagnosis code used to identify obesity in the NHMD. Hyperalimentation is a condition where the quantity of food consumed is more than necessary, for varying causes. E67 *Other hyperalimentation* and E68 *Sequelae of hyperalimentation* cannot be used as absolute markers of obesity and are not considered further here. The code *E65 Localised Adiposity* is

not a reliable predictor of obesity as it does not necessarily mean that a patient is obese according to a formal definition and is also not used in this report.

Table 2.1: ICD-10-AM diagnosis codes related to obesity

ICD-10-AM Code	Label	Description
E65	Localised adiposity	Abdominal apron or overhang Fat pad
E66	Obesity	***Excludes:*** *Adiposogenital dystrophy* *Lipomatosis dolorosa [Dercum]* *Lipomatosis NOS* *Prader-Willi Syndrome*
E66.0	Obesity due to excess calories	
E66.1	Drug–induced obesity	Requires use of an additional external cause code to identify drug
E66.2	Extreme obesity with alveolar hypoventilation	Pickwickian Syndrome
E66.8	Other obesity	Morbid obesity
E66.9	Obesity, unspecified	Simple obesity NOS
E67	Other hyperalimentation	
E68	Sequelae of hyperalimentation	

Coding standards and coding of obesity

A condition, such as obesity, cannot be ICD coded unless it is recorded in the hospital record. However, not all of the potentially codable conditions mentioned in hospital records are coded. The Australian Coding Standards (ACS), which form part of the ICD-10-AM, instruct coders on which conditions should be coded and on the correct interpretation and application of ICD-10-AM codes (NCCH 2008).

The ACS requires that a principal diagnosis is selected and coded for each episode of admitted patient care (ACS 0001—Principal diagnosis) (NCCH 2008). According to the standard, this is the 'diagnosis ... chiefly responsible for occasioning an episode of admitted patient care …'.

The standards also allow for the coding of additional diagnoses (ACS 0002—additional diagnoses), which are defined as 'diagnoses coexisting with the principal diagnosis or arising during the episode' (of care) (NCCH 2008). According to the standard, additional diagnoses should only be coded when they are conditions that affect patient management by requiring:

- commencement, alteration or adjustment of therapeutic treatment, and/or
- diagnostic procedures, and/or
- increased clinical care and/or monitoring.

It is therefore expected that clinical coders would only assign an E66 *Obesity* as an additional diagnosis where the clinical record indicated that at least one of these criteria had been met. The presence of obesity would not, of itself, satisfy the criteria.

There are partial exceptions to this rule. ACS 0002 includes a list of 19 other standards that require that certain conditions or factors should sometimes be coded as an additional diagnosis even though the default requirements of ACS 0002 are not met. Examples are pregnancy, and drug, alcohol and tobacco use disorders. Obesity, as such, is not on this list.

However, the coding standard for diabetes states that when diabetes mellitus with features of insulin resistance is coded (E09.72 *Impaired glucose regulation with features of insulin resistance*, E11.72 *Type 2 diabetes mellitus with features of insulin resistance*, E13.72 *Other specified diabetes mellitus with features of insulin resistance*, and E14.72 *Unspecified diabetes mellitus with features of insulin resistance*) and obesity is documented, then an additional diagnosis code should be assigned to report the obesity. In this scenario the obesity would be coded without having to meet the requirements of ACS 0002.

In summary, the ACS requires coding of obesity when it is the main reason for an episode in hospital (principal diagnosis) or when it is recorded as having affected patient management or where it is associated with diabetes with features of insulin resistance.

The ICD-10-AM category E66 *Obesity* does not provide a definition of obesity, in BMI or any other terms. Nor are examples given in the ACS of when E66 should and should not be assigned.

We are aware of no studies that assessed the BMI for patients who are assigned E66 and compared this with the BMI for other groups of patients. It is noteworthy that ICD-10-AM does not provide a category for Overweight.

It is also noteworthy that the diabetes coding standard described above was discontinued from 1 July 2010.

2.2 Other potential indicators of obesity in the NHMD

Since the ACS limits use of code E66 *Obesity* to cases in which obesity was the main cause of the episode in hospital, or affected certain aspects of patient management, it is likely that not all obese patients admitted to hospital are assigned an obesity diagnosis code. The extent to which this occurs is assessed in Chapter 3.

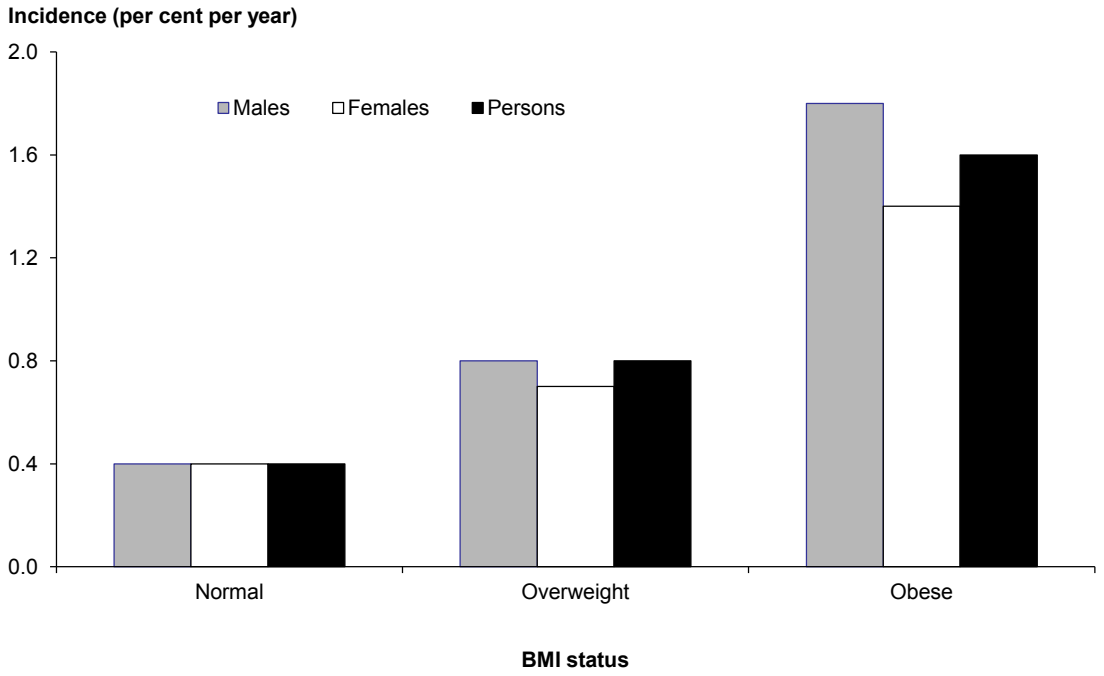
Given this, are there other ICD-10-AM codes that are likely to indicate the presence of obesity? Obesity has been found to be strongly associated with certain diseases, particularly diabetes. In addition, certain procedure codes describe treatments that are specific to obesity. What follows is a discussion of the feasibility of using diagnoses of an obesity-related diseases or procedures as a possible way of identifying obese cases in the NMDS in the absence of the specific obesity diagnosis code E66.

Diabetes mellitus

About 275 Australians develop diabetes every day resulting in 0.8% of Australian adults developing the condition each year (Barr et al. 2005). Obesity has been identified as a risk factor for Type 2 (adult onset) diabetes mellitus (Barr et al. 2005; Hardoon et al. 2010; Mokdad et al. 2003). Studies also suggest causal links between obesity and insulin resistance (Crowe et al. 2009), the key characteristic of Type 2 diabetes.

The Australian Diabetes, Obesity and Lifestyle (AusDiab) study is the largest Australian longitudinal population-based study examining the natural history of diabetes, pre-diabetes

(in which glucose metabolism is impaired but not to the level to cause diabetes), heart disease and kidney disease. The annual incidence of diabetes was almost 4 times higher in obese people than in normal-weight subjects (Barr et al. 2005). Figure 2.1 displays the annual incidence of diabetes in normal, overweight and obese individuals taken from the 2005 AusDiab report (Barr et al. 2005).



Note: Body mass index (BMI: weight/height^2) was categorised into three groups, (i) normal: BMI<25 kg/m^2; (ii) overweight: 25–29.9 kg/m^2; and (iii) obese: ≥30 kg/m^2.

Source: Barr et al. 2005.

Figure 2.1: Incidence of diabetes according to body mass index status

Most work that explores this relationship focuses on obesity as a risk factor for diabetes. Callaway et al. (2006) studied 14,230 women admitted to a Brisbane hospital for obstetric care from 1998 to 2002 and examined the relationship between estimated BMI and undiagnosed Type 2 diabetes. A marked increase in the rate of Type 2 diabetes mellitus with increasing BMI was found among the women (Callaway et al. 2006). Type 2 diabetes mellitus was identified in 0% of normal weight (BMI = 20–25 kg/m^2) participants, 0.6% of overweight (BMI = 25–30 kg/m^2) participants, 1.4% of obese (BMI = 30–40 kg/m^2) participants, and 2.8% of morbidly obese (BMI > 40 kg/m^2) patients (P<0.001 for all scores).

Among a sample of morbidly obese Americans, Type 2 diabetes prevalence has been recorded as 24.3% (Scott et al. 2006). The age-adjusted prevalence of diabetes among the wider American population in the same period was 6.3% (CDC 2003).

While the relationship is strong between obesity and Type 2 diabetes, there is far from complete overlap between the groups. Hence, it is implausible that the presence of a code for Type 2 diabetes in NHMD data is an adequate proxy for the presence of obesity.

Surgical procedures for obesity

Surgical advances in the mid to late 20th century improved the safety for morbidly obese patients of undergoing procedures designed to assist weight loss. These bariatric procedures are generally aimed at reducing calorie intake through reduction of stomach capacity or intestinal re-routing. Such procedures can be identified in NHMD data.

In a report on weight loss surgery in Australia, the AIHW found that between 1998–99 and 2007–08 the number of hospital separations increased from 535 to about 17,000 (AIHW 2010). Weight loss surgery (also known as bariatric surgery) was defined using selected *Procedures for morbid obesity* from block number 889 of the Australian Classification of Health Interventions (ACHI) (see Section 3.6 of this report for further information). Bariatric surgery is generally only recommended for patients with a BMI of greater than 40 kg/m^2 or patients with a BMI greater than 35 kg/m^2 with serious comorbidities (Robinson 2009).

Aside from the increasing prevalence of obesity, factors leading to increases in the incidence of bariatric procedures in Australia and elsewhere include more widespread awareness and acceptability of bariatric treatment, surgical advances (for example, laparoscopic techniques) and increasing numbers of surgeons offering bariatric procedures (Adams et al. 2008; AIHW 2010; Encinosa et al. 2009; Robinson 2009; Steinbrook 2004).

Unlike the presence in the NHMD of diagnosis codes for diabetes, the presence of a bariatric procedure code should be a reliable indicator of obesity in an individual. The presence of bariatric procedure codes and their relation with reported obesity in NHMD data are examined in Chapter 3.

2.3 Previous approaches to identifying obese patients in admitted patient data

Few studies were located that attempted to validate the use of ICD codes in hospital-based administrative data sets to identify obese patients. Much of the work examining the use of ICD coding of obesity in hospitals focuses on children and was done in the United States. Coding in United States hospitals is carried out using a clinical modification of ICD–9 (ICD–9–CM). The code covering obesity is 278, which is equivalent to E66 in ICD–10–AM.

As has been briefly mentioned, the use of adult BMI measures is not appropriate in children. As a result, it is difficult to interpret the presence of an ICD obesity code in records for children unless it is known that its use was based on appropriate criteria, such as age- and sex-specific BMI percentiles.

Woo et al. (2009) used obesity codes in the hospital record in a study of obesity in a large children's hospital in the United States. From July 2003 to April 2007, 63,557 inpatient cases were selected. Individuals aged under 2 or over 20 were excluded, as were a small number of cases designated 'research'. The sample was examined in terms of reported obesity (presence of a reported obesity code ICD–9–CM 278) and validated BMI confirmed with height and weight measures in the record. While only 1.7% (n = 512) of separations studied by these authors contained an obesity diagnosis code, BMI scores for the same patients suggested that 20.4% were obese.

Other United States studies have attempted to identify obese children using ICD–9–CM reported obesity within administrative hospital data. These authors, like Woo et al. (2009), concluded that estimates based on administrative data tended to grossly underestimate the

prevalence of obesity in the groups studies and to misrepresent true patterns of obesity in hospitalised populations (Cook et al. 2005; Hampl et al. 2007; Hlaing et al. 2009).

In Australia, Hauck and Hollingsworth (2010) counted separations containing the ICD-10-AM code for obesity (E66) in a restricted number of specialty areas for adult patients using the Victorian Admitted Episodes Database (VAED) for 2005–06. The primary aim of the study was to investigate the impact of severe obesity on length of stay within certain medical specialties. Hauck and Hollingsworth (2010) defined as 'severe obesity' the records containing diagnosis code E66.

In the study, 435,147 separations from the VAED contained 6,387 episodes where at least one E66 code was in the record. This represented an overall proportion of patients with reported obesity in the sample of 1.5% (Hauck & Hollingsworth 2010). Recorded obesity prevalence for patients treated in specialties such as endocrinology and cardiology were higher than in the total sample (5.0% and 2.9% respectively). Conversely, only 0.3% of obstetrics patients and 0.5% of ear, nose and throat patients were coded as being obese (Hauck & Hollingsworth 2010).

The authors noted that patients in Victorian hospitals were not routinely weighed and so diagnoses of obesity may be based on visual assessment by a treating doctor. They pointed out that the community prevalence of obesity was much higher than that implied by the cases identified as obese on the basis of ICD-10-AM code E66 (Hauck & Hollingsworth 2008). They concluded that E66 tended to indicate the presence of severe or morbid obesity.

All of the few studies of obesity based on the presence of ICD codes in administrative data collections found that this approach greatly underestimated obesity. Two of the reasons put forward for this include physicians not recording height and weight or BMI in case notes and clinical coders not coding obesity when height and weight or BMI are present.

3 Reported obesity in the NHMD

It was concluded in Chapter 2 that options are very limited for the purpose of identifying obese people among admitted patients on the basis of information in the NHMD. The most promising approach relies on the presence in a record of ICD-10-AM diagnosis code E66 *Obesity*. However, as also discussed in Chapter 2, Australian Coding Standards are that only some obese patients will have that code in the data summarising their episode of admitted patient care.

Examination of NHMD data can provide observed proportions of cases with code E66 *Obesity*. Assessment of the plausibility that these proportions provide good estimates of obesity requires expected values. These were obtained from two editions of the ABS NHS. The editions used are the 2007–08 NHS (the latest available at the time of analysis) and the 2004–05 NHS (which contains more data on injury than the 2007–08 NHS).

In addition, some characteristics of the cases with code E66 are described, to assess whether they are a representative sample of the hospital-admitted people who are obese.

3.1 Data and selection criteria

This report uses data for hospital separations in Australia from 1 July 2008 to 30 June 2009 with any diagnosis of E66 *Obesity* in the record. The data year 2008–09 covers a period close in time to the 2007–08 NHS. The hospital separations reported here were coded according to the 6th edition of ICD-10-AM (NCCH 2008). Additional information about the methods and data are in Appendix A: Data issues.

3.2 Reported obesity hospital separations

Indicators

Of all 8,148,448 hospital separations in Australia for 2008–09, only 65,184 (0.80%) have code E66 *Obesity* anywhere in the record (Table 3.1).

E66 is the principal diagnosis code in almost one-quarter (23.5%, n = 15,338). The rest have an E66 code in one or more additional diagnosis fields (76.5%, n = 49,846). This distinction is important for two reasons. First, separations with E66 as the principal diagnosis should be those in which the patient was admitted to hospital primarily because of obesity. Second, the case definition of injury used in this report requires that the principal diagnosis code is from the Injury chapter of ICD-10-AM (S00–T75 or T79). It follows that a case meeting the study definition of injury can only have code E66 as an additional diagnosis (see Chapter 4).

Table 3.1 presents further summary statistics for 2008–09 Australian hospital separations relating to reported obesity. Females accounted for more separations containing an obesity diagnosis (n = 38,938) than males (n = 26,246). Females account for 59.7% of cases with code E66 and for 52.7% of all separations.

Table 3.1: Indicators for hospital separations for reported obesity, Australia 2008–09

Indicators	Males	Females	Persons[a]
All hospital separations 2008–09	3,854,100	4,294,291	8,148,448
Reported obesity separations[b]	26,246	38,938	65,184
As percentage of all hospital separations	0.68%	0.91%	0.80%
Age-standardised rate of reported obesity	236.3	342.6	289.4
E66 as principal diagnosis[c]	3,341	11,997	15,338
E66 as additional diagnosis	22,905	26,941	49,846

(a) Persons totals include separations for which sex was indeterminate or not reported.

(b) Includes all separations containing an E66 *Obesity* code.

(c) Eight separations have an E66 code in both the principal and additional diagnosis fields.

The age-standardised rate of reported obesity separations was 289 per 100,000 population. Females had a higher rate of reported obesity (343 per 100,000 population) than males (236 per 100,000 population).

Population-based rates of reported obesity tended to rise with age (Figure 3.1). Age-specific rates were highest for males (763 per 100,000 population) and females (729 per 100,000 population) aged 65–74. Rates for males and females were very similar in childhood and old age. At intermediate ages, rates for females were higher than those for males.

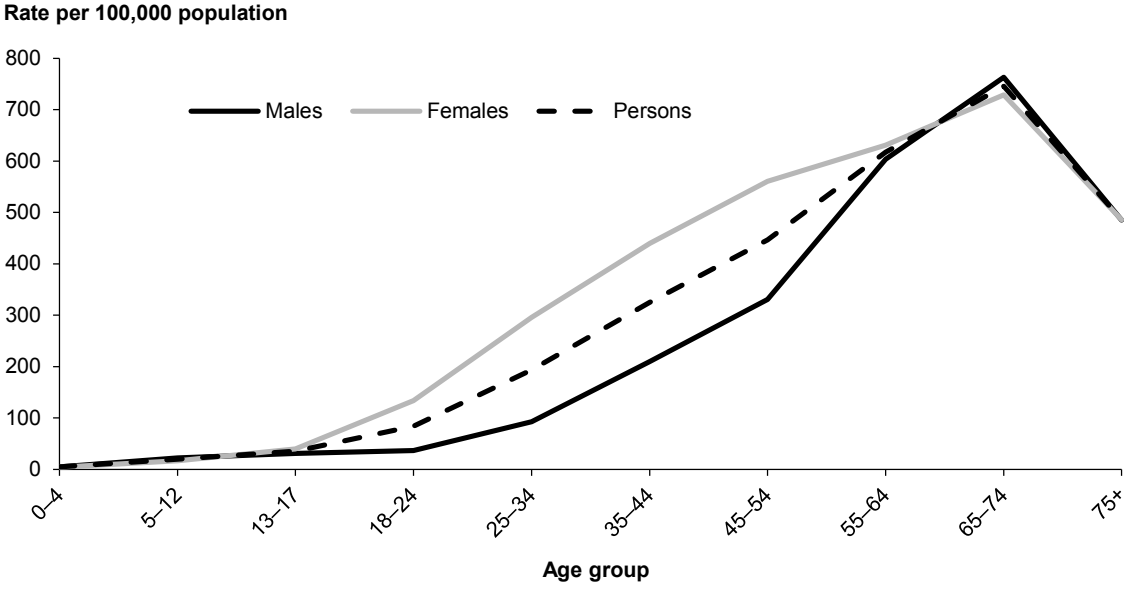


Figure 3.1: Age-specific rates of reported obesity separations by sex, Australia 2008–09

Type of diagnosis

ICD-10-AM code E66 *Obesity* has several subcategories (Table 3.2). In the great majority of cases of reported obesity separations, the subcategory is E66.9 *Obesity, unspecified* (simple obesity) (*n* = 39,436). Most of the remaining separations with reported obesity have the code E66.8 *Other obesity (Morbid obesity)*. A small proportion of the cases have the remaining codes E66.2 *Extreme obesity with alveolar hypoventilation*, E66.1 *Drug-induced obesity* and E66.0 *Obesity due to excess calories*.

Table 3.2: Type of obesity diagnosis, Australia 2008–09

ICD-10-AM Code	Description	Separations			Per cent of all hospital separations
		Males	Females	Total	
E66	**Obesity**	**26,246**	**38,938**	**65,184**	**0.8**
E66.0	Obesity due to excess calories	91	106	197	0.004
E66.1	Drug–induced obesity	10	16	26	< 0.001
E66.2	Extreme obesity with alveolar hypoventilation	117	188	305	0.002
E66.8	Other obesity (Morbid obesity)	8,435	16,785	25,220	0.31
E66.9	Obesity, unspecified (simple obesity)	17,593	21,843	39,436	0.48

Reported obesity and expected obesity

The findings presented above summarise the obesity reported in NHMD data. Assessments of whether these observed data are likely to provide a useful indication of obesity among admitted patients can be based on ABS NHS data. The 2007–08 NHS obtained measured data on height, weight and girth for a large, representative sample of the Australian population, and also self-reported data on height and weight. The 2004–05 NHS obtained self-reported data on height and weight.

Two types of assessment are made here: (1) a comparison of proportions of obesity in the general population (based on the 2007–08 NHS) with observed 'reported obesity' in the NHMD and (2) an analysis of the relationship between obesity and the likelihood of being admitted to a hospital.

The first assessment was done by comparing proportions of 'diagnosed obese' cases in the NHMD with proportions of measured obesity in the general population, according to the measured results of the 2007–08 NHS. The comparisons presented here are for the age groups reported for the 2007–08 NHS (Table 3.3).

The first column of data in Table 3.3 shows the number of persons per hundred in each age-group in the Australian population who were obese (BMI ≥ 30 kg/m^2), according to 2007–08 NHS. The proportion rose with age from 6.5% of children aged 5 to 12 to a peak of 34.1% of those aged 55–64. Considering the whole age range of 5 and older, 21.6% were found to be obese.

The next column shows a conceptually similar proportion based on hospital separations in 2008–09. Values in this column are the number of separations with code E66 *Obese* per 100 separations at each age group.

If obesity is as common among people admitted to hospital in Australia as it is in the general population, then the values in these two columns should be similar. As can be seen, the

percentages of reported obesity are much lower than the population values. The last column in Table 3.3 shows the ratio of reported obesity (per 100 separations) to measured obesity (per 100 population) from the 2007–08 NHS.

For all ages 5 and older taken together, the prevalence or reported obesity was 3.7% of the measured obesity in the 2007–08 NHS. The proportions in Table 3.3 are also charted in Figure 3.2.

Table 3.3: Proportion of separations with reported obesity (NHMD 2008–09) and Australian population obesity prevalence (2007–08 NHS) by age group

Age group[(a)]	Population prevalence of obesity per 100 persons: NHS 2007–08[(b)]	Reported obesity per 100 separations in each age group	Ratio of population prevalence to reported obesity
5–12	6.5	0.23	0.035
13–17	9.2	0.30	0.033
18–24	13.0	0.42	0.032
25–34	18.8	0.73	0.039
35–44	24.6	1.14	0.046
45–54	28.0	1.29	0.046
55–64	34.1	1.15	0.034
65–74	31.6	0.86	0.027
75+	23.0	0.39	0.017
Total (ages 5 and older)	**21.6**	**0.8**	**0.037**

(a) Separations for the 0–4 age have been omitted (reported obese *n* = 66).

(b) Obesity was classified as measured BMI ≥ 30.0.

These comparisons do not allow for the possibility that people who are admitted to hospital differ from others in terms of the proportion who are obese. For that possibility to account for a noteworthy part of the difference, obese Australians would have to be much *less* likely than others to be admitted to hospital. While that seems unlikely at face value, it is desirable to check this possible explanation. That is the subject of the second assessment based on NHS data.

The second assessment made use of data from the 2004–05 NHS. The assessment could not be done using tables published by the ABS but required analysis of data in a Confidentialised Unit Record File. The 2004–05 NHS obtained self-assessed data on weight and height, from which BMI was calculated. While self-assessed data are not as reliable as measured data, they are adequate for this purpose. The survey also included a question on whether each respondent had been admitted to hospital during the previous year.

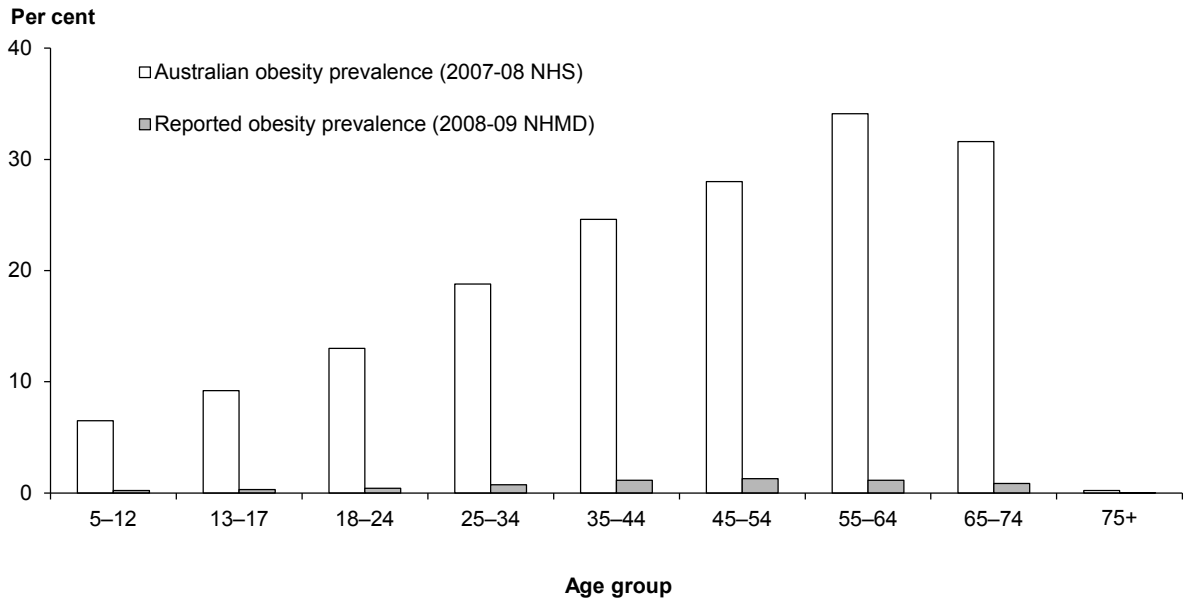


Figure 3.2: Proportion of separations with reported obesity (2008–09 NHMD) and Australian population obesity prevalence (2007–08 NHS) by age group

Table 3.4 shows how the likelihood of having been admitted to hospital at least once in the previous year varies with BMI. The incidence rate ratio follows a U-shape in relation to BMI. The respondents with BMI in the normal ranges were least likely to have been hospitalised and those with the most extreme BMI values, whether high or low, were more likely to have been admitted to a hospital.

Table 3.4: Admission to hospital in previous year by level of BMI, Australia (2004–05 NHS)

		95% confidence interval	
BMI range	**Incidence Rate Ratio[(a)]**	**Lower**	**Upper**
Grade 3 thinness (BMI < 16)	1.57	0.97	2.54
Grade 2 thinness (BMI16)	1.06	0.66	1.70
Grade 1 thinness (BMI 17–< 18.5)	1.13	0.86	1.48
Normal range (BMI 18.5–< 20)	0.97	0.80	1.17
Normal range [base category] (BMI 20–< 25)	1		
Grade 1 overweight (BMI 25–< 30)	1.03	0.93	1.14
Grade 2 overweight (BMI 30–< 40)	1.20	1.07	1.35
Grade 3 overweight (BMI ≥ 40)	1.65	1.23	2.20

(a) Poisson regression adjusted for age-group and sex.

The weighted proportion of respondents with BMI below the normal range (3%) was much smaller than those in the normal ranges (45%) or in the overweight and obese ranges (52%). Reflecting this distribution, the confidence intervals around the estimates for people with below normal weight are wide, and include 1.0, so the elevation of admission at this end of the range cannot be said to be statistically significant. However the elevation reaches

statistical significance for the two groups with the highest BMI, which meet the usual criteria for obesity (BMI ≥ 30 kg/m^2) and morbid obesity (BMI ≥ 40 kg/m^2). The pattern observed here might be influenced by other factors associated with BMI and admission to hospital, such as age and sex. The model that produced the rate ratios in Table 3.4 included age and sex. That is, the rate ratios are adjusted for the differing distributions of age and sex in the BMI groups being compared.

The elevated incidence rate ratio for obese respondents compared with those in the normal BMI range is relevant here because it shows that obese persons are, if anything more likely than those in the normal BMI range to be admitted to hospital. It refutes the possibility raised above, and implies that the proportion of the records of obese people admitted to hospital that have code E66 *Obesity* may be even lower than is indicated in Table 3.3.

This finding is not unexpected given the influence of the relevant ASC coding standards (Section 2.2). It should also be noted that the comparison involves obesity prevalence in the population of Australia with the prevalence of reported obesity in a hospitalisations population in which individual people can be represented more than once.

Results have recently been published of a large population-based study of BMI and risk of hospital admission in New South Wales (Korda et al. 2012). These results confirm, for persons aged 45 and older, that BMI in the overweight and obese ranges is associated with higher rates of hospital admission than BMI in the normal range.

3.3 Separations with diagnosis code for obesity

This section provides a description of the apparently small subset of obese admitted patients whose records include ICD-10-AM code E66 *Obesity.* While it is evident that these cases are not a useful basis for quantifying obesity among admitted patients, it is possible that they might provide useful insights into the types of cases to which this code is applied and, perhaps, to ways in which obese patients differ from or are similar to others.

Table 3.5 allows comparison of the age distribution of obesity diagnoses among hospital separations with the age distribution of obesity in the Australian population, according to 2007–08 NHS. The age distributions are similar, but not identical. According to both sources, the largest proportion of the obese group is in the age group 55 to 64.

The Australian Coding Standards imply that ICD-10-AM code E66 *Obesity* should appear mainly in the context of certain types of case. For those types of case, the presence or absence of E66 might provide a reliable guide to the presence or absence of obesity. This section presents an assessment of the separation records that contain E66 with a view to identifying the main types of case in which E66 appears.

As shown in Table 3.1, about one-quarter of separation records with E66 *Obesity* have that code as the principal diagnosis, which implies that obesity was considered to be the main reason for these episodes in hospital. Certain types of surgical procedures are provided as treatment for obesity and the episodes in hospital during which these procedures are provided can be regarded as being due to obesity. The provision of selected types of procedure to the patients with E66 in their separation records is summarised in Table 3.6. The three types of procedure listed are present in more than 90% of all cases in which E66 is the principal diagnosis code.

Table 3.5: Distribution by age group, separations with reported obesity (2008–09 NHMD) compared with the Australian population (2007–08 NHS)

	Separations with reported obesity: 2008–09 NHMD						Obese individuals in Australian population: 2007–08 NHS[a] (per cent)		
Age group[b]	Males	Per cent	Females	Per cent	Persons	Per cent	Males	Females	Persons
5–12	249	0.9	179	0.5	428	0.7	3.5	3.0	3.3
13–17	230	0.9	280	0.7	510	0.8	3.8	1.8	2.8
18–24	404	1.5	1,408	3.6	1,812	2.8	5.7	7.7	6.6
25–34	1,412	5.4	4,447	11.4	5,859	9.0	13.6	12.8	13.2
35–44	3,264	12.5	6,907	17.8	10,171	15.6	18.2	17.7	18.0
45–54	4,888	18.6	8,443	21.7	13,331	20.5	19.4	18.7	19.1
55–64	7,346	28.0	7,745	19.9	15,091	23.2	19.5	19.6	19.5
65–74	5,696	21.7	5,673	14.6	11,369	17.5	11.2	11.2	11.2
75+	2,722	10.4	3,825	9.8	6,547	10.1	5.0	7.6	6.2
Total	**26,211**	**100**	**38,907**	**100**	**65,118**	**100**	**100**	**100**	**100**

(a) Obesity defined as measured BMI ≥ 30.0.

(b) Separations at age <5 have been omitted (reported obesity *n* = 66).

Table 3.6: Presence of selected procedures, separations with reported obesity (2008–09 NHMD)

	ICD-10-AM code E66 Obesity present as					
Procedure type[a]	Principal diagnosis[b]	Per cent	Additional diagnosis	Per cent	Total	Per cent
Procedures for morbid obesity (889)	13,403	87.4	2,112	4.2	15,515	23.8
Gastrectomy, including partial (875–879)	563	3.7	154	0.3	717	1.1
Liposuction or lipectomy (1666)	162	1.1	105	0.2	267	0.4
Any of these	14,056	91.6	2,342	4.7	16,398	25.2
None of these	1,282	8.4	47,504	95.3	48,786	74.8
Total	**15,338**	**100**	**49,846**	**100**	**65,184**	**100**

(a) Procedure codes are according to the Australian Classification of Health Interventions.

(b) Includes the *n* = 8 records with E66 as principal diagnosis and as an additional diagnosis.

We now consider other diagnosis codes that are in separation records along with diagnosis code E66. The most frequently appearing other diagnosis codes are those for diabetes and other conditions involving impaired glucose metabolism, which are in nearly half of the E66 *Obesity* records (Table 3.7). In the great majority of these cases, the specific condition recorded was Type 2 diabetes mellitus (E11).

These codes are present in only a small proportion of the records in which E66 *Obesity* is the principal diagnosis. However, almost 60% of cases with E66 as an additional diagnosis also had a code for diabetes or another glucose regulation disorder.

Table 3.7: Presence of selected other diagnoses in separations with E66 Obesity (2008–09 NHMD)

	ICD-10-AM code E66 Obesity present as					
Other diagnosis[a]	Principal diagnosis[b]	Per cent	Additional diagnosis	Per cent	Total	Per cent
Type 2 diabetes mellitus (E11)[c]	412	2.7	28,603	57.4	29,015	44.5
Other diabetes, impaired glucose regulation (E09, E10, E12–E14)	97	0.6	1,243	2.5	1,340	2.1
Other	14,829	96.7	20,000	40.1	34,829	53.4
Total	**15,338**	**100**	**49,846**	**100**	**65,184**	**100**

(a) Diagnosis codes are according to the ICD-10-AM.

(b) Includes the *n* = 8 records with E66 as principal diagnosis and as an additional diagnosis.

(c) Includes the *n* = 19 records with E11 and other codes in the range E09–E14.

The cases with both E66 *Obesity* and a code for diabetes as additional diagnoses have a wide variety of diseases coded as the principal diagnosis, though weighted towards diseases of the circulatory system (25.9%) and kidneys (9.1% renal dialysis).

The results in Section 3.3 imply that the great majority of obese people admitted to hospitals in Australia do not have this characteristic recorded by the presence of ICD-10-AM code E66 *Obesity*. More than 90% of cases with E66 as the principal diagnosis (which equate to 21% of all records with E66) are admissions for three types of surgical procedures, which are used to treat severe obesity. Also, nearly 47% of the E66 separations have diagnosis codes for diabetes and related disorders. In total, 68.2% of all cases with code E66 in the record are of one or both of these two types. The remaining one-third of cases are diverse (code I10 *Essential (primary) hypertension* is in 22% of them).

These findings are relevant to the main question underlying this project: whether obesity can be identified in the NHMD in a way that can contribute to studying the relationship between obesity and injury. The presence of code E66 is the most promising marker of obesity found in the NHMD. The analysis in Section 3.3 shows that the potential value of E66 as a marker of obesity is quite low, because it is present in a much smaller proportion of records than is expected based on the prevalence of obesity in the Australian population. Despite this, E66 might have some value as a marker if the subset of records of obese people admitted to hospital in which it is present is representative of all obese people admitted to hospital, at least broadly. The findings reported in this section suggest that this is not so. More than two-thirds of separations with code E66 are of two rather specific types: people admitted to hospital for *Procedures for morbid obesity* (ACHI 887) and people with diabetes. In contrast, Korda et al (2012), in their recently published investigation of BMI as a risk factor for hospitalisation, show that overweight and obese New South Wales residents, if admitted to hospital, have a wide range of principal diagnoses.

The findings reported here are consistent with the ACS. As described in Chapter 2, the ACS requires obesity (or any other diagnosis) to be coded as the principal diagnosis when it is the main reason for an admission having occurred—that is so for cases in which an obese person is admitted for surgical treatment of their obesity. The ACS also allows the coding of conditions as additional diagnoses, but only if they are recorded as having materially affected the episode in hospital. Limited exceptions to this restriction on coding additional diagnoses are provided in the ACS. The only one with direct relevance to obesity concerns cases in which diabetes with features of insulin resistance is present (ACS 0401). This is

consistent with the finding reported here that almost 60% of cases with E66 as an additional diagnoses also have a code for diabetes.

Diabetes provides the unique example of a condition for which the ACS appears to moderate the normal restriction (stated in ACS 0002) that a condition such as obesity should only be coded as an additional diagnosis if it demonstrably affected the episode of care. In other words, it appears to come closer than other conditions to representing the situation of allowing obesity to be coded as an additional diagnosis simply on the basis that it is present. Is this reflected in the observed prevalence of code E66 in records that include codes for diabetes?

There were 312,216 separations with a diagnosis code for Type 2 diabetes mellitus in 2008–09, about 4% of all hospital separations (Table 3.8). Overall, 9.3% of the separation records with a Type 2 diabetes code also had a code for obesity (E66). The proportion was a little higher for females (10.4%) than for males (8.4%).

Table 3.8: Indicators for hospital separations with a diagnosis of Type 2 diabetes, Australia 2008–09

Indicators	Males	Females	Persons[(a)]
All hospital separations 2008–09	3,854,100	4,294,291	8,148,448
All Type 2 diabetes separations[(b)]	171,773	140,441	312,216
Principal diagnosis code is Type 2 diabetes	37,302	30,939	68,242
Of all hospital separations (per cent)	4.5%	3.3%	3.8%
Type 2 diabetes separations also with obesity diagnosis	14,469	14,546	29,015
Diabetes separations with obesity diagnosis per 100 diabetes separations	8.4	10.4	9.3

(a) Persons totals include separations for which sex was indeterminate or not reported.

(b) Includes separations containing both code E11 Type 2 diabetes mellitus and code E66 *Obesity* in any diagnosis fields.

These proportions are higher than those seen for hospital separations generally (0.8% for persons aged 5 and older; Table 3.3) but so is the proportion to be expected, because the prevalence of obesity is higher among people with diabetes than it is in the remainder of the population.

Data from the 2004–05 NHS can provide an indication of this. Considering persons aged 15 and older who had been admitted to a hospital in the previous year, about 17% of non-diabetics and 35% of diabetics on treatment (insulin or other medications) were obese according to BMI based on self-reported weight and height. The data from the 2007–08 NHS shows that BMI based on self-report underestimates obesity when compared with BMI based on measurements. Application of the twofold elevation in the prevalence of obesity for persons with diabetes estimated on the basis of the 2004–05 NHS to the measurement-based community prevalence of obesity provided by the 2007–08 NHS (21.6% for persons aged 5 and older; Table 3.3) suggests that a more realistic expected prevalence of obesity among persons with diabetes who are admitted to hospital is more than 40%.

If that estimate is accepted, then the observed prevalence (9.3%; Table 3.8) indicates that—even for the special instance of admissions of people with diabetes—only a small minority of cases in which obesity is present are recorded as ICD-10-AM code E66 *Obesity*.

Data are not shown here for diabetes with features of insulin resistance. It would be assumed that the proportion of those separations for which obesity was also recorded would be higher than for separations with any Type 2 diabetes. However, diabetes with features of insulin resistance is relatively uncommonly reported, so would not form a useful basis for identifying obesity in the NHMD records.

3.4 Procedures for morbid obesity

It was shown above that three types of surgical procedure were reported for more than 90% of the separations in which E66 *Obesity* appears as the principal diagnosis (Table 3.6). One type, *Procedures for morbid obesity* (889), accounts for 87%. This section summarises data on the separations in which procedures of that type are coded.

In 2008–09, a total of 18,709 *Procedures for morbid obesity* were carried out (Table 3.9). These are the procedures assigned to code block 889 of the ACHI. Overall, 82.9% of these separation records include code E66 *Obesity*. The most common procedure was *Laparoscopic gastric reduction*, which accounted for 76% of all bariatric procedures and 90% of bariatric procedures carried out in reported obesity separations.

Table 3.9: Separations involving a Procedure for morbid obesity, by whether an obesity diagnosis code is present, Australia 2008–09

			All bariatric procedures	
Bariatric procedure[(a)] (ICD-10-AM code)	**No reported obesity**	**Reported obesity (E66)**	**Total**	**Per cent**
Laparoscopic gastric reduction (30511–01)	326	13,890	14,216	76.0
Gastric reduction (30511–00)	54	640	694	3.7
Gastric bypass (30512–00)	33	219	252	1.3
Insertion of gastric balloon (90950–00)	23	158	181	1.0
Biliopancreatic diversion (30512–02)	n.p.	n.p.	29	0.2
Laparoscopic biliopancreatic diversion (30512–01)	n.p.	n.p.	6	0.0
Subtotal (new bariatric procedures)	*460*	*14,918*	*15,378*	*82.2*
Revision of gastric band (14215–00)	2,012	365	2,377	12.7
Surgical reversal of procedure for morbid obesity (30514–00)	722	232	954	5.1
Subtotal (modified or reversed bariatric procedure)	*2,734*	*597*	*3,331*	*17.8*
Total	**3,194**	**15,515**	**18,709**	**100.0**

(a) Includes all procedures in ACHI block 889.

Two subcategories can be identified among bariatric surgery separations, which allow new bariatric procedures to be distinguished from those where a pre-existing bariatric procedure is modified or reversed. For separations involving a new bariatric procedure, an E66 *Obesity* code was recorded in 97% of the total (*n* = 14,918).

In comparison, an E66 code was recorded in only 18% (*n* = 597) of separations involving the reversal or adjustment of a previous bariatric procedure (that is, *Surgical reversal of procedure for morbid obesity* and *Revision of gastric band*). For patients undergoing a gastric band revision or reversal procedure, BMI may no longer be high enough for reporting of obesity as a diagnosis code, perhaps due to the effects of the initial bariatric surgery procedure.

New bariatric procedures are usually only indicated for patients who are severely obese (Robinson 2009). The presence of code E66 in all but 3% of cases with bariatric procedure codes, usually as the principal diagnosis, is consistent with this and is an expected effect of the coding standards.

4 Obesity and hospitalised injury

It was shown in Chapter 3 that the presence or absence of an E66 code in NHMD records does not partition them according to whether the patient was obese or non-obese. E66 is present in a much smaller number of records than is expected on the basis of population survey data. Further, E66 is present in a subset of records that is probably not representative of all obese persons admitted. It is likely, however, that patients whose NHMD records include code E66 *Obesity* were obese.

In this chapter, NHMD separation records for episodes in hospital due to injury are divided into two groups, according to whether code E66 *Obesity* is in the record as an additional diagnosis, and the groups are compared.

It should be noted that an implication of the work reported in Chapter 3 is that the set of injury cases without code E66 probably includes many more obese cases than the set with code E66. However, the latter group should comprise only obese patients while the former should include all of the non-obese patients as well as the obese patients whose records were not assigned code E66. A working assumption is that the distribution of BMI is higher for the injury patients whose records include code E66 than it is for the remainder. Available data do not allow this assumption to be tested directly.

Selection criteria

The two sets of records compared in this chapter were both drawn from the NHMD file of the separations from Australian hospitals from 1 July 2008 to 30 June 2009. The records had been coded according to the 6th edition of ICD-10-AM (NCCH 2008).

For the purposes of this chapter, injury cases are those where the principal diagnosis code was in the range S00 to T75 or T79 (n = 445,601). This is the range used in most National Injury Surveillance Unit injury reports (Berry & Harrison 2007). Separation records satisfying these criteria were divided into two subgroups:

- With code E66 *Obesity* (n = 1,363) as an additional diagnosis, referred to here as 'reported obesity'.
- Without code E66 *Obesity* (n = 444,238) as an additional diagnosis, referred to as 'no reported obesity'.

4.1 Indicators of obesity and injury

There were 1,363 injury separations with reported obesity in 2008–09, representing 2% of all reported obesity cases and 0.3% of injury separations (Table 4.1). The age-standardised rate of reported obesity injury separations was 5.2 per 100,000 population, with the rate for females a little higher than that for males. The average number of days spent in hospital was more than 4 times longer for injury cases with an obesity code than for other injury cases. Average length of stay was much longer for the reported obesity injury cases at all ages except childhood (for which the number of injury cases with an obesity code is small).

Table 4.1: Indicators for injury hospital separations by reported obesity, Australia 2008–09

	No reported obesity			Reported obesity		
Indicators	**Males**	**Females**	**Persons[(a)]**	**Males**	**Females**	**Persons[(a)]**
All hospital separations 2008–09	3,827,854	4,255,353	8,083,264	26,246	38,938	65,184
Injury separations[(b)]	257,352	186,883	444,238	581	782	1,363
As percentage of all hospital separations	6.7	4.4	5.5	2.2	2.0	2.1
Age-standardised rate of injury separations	2,230.1	1,499.7	1,882.5	4.6	5.8	5.2
Mean length of stay (days)	3.1	4.5	3.7	12.5	13.2	12.9

(a) Persons totals include separations for which sex was not reported.

(b) Injury separations include those where the principal diagnosis was in the range S00–T75 or T79.

Compared with other injury separations, those with reported obesity were less likely to involve children and young adults and more likely to involve middle-aged adults (Table 4.2).

Table 4.2: Injury hospital separations by age and whether obesity reported, Australia 2008–09

	No reported obesity		Reported obesity	
Age group	**Number**	**Per cent**	**Number**	**Per cent**
0–4	21,778	4.9	n.p.	n.p.
5–12	30,641	6.9	n.p.	n.p.
13–17	31,832	7.2	17	1.2
18–24	54,664	12.3	39	2.9
25–34	58,122	13.1	81	5.9
35–44	52,425	11.8	168	12.3
45–54	44,567	10.0	201	14.7
55–64	36,174	8.1	284	20.8
65–74	29,013	6.5	299	21.9
75+	85,022	19.1	257	18.9
Total	**444,238**	**100.0**	**1,363**	**100.0**

Note: Age groups were taken from the NHS 2007–08 and differ from age ranges used in other AIHW reports.

Among injury separations with code E66 *Obesity* as an additional diagnosis, a small number of other additional diagnoses appear in a large proportion of cases, particularly Type 2 diabetes mellitus and primary hypertension. Table 4.3 displays the five most common additional diagnoses in injury separations with an obesity diagnosis in additional diagnoses fields.

Table 4.3: Top five additional diagnoses in injury separations with reported obesity

Additional diagnosis	Separations	Per cent
E66–Obesity	**1,363**	**100.0**
E11–Type 2 diabetes mellitus	745	54.7
I10–Essential (primary) hypertension	710	52.1
Z72.0–Tobacco use, current	206	15.1
Z86.43–Personal history of tobacco use disorder	190	13.9
G47.3–Sleep apnoea	112	8.2

Four of these additional diagnoses are much less prevalent among injury separation records without reported obesity (Table 4.4). The difference is most marked for diabetes and hypertension diagnosis codes, which occur in only 2.1% and 3.6%, respectively. It should be noted that these comparisons do not allow for the different age distribution of the two groups of injury cases. This finding is not unexpected, given the correlation between obesity, diabetes, and hypertension.

Table 4.4: Top five additional diagnoses in injury separations with no reported obesity

Additional diagnosis	Separations	Per cent
Total injury separations	**444,238**	**100.0**
E11–Type 2 diabetes mellitus	9,180	2.1
I10–Essential (primary) hypertension	16,099	3.6
Z72.0–Tobacco use, current	57,362	12.9
Z86.43–Personal history of tobacco use disorder	21,878	4.9
G47.3–Sleep apnoea	345	0.1

4.2 External cause

An examination of injury separations by external cause, by the presence or absence of an obesity code, is presented in Table 4.5. Four external causes account for more than 88% of the injury separations with no reported obesity. Listed from most to least numerous, they are falls, the diverse other unintentional group, transport, and intentional self-harm. The same four external causes, in the same order, were most numerous among injury separations with code E66 *Obesity*.

Table 4.5: External cause of injury separations by reported obesity, Australia 2008–09

	No reported obesity		Reported obesity	
External cause	**Number**	**Per cent**	**Number**	**Per cent**
Transportation	60,736	13.7	150	11.0
Drowning	516	0.1	n.p.	n.p.
Poisoning, pharmaceuticals	6,838	1.5	29	2.1
Poisoning, other substances	2,635	0.6	n.p.	n.p.
Falls	167,355	37.7	744	54.6
Fires/burns/scalds	6,540	1.5	26	1.9
Other unintentional	137,978	31.1	229	16.8
Intentional, self-inflicted	26,810	6.0	130	9.5
Intentional, inflicted by another	25,780	5.8	17	1.2
Undetermined intent	6,958	1.6	17	1.2
Total[(a)]	**444,238**	**100.0**	**1,363**	**100.0**

(a) Total includes cases coded to medical misadventure and cases without an external cause code.

Falls

Separations containing an external cause code for an unintentional fall accounted for 38% of the injury cases without an obesity code and for 55% of these with reported obesity. A majority of falls records are for females in both of the groups, though the female predominance is greater in the reported obesity group (Table 4.6).

Table 4.6: Fall-related injury separations by reported obesity and sex, Australia 2008–09

	Males		Females		
	Number	**Per cent**	**Number**	**Per cent**	**Persons**
No reported obesity	73,289	43.8	94,066	56.2	167,355
Reported obesity	263	35.3	481	64.7	744

Age-specific proportions of injury separations due to falls with no reported obesity show two peaks: in childhood and at ages 75 and older (Figure 4.1). Injury separations with reported obesity show no peak in childhood and occur more frequently in middle age.

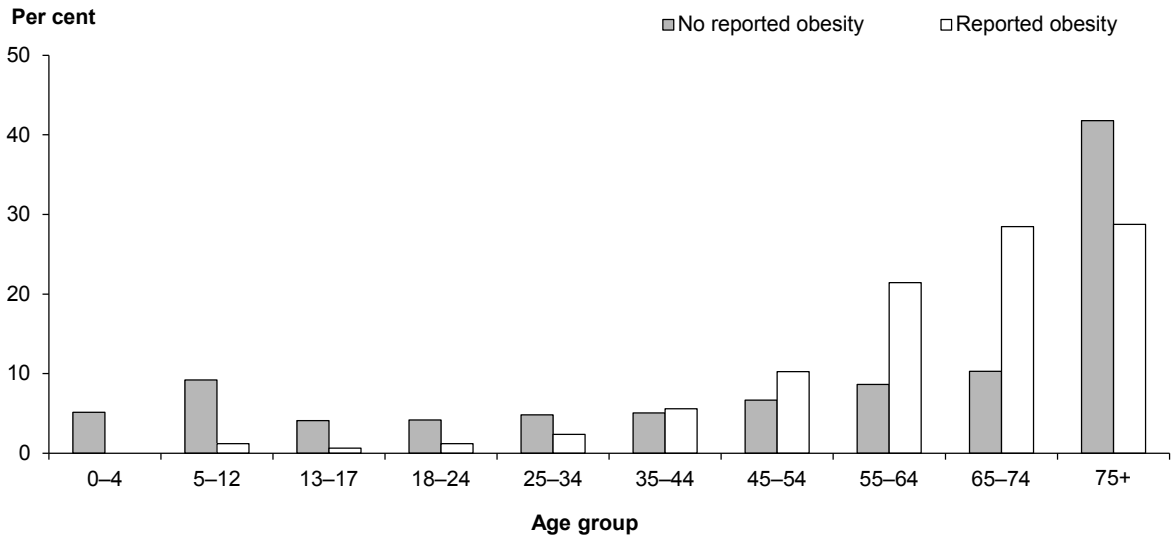


Figure 4.1: Proportion of fall-related injury separations by reported obesity and age group

5 Discussion and conclusions

Previous work reviewing literature on obesity and injury found mixed evidence which, on balance, suggests that obesity tends to increase the risk of injury, alter the pattern of injury and complicate recovery from injury (Norton et al. 2011).

Options were considered for further investigation of the matter. The NHMD is one of the two most important sources of empirical data on the occurrence of serious injury in Australia. If the NHMD is capable of revealing which of the people with admitted injury were obese, then it would provide a very powerful basis for investigating whether, how and to what extent obesity affects injury occurrence, treatment and outcomes. The work presented in this report was undertaken to ascertain whether the NHMD can be used for that purpose.

From the outset it was known that the NHMD data set did not include fields for BMI, weight or height.

The classifications used to code diagnoses and procedures in the NHMD were studied to identify categories that might be useful, either because they directly identify obese patients or because the conditions or procedures that they refer to might be more or less restricted to people who are obese (that is, they might be proxies for obesity).

The most promising category found is ICD-10-AM code E66 *Obesity*. At face value this might be expected to provide much of what was sought, subject to coding quality and the availability of data identifying the presence of obesity in the records available to clinical coders. However, the application of the code is governed by the Australian Coding Standards, which restrict the circumstances in which obesity should be coded. According to the standards, obesity should be coded as the principal diagnosis if obesity is the main reason for an admission. This is so when an obese person is admitted for surgery to treat the obesity. Obesity should also be coded, but as an additional diagnosis, when it is not just present, but is stated in the record to have materially affected the care required.

It was recognised that these constraints were likely to limit the value of code E66 as a marker of the presence of obesity among injury cases. That suspicion was strengthened by an assessment of the small literature on the topic. We proceeded, nevertheless, to assess the NHMD data. This was done in two parts.

First, all NHMD records in the data year 2008–09 that included code E66 were examined (Chapter 3). The investigation focused on two points. The first was whether the proportion of cases with code E66 *Obesity* was about what would be expected in light of other evidence. The comparison sources used were two editions of the ABS NHS. The comparison showed that NHMD records with code E66 were very much less frequent than expected on the basis of NHS data. The second point was whether the cases with code E66 were likely to be a representative sample of all obese cases admitted to hospital. The finding was that they were not. Rather, they reflected the coding standards: E66 was largely restricted to cases admitted for new bariatric surgery (when it appeared as the principal diagnosis) and to cases with Type 2 diabetes. Two-thirds of all cases with E66 are of one of these types. The cases with code E66 as the principal diagnosis are likely to have severe obesity, because nearly all of these cases were admitted for procedures that are normally only performed if obesity is severe. We did not find equivalently helpful internal evidence on which to come to a conclusion about the likely distribution of BMI for the cases with code E66 as an additional

diagnosis. Neither did we find published evidence on this. However, we suspect that BMI is likely to be high or very high for many of these cases. That is because, for a case involving obesity to satisfy the default coding guidelines, the record must show that the presence of obesity had noteworthy effects on the care required or provided. We suspect that this requirement is more likely to be satisfied where obesity is severe.

Second (Chapter 4), we examined the subset of the cases with code E66 that also met the usual NISU definition of injury (principal diagnosis in the range S00 to T75 or T79). These cases were compared with all other injury separations in the same period. A total of 1,363 separation records that met the criteria for injury also contained code E66 *Obesity* – these comprise only 0.3% of injury separations and 2% of all obesity cases. The smallness of these proportions, combined with the finding (Chapter 3) that the separation records with code E66 are not a representative sample of all episodes in which obesity is likely to be present, leads to the conclusion that the data are unlikely to provide reliable insights concerning obesity and injury.

The most noteworthy finding of the comparison between injury separation records with and without code E66 *Obesity* is that the cases with code E66 had a much longer mean length of stay than did the other injury cases. This difference may, at least in part, be a consequence of the coding standards rather than a reliable guide to the effect of obesity on length of stay. This is because markedly elongated stay in the presence of obesity may reflect more care provided and therefore satisfy the requirements of the ACS for coding E66 as an additional diagnosis. Hence, unusually long-stay obese cases may be over-represented in the small subset of separation records of injury cases involving an obese patient to which code E66 is applied. Similar over-representation in the subset of obese cases that have code E66 could occur for other types of identifiable complications or poor outcome for which more care was associated. We were unable to investigate this possibility directly.

Issues with identification of obesity from NHMD data

We have found that Australian routinely collected hospital data do not identify most records in which the patient is obese. This has four main implications:

1. A suitable set of obese patients cannot be identified in the NHMD. The set of cases that can be identified on the basis of having code E66 is likely to misrepresent patterns of health-care use for obese patients generally and may not be large enough for certain types of analysis.
2. Non-obese patients cannot be identified. Hence, even if a useable set of obese cases can be identified, a non-obese comparison group is lacking.
3. While cases with code E66 *Obesity* probably have BMI > 30 kg/m^2, the distribution of BMI among cases with this code is not known, nor whether it differs to an important extent between subsets of cases (for example, injury cases compared with other cases).
4. The number of obese admitted patients and the proportion they make up of all admitted patients cannot be determined from the NHMD. (Health surveys provide occasional opportunities to estimate this.)

Table 5.1 lists the obesity prevalence estimates obtained by using different identification methods. Of note is the large difference between reported prevalence recorded in a study where trained clinicians have re-examined patients' charts, and the corresponding reported prevalence previously generated by clinical coders using ICD-9-CM and ICD-10 codes for the same records.

Table 5.1: Recorded obesity prevalence using various identification methods

Method used to identify obesity	Country	ICD version used	Obesity prevalence
Reported obesity separations in 2008–09 Australian hospital population using NHMD data (current study)	Australia	ICD-10-AM	0.8%
Reported obesity in 2005–06 Victorian Admitted Episodes Data (Hauck & Hollingsworth 2010)	Australia	ICD-10-AM	1.47%
Reported obesity in sample of Alberta hospital discharge records (Quan et al. 2008)	Canada	ICD-9-CM	2.7%
Reported obesity in sample of Alberta hospital discharge records (Quan et al. 2008)	Canada	ICD-10	1.9%
Re-examination by trained clinicians of hospital charts in sample of Alberta hospital discharge records (Quan et al. 2008)	Canada	NA	8.4%
Reported height and weight in the 2007 Canadian Health Measures Survey	Canada	NA	24.1%[(a)]
Measured height, weight and girths in the Australian NHS 2007–08	Australia	NA	24.6%[(b)]
Self-reported height and weight in a cohort (ages 45 and older at inception) linked to records of subsequent episodes in hospital (Korda et al. 2012)	Australia (NSW)	NA	22%

(a) Proportion of adult Canadians with a BMI > 30 (Statistics Canada 2011).

(b) Proportion of Australian adults with BMI > 30 (ABS 2009a).

Note: Reported obesity refers to methods based on obesity codes in routinely collected hospital data.

Developing a reliable obesity identifier

Given the high and rising prevalence of obesity in the Australian population, evidence that obesity is associated with increased morbidity and mortality, and concern to manage costs and quality of care provided in hospitals, it can be seen as surprising that the main collection of data on hospital care in Australia does not collect data on obesity.

Inclusion of height and weight information in separations data would enable analysis of effects of BMI on injury occurrence, treatment and outcomes. Height and weight as independent variables may prove useful for other analyses of injury. The focus here is on the utility of BMI and related items for injury. However, these items would also be valuable for studies of other conditions and might well contribute to routine administrative purposes.

The work of a number of authors supports the argument for routine recording of height and weight in administrative data (Caccamese et al. 2002; Callaway et al. 2006; Cleator et al. 2002; Hauck & Hollingsworth 2010; Woo et al. 2009).

The internationally accepted approach for classifying overweight and obese patients is to use BMI. A recommendation to include height and weight systematically in hospital separations data would implement the most widely accepted method for gauging obesity in a population. From a clinical perspective, however, routine and systematic inclusion of height and weight in hospital records may run the risk of discouraging the use of other anthropometric indicators for gauging body composition and chronic disease risk (such as waist-to-hip ratio). Nonetheless, BMI probably remains the most practical tool to provide a consistent measure of weight for inclusion in hospital records.

Another route to improving the information on obesity in the NHMD is by making changes to the ACS and the ICD-10-AM. In principle, the ACS could be altered to require use of the

current obesity code in all cases where obesity meeting a particular criterion is present. Alternatively, a code could be added to the risk factor section of ICD-10-AM, similar to Z72.0 *Tobacco use, current,* which is provided to enable coding of whether a patient is a smoker. ACS 0503 instructs coders to 'Assign this code if the documentation indicates that … The patient has smoked tobacco (any amount) within the last month' (NCCH 2008). An analogous category might usefully distinguish obesity and morbid obesity, and whether measurement or estimation is the basis for the assessment.

The feasibility of additional NHMD items or ICD-10-AM codes for obesity depends on the presence of relevant data (weight and height, calculated BMI or clinical assessment that obesity is present) in a large proportion of hospital records. As a precursor to any decision, and to test the feasibility and relative merits of various approaches, a study of a representative sample of separation records is desirable. A project led by Dr Kirsten McKenzie in which the hospital records of a probability sample of several thousand injury cases in four states were reviewed and compared with discharge data demonstrates the feasibility of a suitable study design (McKenzie et al. 2009). Such a study need not be restricted to injury cases. The study could be designed to provide information relevant to estimating the effects on coder burden and cost that would result from a decision to add BMI or related items to the NHMD, as well as the benefits of obtaining the information. The study would also measure the proportion of obese cases currently coded to E66 and the BMI distribution of these cases, which would allow better interpretation of current NHMD data.

Appendix A: Data issues

National Hospital Morbidity Database

The hospital separations data were provided by the AIHW, from the NHMD. Detailed information about individual data elements within the NHMD is in the *National health data dictionary* (AIHW 2008b), or online at the AIHW's Metadata Online Registry, METeOR, at <http://meteor.aihw.gov.au>.

Values in this report are based on numbers of separation records. Some admitted cases of injury result in more than one separation record; hence, values presented here may overestimate the number of incident cases of injury. The method used in most NISU reports to allow for this (that is, omission of inward transfers from other acute hospitals from estimates of incidence) was judged not to be suitable here because no evidence was available on whether it was valid for the set of records with reported obesity, which was the main subject of the report.

Injury separations are those with ICD-10-AM principal diagnosis codes of S00 to T75 or T79.

The NHMD data used in this report were coded according to the 6th edition of the Australian clinical modification of ICD-10, the ICD-10-AM (NCCH 2010).

Explanation of terms

bariatric: The part of medical and surgical practice concerned with the causes, treatment and prevention of obesity.

body mass index (BMI): Weight (in kilograms) divided by the square of height (in metres).

obesity: Body mass index greater than or equal to 30. '[A] physiological condition in which excess body fat has accumulated to an extent that it can negatively affect health' (Bruce-Keller et al. 2009).

Small case counts

In the tables, cell counts of five cases or fewer have been suppressed to protect patient confidentiality. In the instances where only one cell in a row or column has a count of five or less, other cells in the same row or column have also been suppressed.

Errors, inconsistencies

This report uses data collected from state and territory hospitals. After coding and collection from the states and territories, the data are further processed by the AIHW and NISU. The geographical spread of the data and the large number of people involved in its processing increase the risk of inconsistencies across time and place in the data. Variations in reporting and coding continue to exist across jurisdictions, although national minimum data sets have been in place for some time.

National Health Survey data

Data from the 2007–08 NHS were abstracted from spreadsheets that form part of ABS publication 4346.0 *National Health Survey: summary of results, 2007–2008* (Reissue). The versions used were the latest available at July 2012, which have an ABS release date of 23 November 2010. These were obtained from:

<www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.02007–2008%20(Reissue)?OpenDocument>.

Data from the 2004–05 NHS were analysed using the Confidentialised basic Unit-Record File supplied on CD-ROM disk. Analysis was conducted using Stata 12.1. Survey weights and design were allowed for by conducting all analysis using the Stata svy suite of commands and after applying the following command to apply them:

svyset [pweight=NHSFINWT], jkrweight(WPM01*) vce(jackknife).

NHSFINWT is the case selection weight for persons and the set of variables WPM01* are replicate weights supplied by the ABS to enable calculation of sampling error and related statistics in a way that allows for survey characteristics.

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List of figures

Obesity and injury are major health burdens on society. This report studies the feasibility of using the National Hospital Morbidity Database to investigate the relationship between obesity and hospitalised injury in Australia. The database does not currently provide a reliable basis for measuring obesity among admitted patients or for assessing the characteristics of injury cases with obesity. Inclusion of height and weight information in separations data would enable analysis of the effects of body mass index on injury occurrence, treatment and outcomes.