# Unpacking analyses relying on area-based data: Are the assumptions supportable

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## 1. Introduction

The majority of work in Australia describing the association between health status, health service utilisation and socioeconomic status uses an area-based measure of socioeconomic status. This proxy measure is used because there is no direct measure of socioeconomic status in the health-related datasets. Its application requires a number of assumptions, including that people who move do so between geographic areas of similar socioeconomic status; and that, the often large areas used in these analyses provide a reliable indication of the socioeconomic status and health service utilisation of the individuals in the area. Also inherent in these analyses is an uncertainty arising from the use of data as to events (ie., admissions), rather than individuals.

This paper uses the Western Australian Data Linkage System to explore the reliability of area data as a proxy for socioeconomic disadvantage when analysed for large geographic units. It does this by examining the extent to which hospital inpatient admission[1] rates vary, both overall and by socioeconomic status of area of residence, when calculated at various levels of aggregation (Census Collection District (CD) – the smallest area level for which a measure of socioeconomic status is available), postcode and Statistical Local Area (SLA)). Methods applied include the calculation of correlation coefficients and examination of hospital separation rates by quintile of socioeconomic disadvantage of area, separately for events and individuals. Results are also provided of the extent of change in socioeconomic status of area of residence between an individual's admissions over five years.

The paper concludes with a discussion of additional links that would add to the value of the already valuable dataset within the Western Australian Data Linkage System.

## 2. Methods

*Terminology*

The report addresses differences in the number of individuals admitted and the number of admissions[2]. These are described as 'individuals', or individuals admitted' and admissions (the total number of admissions, where an individual may have had one or more admissions over the five years).

*Data sources*

Details of all admissions to public and private hospitals in Western Australia for the five years 1994 to 1998 were extracted from the Western Australian Hospital Morbidity Database (HMDS). Any admission records thought to belong to the same person had previously been linked together within the Data Linkage System, permitting the analyses to be performed for admissions or individual persons. The population used in calculating rates is the 1996 Census population.

*Area*

The areas used in the analysis are the Census Collection District (CD), postcode and Statistical Local Area[1] (SLA).

The HMDS includes address details for each admission to hospital in Western Australian since 1993. These addresses have been linked to a Western Australian street address database to assign northing and easting points (geo-codes). These points are then assigned to the appropriate 1991 or 1996 collector's district using the ABS CDData96 mapping tool. The postcode and SLA of the address can be determined from the postcode or SLA of the CD.

Consequently, comparisons can be made between results for CD and postcode area, CD and SLA and postcode and SLA. This is particularly important as much of the area analysis undertaken in the health sector in Australia uses the postcode or the SLA and it is well known that the larger the area, the less homogenous the population is likely to be. In fact, SLA coding is sometimes undertaken by a proportional allocation of the postcode, at other times using the town, locality or suburb and/ or full street address.

*Measurement of socioeconomic status*

In the absence of any direct measure of socioeconomic status in the hospital inpatient data, the socioeconomic status of the area of the address of the individual admitted is used as a proxy measure. The Index of Relative Socio-Economic Disadvantage (IRSD)[2] has been used to provide the socioeconomic status of the area of the address. The index is calculated by the Australian Bureau of Statistics (ABS) at the CD level. For postcodes and SLAs, the index is the weighted average of the IRSD scores for CDs in the postcode or SLA. This calculation is undertaken for all CDs in the postcode or SLA, not just those with individuals or admissions recorded.

For this analysis, each area (CD, postcode or SLA) has been allocated to one of five groups (quintiles). Quintile 1 comprises the SLAs with the highest IRSD scores (most advantaged areas), and Quintile 5 comprises the SLAs with the lowest IRSD score (most disadvantaged areas): each quintile comprises approximately 20% of the Perth population. This process does not provide an exact allocation of population, so the resultant populations are only 'approximately' equal, and the larger the areal units being allocated, the less likely they are to be equal. For example, when areas were ranked by their IRSD score at the CD level and then grouped to produce quintiles, the resultant populations were relatively close to the ideal population of 245,607 per quintile (one fifth of 1,288,036) (Table 1). The postcode based quintiles had rather 'lumpier' populations, while those based on SLAs were the most problematic. As an example, the SLA of Wanneroo – South West (with a population of 103,176) had a score marginally below the cut-off score between Quintile 1 and Quintile 2. However, the inclusion of Wanneroo – South West in Quintile 2 resulted in populations in Quintile 1 and 2 of 161,707 and 321,889, respectively. Moving Wanneroo – South West to Quintile 1 left a population o 218,713 in quintile 2 and increased that in Quintile 1 to 265,883. While these populations are substantially different from the ideal population, they are the best that can be achieved.

| Quintile | CD | Postcode | SLA |
|---|---|---|---|
| 1 | 246,131 | 255,726 | 265,883 |
| 2 | 245,406 | 255,942 | 218,713 |
| 3 | 246,937 | 259,835 | 269,879 |
| 4 | 244,072 | 251,378 | 234,378 |
| 5 | 245,490 | 251,416 | 239,183 |
| **Total** | **1,228,036** | **1,228,036** | **1,228,036** |

**Table 1 Population of quintiles at various area levels, 1996**

*Analysis*

Three (different) IRSD scores were added to each hospital admission record, based on the CD, postcode or SLA that had been previously assigned to the address on that record. It should be noted that these IRSD scores were actually the average score for the particular CD, postcode or SLA as determined at the 1996 Census. Quartile and quintile ranks for each aggregation level were also applied using population-weighted levels as described above.

For analyses involving persons rather than admissions, raw (and rank) IRSD values for the first admission in the 5-year period were used. These 'first' admissions were isolated using the internal links between admission records for the same person and the admission date. Of course many of these 'first' admissions could have been preceded by admissions occurring before 1994.

**3. Findings**

*Individuals*

Over the five years from 1994 to 1998, 358,948 residents of Perth were admitted to hospital on one or more occasions, an average of 71,750 individuals admitted per annum. Just over half (53.6%) the individuals admitted were females and just under half (46.4%) were males.

The age and sex profile of the first admission to hospital for residents of Perth is shown in Figure 1 against the profile of the population in 1996. The most notable differences in the proportions of males and females admitted were in the 0 to 14, 20 to 34 and 75 years and over age groups. The proportion of males aged 0 to 4 years admitted to hospital was 1.6 times higher than that for females, and 1.5 times higher in the 5 to 9 and 10 to 14 year age groups (Table 2). Females predominate in the 20 to 34 year age groups, largely reflecting admissions to hospital for childbirth and associated conditions.

For males, the profiles of the population and of individuals admitted are similar, apart from at ages 0 to 4 and 10 to 14 years. In these two age groups the proportion of males admitted to hospital is less than their share of the population. The differences are more substantial for females, with a larger under-representation at younger ages (below 15 years of age) and an over-representation in the 20 to 39 year age groups. The main differences in the profiles of males and females admitted are also evident at the youngest ages (higher proportions of males), from ages 20 to 39 years (higher proportions of females), from 50 to 59 years (higher proportions of males) and at age 80 years and over (higher proportions of females).

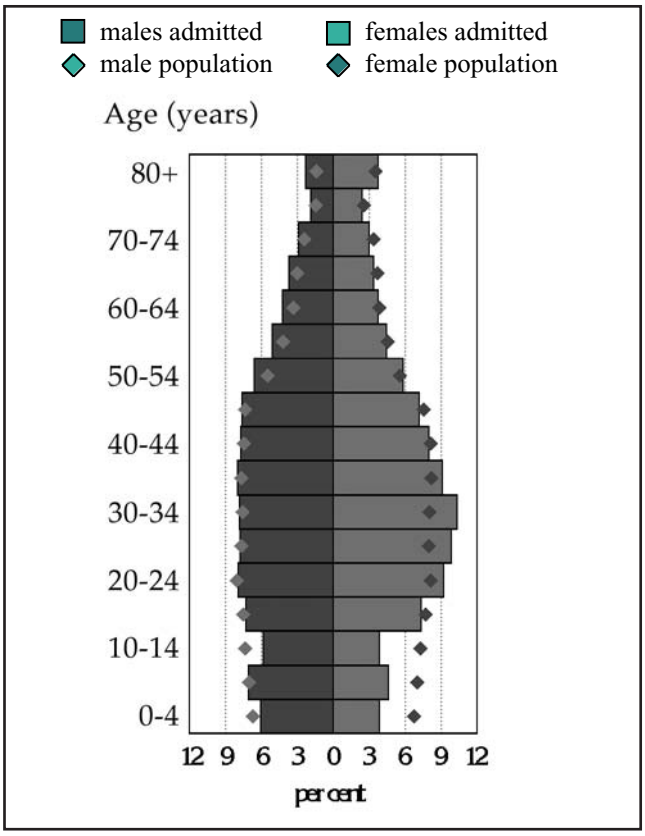


**Figure 1 Perth residents admitted to hospital, by age and sex, 1994–98**

Note: Perth Population is at 30 June 1996. Per cent shown is of males and females separately, not of persons

Over the five years from 1994 to 1998 the rate of individuals admitted was 16.4% higher for females (247.6 admissions per 1,000 population) than for males, (212.7 admissions per 1,000 population). As would be expected from the data in Figure 1, the rates of males and females admitted vary notably by age. For females, the rates are highest in the 30 to 34 year age group (with a further three of the five of the highest female rates between ages 20 to39 years), with the second highest rate in the 80 years and over age group. The highest male rate in the 80 years and over age group is substantially above the next highest rates in the 50 to 69 year age groups. \\

| | Rate per 1,000 | | |
|---|---|---|---|
| Age | Males | Females | Persons |
| 0–4 | 185.3 | 147.2 | 166.8 |
| 5–9 | 207.1 | 168.4 | 188.3 |
| 10–14 | 163.5 | 135.5 | 149.9 |
| 15–19 | 201.0 | 244.4 | 222.4 |
| 20–24 | 204.3 | 288.2 | 245.6 |
| 25–29 | 207.8 | 315.7 | 261.4 |
| 30–34 | 212.9 | 328.1 | 270.9 |
| 35–39 | 214.3 | 282.5 | 248.8 |
| 40–44 | 213.4 | 250.4 | 232.3 |
| 45–49 | 214.3 | 242.4 | 228.2 |
| 50–54 | 243.6 | 270.2 | 256.5 |
| 55–59 | 242.6 | 254.7 | 248.6 |
| 60–64 | 252.7 | 257.5 | 255.2 |
| 65–69 | 240.5 | 241.4 | 241.0 |
| 70–74 | 232.2 | 237.9 | 235.3 |
| 75–79 | 237.5 | 254.8 | 247.6 |
| 80+ | 291.7 | 283.5 | 286.2 |
| **Total** | **212.7** | **247.6** | **230.3** |

Note: Frequency missing = 289.

**Table 2 Perth residents admitted to hospital, by age and sex, 1994–98**

A total of 358,768 Perth residents had one admission to a Western Australian hospital over the five years from 1994 to 1998, with a further 298,805 people admitted on two or more occasions. The number of people with two or more admissions in any period is higher in the earlier years, as the more time that passes the greater the opportunity for a second admission (Table 3). That is, those with a first admission in 1994 have had more time to record a second admission than have those with a first admission in 1995: thus the greater number with two or more admissions in 1994.

| Year | Individuals | | |
|---|---|---|---|
| | One admission | Two or more admissions | Total |
| 1994 | 71,566 | 118,039 | 189,605 |
| 1995 | 68,400 | 75,830 | 144,230 |
| 1996 | 68,989 | 52,577 | 121,566 |
| 1997 | 71,917 | 34,497 | 106,414 |
| 1998 | 77,896 | 17,862 | 95,758 |
| **Total** | **358,768** | **298,805** | **657,573** |

**Note: Frequency missing = 289.**

**Table 3 Perth residents admitted to hospital, by number of admissions and year of admission, 1994–98**

Just over half (54.6%) those admitted to hospital had one admission over this period, and more than one third (36.0%) had between two and four admissions, a total of 90.6% of those admitted (Table 4).

| Admissions per person | Number | Per cent |
|---|---|---|
| 1 | 358,769 | 54.6 |
| 2–4 | 236,611 | 36.0 |
| 5–9 | 46,377 | 7.1 |
| 10+ | 15,821 | 2.4 |
| **Total** | **657,578** | **100.0** |

**Note: Frequency missing = 289.**

**Table 4 Residents of Perth admitted to hospital, 1994 to 1998, by number of admissions per person**

Females accounted for just over half (53.6%) of those admitted once, compared with 59.7% of those admitted more than once. For males, the proportions were 46.4% and 40.3%, respectively.

*Admissions*

There were a total of 1,665,308 admissions to a Western Australian hospital of Perth residents, an average of 2.53 admissions per person admitted over the five years from 1994 to 1998. Over half (55.1%) of the admissions were of females and 44.9% were of males.

Figure 2 shows the profiles of males and females, by age, for both individuals admitted (as in Figure 1) and admissions. For males, the proportion of individuals admitted is highest at ages 20 to 49 years, dropping away at younger and older ages, with the latter exhibiting a particularly marked drop. Total admissions for males are generally highest at older ages (the highest at ages 70 to 74 years), reflecting the higher number of admissions per person. The notable exception is the high proportion of admissions in the 0 to 4 year age group. The profile of the proportion of females admitted is similar to that for males, although it is somewhat distended at ages 20 to 39 years. The proportion of total admissions of females at ages 25 to 54 years has a similar profile to that for individuals admitted.

The main differences in the profiles of male and female admissions are evident at the youngest ages (higher proportions of males), from ages 20 to 44 years (higher proportions of females) and from 50 to 79 years (higher proportions of males).

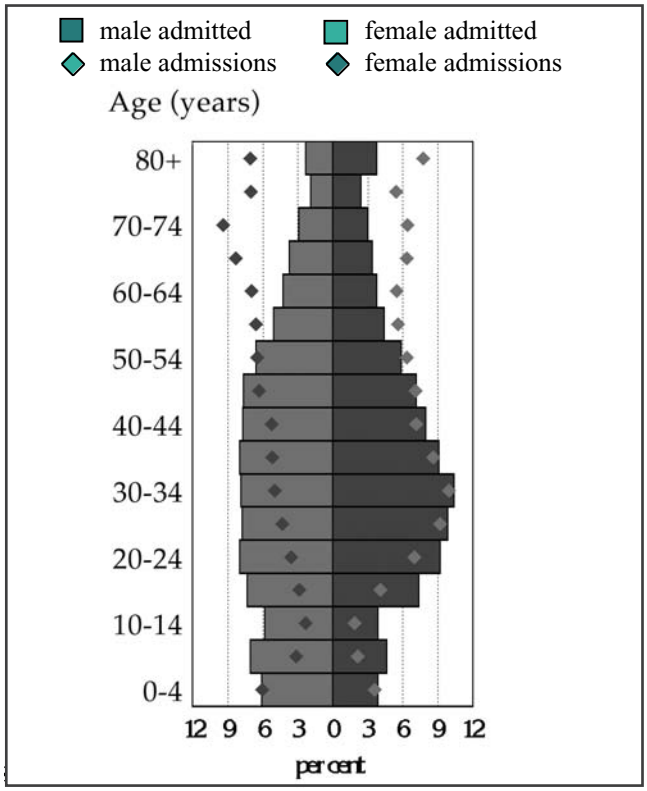


**Figure 2 Perth residents admitted to hospital and total admissions, by age and sex, 1994–98**

Note: Per cent shown is of males and females, separately, not of persons

Unlike the rates for individuals admitted (Table 2), the highest admission rates for both males and females occur in the oldest age groups (Table 5). The five highest rates for both males and females are in the age groups 60 to 64 years and over, with male rates higher (and often substantially higher) than female rates. Also of note is the high rate of admissions for females at ages 30 to 34 years (1,672.2 admissions per 1,000 population): this is the sixth highest rate for females, and is more than twice the rate for males at the same age (729.5 admissions per 1,000 population).

| | *Rate per 1,000* | | |
|---|---|---|---|
| **Age** | **Males** | **Females** | **Persons** |
| 0-4 | 989.4 | 697.9 | 847.6 |
| 5-9 | 513.2 | 379.4 | 448.0 |
| 10-14 | 375.3 | 310.5 | 343.8 |
| 15-19 | 443.7 | 693.4 | 567.2 |
| 20-24 | 505.2 | 1,151.9 | 823.5 |
| 25-29 | 630.1 | 1,562.6 | 1,093.4 |
| 30-34 | 729.5 | 1,672.2 | 1,203.9 |
| 35-39 | 747.8 | 1,411.6 | 1,083.2 |
| 40-44 | 780.6 | 1,175.8 | 982.2 |
| 45-49 | 947.6 | 1,253.0 | 1,099.0 |
| 50-54 | 1,289.3 | 1,528.1 | 1,405.5 |
| 55-59 | 1,686.8 | 1,666.8 | 1,676.9 |
| 60-64 | 2,210.8 | 1,957.6 | 2,082.6 |
| 65-69 | 2,859.5 | 2,356.6 | 2,598.8 |
| 70-74 | 3,991.2 | 2,661.3 | 3,268.6 |
| 75-79 | 4,723.2 | 2,979.7 | 3,706.7 |
| 80+ | 4,823.9 | 3,086.5 | 3,667.4 |
| Total | 1,099.0 | 1,345.0 | 1,223.0 |

**Table 5 Admissions of Perth residents, by age and sex, 1994–98**

Note: Frequency missing = 180

*Effect of aggregation of areas on disadvantage scores*

As noted, much of the area analysis undertaken in the health sector in Australia uses the postcode or SLA as the unit of analysis. This raises the question of the extent to which area based analyses at the postcode or SLA level provide a reliable indication of the socioeconomic status and health service utilisation of the individuals or the events in the area. This paper explores the reliability of postcode or SLA level data by examining the extent to which hospital inpatient admission rates vary when calculated at various levels of aggregation (CD, postcode and SLA). Ideally, the comparison would be between the socioeconomic status of individuals and of areas: however, the smallest area level for which a measure of socioeconomic status is available is the CD.

Variation in the minimum and maximum IRSD scores when calculated at the CD, postcode and SLA level is striking and clearly shows the value of the smaller unit in area based analyses (Table 6). The range at the CD level is from a minimum index score of 532 to a maximum index score of 1221, a differential of 2.3 times. When individuals and admissions are analysed by postcode, the range in the IRSD scores is narrower, from 863 to 1168 (a differential of 1.4). At the SLA level it is slightly lower again (a differential of 1.3). The effect of aggregation to the larger areas is most noticeable in the minimum IRSD score, increasing the minimum score by 70.5% from the CD level to the SLA level. At the other end of the scale, the maximum score varies little, dropping by 4.0%. That is, the greatest loss in specificity in the IRSD score is in the most disadvantaged areas.

| **Variable** | **Median**[1] | **Minimum** | **Maximum** | **Ratio: Maximum/minimum** |
|---|---|---|---|---|
| Collection District | 1012 | 532 | 1221 | 2.3 |
| Postcode | 1015 | 863 | 1168 | 1.4 |
| Statistical Local Area | 1017 | 907 | 1174 | 1.3 |
| **Ratio of IRSD scores**[2] | **1.0** | **1.70** | **0.96** | **..** |

**[1]The median IRSD scores are for individuals only**

**[2]The Ratio of IRSD scores is the ratio of the IRSD score at the SLA level to the score at the CD level.**

**Table 6 Range of IRSD scores for individuals and admissions**

Thus, the use of larger area aggregates reduces the gap between the index scores for the most disadvantaged and least disadvantaged areas (thus diluting differentials between these areas), with the greatest impact on the scores for the most disadvantaged areas (thus understating the extent of disadvantage).

There was a strong association between the IRSD scores for CDs and those for postcodes of usual address at the first admission (a Spearman correlation coefficient of 0.74). A weaker association was found between the quintiles for CD and those for SLA (0.64 for people with one admission and 0.63 for people with more than one admission) (Table 7). Similar Spearman correlation coefficients were calculated for raw IRSD scores.

| **Variable** | **Area level of first discharge** | | |
|---|---|---|---|
| | **CD** | **Postcode** | **SLA** |
| Individuals: | | | |
| - one admission | 1.0 | 0.74 | 0.64 |
| - more than one admission | 1.0 | 0.74 | 0.63 |
| - more than one admission & moved address | 1.0 | 0.73 | 0.62 |
| Admissions | 1.0 | 0.74 | 0.63 |

**Table 7 Spearman correlation coefficients for first discharge (individuals) by area levels**

*Effect of aggregation of areas on admission rates – CD level data*

Data at the CD level for the five years from 1994 to 1998 show that admission rates vary from 119,813 admissions per 100,000 population in the most advantaged areas to 176,157 admissions per 100,000 population in the most disadvantaged areas (Table 8). This is a differential of 47%. The differential in rates of individuals admitted (as distinct from admissions) is substantially lower, at 16%. The disparity in these differentials is a result of variations in the number of admissions per individual. For example, while people admitted to hospital over the five years to 1998 had an average of 2.5 admissions per person, this varied from 2.3 admissions per person in the least disadvantaged areas to 3.0 in the most disadvantaged areas.

| | Individuals admitted | | | Admissions | | |
|---|---|---|---|---|---|---|
| | CD | Postcode | SLA | CD | Postcode | SLA |
| | | | Number | | | |
| Q1: Least disadvantaged | 126,615 | 123,380 | 138,127 | 294,130 | 303,131 | 340,294 |
| Q2 | 130,907 | 123,465 | 114,244 | 294,307 | 326,652 | 279,537 |
| Q3 | 133,073 | 126,770 | 142,107 | 316,066 | 328,999 | 363,908 |
| Q4 | 124,279 | 128,863 | 123,199 | 327,228 | 328,630 | 313,879 |
| Q5: Most disadvantaged | 142,704 | 155,100 | 139,901 | 433,577 | 377,896 | 367,690 |
| **Total** | 657,578 | 657,578 | 657,578 | 1,665,308 | 1,665,308 | 1,665,308 |
| | | | Rate[1] | | | |
| Q1: Least disadvantaged | 51,442 | 48,247 | 51,950 | 119,813 | 120,567 | 127,986 |
| Q2 | 53,343 | 48,239 | 52,235 | 120,582 | 129,945 | 127,810 |
| Q3 | 53,889 | 48,789 | 52,656 | 127,995 | 126,618 | 134,841 |
| Q4 | 50,919 | 51,263 | 52,564 | 133,342 | 128,400 | 133,920 |
| Q5: Most disadvantaged | 58,130 | 61,691 | 58,491 | 176,157 | 147,734 | 153,728 |
| **Total** | 53,547 | 53,547 | 53,547 | 135,607 | 135,607 | 135,607 |
| **Rate ratio[1]** | **1.13** | **1.28** | **1.13** | **1.47** | **1.23** | **1.20** |

**Note: Frequency missing = 180.**

**[1]Rate per 100,000 population**

**[2]Rate ratio is the ratio of the rate in Quintile 5 to the rate in Quintile 1**

**Table 8 Residents of Perth admitted to hospital, 1994 to 1998, by socioeconomic disadvantage of area for selected area level**

Thus, 13% more people were admitted from the most disadvantaged areas (58,130 individuals per 100,000 population from Quintile 5 compared with 51,442 per 100,000 population from Quintile 1). In fact, there were 47% more admissions of people from these areas (176,157 admissions per 100,000 population from Quintile 5 compared with 119,813 per 100,000 population from Quintile 1).

*Postcode and SLA level data*

The differentials in admission rates between Quintile 5 and Quintile 1 areas are smaller when data is aggregated to the postcode (1.23 times) or SLA (1.20 times) level when compared with CD level data (a differential of 1.47 times) (Table 8). In the case of postcodes, this is largely because of the lower admission rate in Quintile 5 areas (likely to be a result of the process of aggregating CDs), whereas for SLAs it is a combination of a lower admission rate in Quintile 5 areas and a higher rate in Quintile 1 areas (likely to be a result of the aggregation process, exacerbated by the variable size of SLAs – see Section 2, Methods for further details). The differential in rates of individuals admitted is the same for data at the SLA and CD level. This again reflects the difficulty inherent in producing groups of approximately equal populations.

While just over half (54.6%) those admitted to hospital had one admission over this period, the proportion varied from 56.3% in Quintile 1 to 51.9% in Quintile 5 (Table 9). This is as expected, with people from the most disadvantaged areas representing a smaller proportion of those with one admission and a larger proportion with more than one admission.

| Admissions per person | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | Total |
|---|---|---|---|---|---|---|
| | | | Number | | | |
| 1 | 69,485 | 69,118 | 69,960 | 69,709 | 80,497 | 358,769 |
| 2–4 | 43,274 | 43,776 | 45,566 | 46,747 | 57,244 | 236,607 |
| 5–9 | 7,907 | 7,902 | 8,449 | 9,220 | 12,899 | 46,377 |
| 10+ | 2,714 | 2,668 | 2,793 | 3,187 | 4,459 | 15,821 |
| **Total** | **123,380** | **123,465** | **126,770** | **128,863** | **155,100** | **657,578** |
| | | | Per cent | | | |
| 1 | 56.3 | 56.0 | 55.2 | 54.1 | 51.9 | 54.6 |
| 2– 4 | 35.1 | 35.5 | 35.9 | 36.3 | 36.9 | 36.0 |
| 5–9 | 6.4 | 6.4 | 6.7 | 7.2 | 8.3 | 7.1 |
| 10+ | 2.2 | 2.2 | 2.2 | 2.5 | 2.9 | 2.4 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |

**Note: Frequency missing = 289.**

**Table 9 Number of admissions per individual, by socioeconomic disadvantage of area, Perth residents, 1994 to 1998**

The differential in the proportion of the population in Quintiles 5 and 1 having one admission was 16.2% (a rate of 32,790 admissions per 100,000 persons in Quintile 5 and 28,231 admissions per 100,000 persons in Quintile 1), compared with more than twice that (38.8%) for people having two or more admissions (a rate of 30,389 admissions per 100,000 persons in Quintile 5 and 21,897 admissions per 100,000 persons in Quintile 1) (Table 10).

| Admissions per person | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | Total |
|---|---|---|---|---|---|---|
| | | | Per cent | | | |
| 1 | 19.4 | 19.3 | 19.5 | 19.4 | 22.4 | 100.0 |
| 2+ | 18.0 | 18.2 | 19.0 | 19.8 | 25.0 | 100.0 |
| **Total** | 18.8 | 18.8 | 19.3 | 19.6 | 23.6 | 100.0 |
| | | | Rate per 100,000 population | | | |
| 1 | 28,231 | 28,165 | 28,331 | 28,561 | 32,790 | 29,215 |
| 2+ | 21,897 | 22,146 | 23,006 | 24,236 | 30,389 | 24,332 |
| **Total** | 50,128 | 50,311 | 51,337 | 52,797 | 63,180 | 53,547 |

**Note: Frequency missing = 289.**

**Table 10 Admissions per individual, by socioeconomic disadvantage of area, Perth residents, 1994 to 1998**

*Reliability over time of address as a proxy for socioeconomic status*

Studies using the address of usual residence as a proxy for socioeconomic status require two important assumptions. They are that:

• people who move, do so between areas of similar socioeconomic status; and that

• the areas used in these analyses (which vary in size and are quite often large) provide a reliable indication as to the socioeconomic status and health service utilisation of the individuals in the area.

Before examining whether people move within areas of similar socioeconomic status, it is worth noting the extent of movement of Perth residents admitted to hospital in Western Australia, and of the Perth population in general. Of the 298,809 people admitted more than once over the five year period 1994 to 1998, 64,075 (21.4%) had a different address[3] at the time of the second admission. That is, just over one in five people (admitted to hospital more than once in a five year period) had moved out of their CD. This is lower than the rate of movement in the general population. Data from the 1996 Census show that 53.5% of Perth's population at the 1996 Census reported that they had a different address than at the previous Census, five years earlier. Data were not available to compare the IRSD of the first and last SLA of address. However, 24.0% of Perth residents who moved between the 1991 and 1996 Censuses moved to an address within the same SLA. That is, some 59.3% of the population were in the same SLA after five years (either moved within the SLA, or did not move).

In summary, four out of five people admitted to hospital more than once in a five year period had not moved (out of the CD of their address at the first admission) by the time of their second admission.

The following table illustrates the extent of movement by quintile of socioeconomic disadvantage of area. People who moved are as described above (and in footnote 4). For this part of the analysis, the CD of first and last admission have been allocated to quintiles of socioeconomic disadvantage of area, to provide a comparison of the extent of movement between different levels of disadvantage.

The table (Table 11) shows that:

• people from the most well off areas are somewhat less likely to have moved[3] than are those from the most disadvantaged areas – 40.2% of people in the most advantaged areas (Quintile 1) remained there, despite moving from the CD of their first admission. The proportion in the most disadvantaged areas (Quintile 5 areas was a lower 30.5%;

• while there is movement right across the socioeconomic profile, most movement is between adjacent quintiles. For example, of the 18,875 people in the most disadvantaged areas at their first admission, 71.2% had moved to a CD in the same or next ranked quintile (Quintiles 5 or 4), with just 4.6% moving to the most advantaged areas. Similarly, of the 9,537 people in the most well off areas at their first admission, 63.0% had moved to a CD in the same or next ranked quintile (Quintiles 1 or 2), with just 4.7% moving to the most disadvantaged areas;

• the most substantial movement between quintiles was of people moving from an address rated as Quintile 5 to one rated as Quintile 4 (40.7%).

| CD of first admission | CD of last admission (%) | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | Total | Number |
| Quintile 1 | 40.2 | 22.8 | 16.4 | 15.9 | 4.7 | 100.0 | 9,537 |
| Quintile 2 | 21.5 | 24.4 | 22.9 | 23.6 | 7.5 | 100.0 | 10,551 |
| Quintile 3 | 12.7 | 20.3 | 24.1 | 32.5 | 10.5 | 100.0 | 11,730 |
| Quintile 4 | 7.8 | 14.6 | 22.0 | 40.3 | 15.3 | 100.0 | 13,298 |
| Quintile 5 | 4.6 | 9.2 | 15.0 | 40.7 | 30.5 | 100.0 | 18,875 |
| **Total** | **14.8** | **16.9** | **19.6** | **32.6** | **16.0** | **100.0** | **63,991** |

**Note: Frequency missing = 84**

**Table 11 Residents of Perth admitted to hospital more than once, 1994 to 1998, who changed address, by socioeconomic disadvantage of area**

There is a strong association between the quintile of socioeconomic disadvantage of area at the first and the last discharge when analysed by CD (a correlation coefficient of 0.88) or SLA (a correlation coefficient of 0.89) of usual address (Table 12). This supports the earlier evidence that people admitted to hospital who had moved between admissions, moved to areas of similar socioeconomic status. The weaker correlations between CD and SLA remind us of the loss in specificity of the index score when aggregated to the SLA level.

| Area of address | CD of | | SLA of | |
|---|---|---|---|---|
| | first admission | last admission | first admission | last admission |
| **CD of first admission** | 1.00 | 0.88 | 0.66 | 0.60 |
| **CD of last admission** | 0.88 | 1.00 | 0.60 | 0.65 |
| **SLA of first admission** | 0.66 | 0.60 | 1.00 | 0.89 |
| **SLA of last admission** | 0.60 | 0.65 | 0.89 | 1.00 |

[1]**Includes people admitted more than once, who had moved from the CD of their address at their first admission.**

**Table 12 Correlation coefficients between quintile of socioeconomic disadvantage of area of address of first and last admission[1], at various levels of aggregation of areas, 1994–98**

**Conclusions**

The information presented above shows that the use of larger area aggregates reduces the gap between the index scores for the most disadvantaged and least disadvantaged areas (thus diluting differentials between these areas), with the greatest impact on the scores for the most disadvantaged areas. The result is an understatement of the extent of disadvantage in the most disadvantaged areas, as well as the differential in disadvantage between the most well off and the poorest areas.

An indication of the likely impact on results of the aggregation of data to a higher area level is provided by the correlation analysis. It shows that there is a strong association between the quintile of the CD and the postcode of usual address at the first admission (a correlation coefficient of 0.74), and a weaker association when the data is aggregated to the SLA level (0.64 for people with one admission and 0.63 for people with more than one admission).

As to the hospital inpatient data, the analysis shows there to be both more people admitted from the most disadvantaged areas (13% more), and more admissions of people from these areas (47% more).

As regards the extent of movement, four out of five people admitted to hospital more than once in a five year period had not moved (out of the CD of their address at the first admission) by the time of their second admission. In addition:

• people from the most well off areas are less likely to have moved than are those from the most disadvantaged areas – 40.2% of people in the most advantaged areas (Quintile 1) remained there, despite moving from the CD of their first admission: the proportion in the most disadvantaged areas (Quintile 5 areas was a lower 30.5%;

• while there is movement right across the socioeconomic profile, most movement is between adjacent quintiles. For example, of the 18,875 people in the most disadvantaged areas at their first admission, 71.2% had moved to a CD in the same or next ranked quintile (Quintiles 5 or 4), with just 4.6% moving to the most advantaged areas. Similarly, of the 9,537 people in the most well off areas at their first admission, 63.0% had moved to a CD in the same or next ranked quintile (Quintiles 1 or 2), with just 4.7% moving to the most disadvantaged areas;

• the most substantial movement between quintiles was of people moving from an address rated as Quintile 5 to an address rated as Quintile 4 (40.7%).

There is a strong association between the quintile of socioeconomic disadvantage of area at the first and the last discharge when analysed by CD (a correlation coefficient of 0.88) or SLA (a correlation coefficient of 0.89) of usual address. This supports the earlier evidence that people admitted to hospital who had moved between admissions, moved to areas of similar socioeconomic status. The weaker correlations between CD and SLA remind us of the loss in specificity of the index score when aggregated to the SLA level.

In summary, postcode level and SLA level data provide a reliable indication of socioeconomic disadvantage of area. That is, the association between rates of total hospital admissions and individuals admitted and socioeconomic disadvantage of area is in the same direction in the postcode and SLA based data as it is in the CD based data. Further, the strength of the relationship between rates of total hospital admissions and individuals admitted and socioeconomic disadvantage of area is diluted. That is, using smaller areas (CDs) produces stronger associations than when we use larger (postcode or SLA) areas.

Given the widespread use in Australia of area based analyses at the postcode and SLA level, it is important to know that they can provide a reliable indication of the direction and underlying strength of association of socioeconomic disadvantage of area. However, it is clear that data as to the socioeconomic position at the CD level, or more importantly of the individual, would also be of value. Were data to be available across Australia on a similar basis to that from the Western Australian Data Linkage System, it would be possible to undertake far more policy-relevant research than is currently possible with the separations-based national database.

More importantly, if it were possible to get the agreement of the ABS to link data (using probabilistic linkage) for individuals in the Western Australian Data Linkage System to the Population Census, much more value could be added to these analyses. For example, it would be possible to access the individual characteristics of education, occupation, labour force status, housing tenure etc., and to more directly examine the relationships between the number of individuals admitted/total admissions, and these important socioeconomic variables. It is to be hoped that such arrangements can be made in the near future.

**Acknowledgements**

The hospital admission data on which this analysis was based was drawn from the Western Australian Data Linkage System. The Western Australian Data Linkage System was established in 1995 with three year funding from the Western Australian Lotteries Commission. Its aim is to link unit records from core Department of Health data collections and other relevant data collections, for the purpose of providing linked data to support health planning, purchasing, evaluation and research.

The data extraction and analysis for this paper was undertaken by Diana Rosman, Manager, Data Linkage Unit, Health Information Centre, Department of Health (Western Australia).

**Endnotes**

1. The technical term describing a completed hospital episode (ie., the discharge, death or transfer of a patient) is a 'separation'. At the time of admission, the age, sex, address of usual residence and other personal details of the patient are recorded. At the end of the episode, at the time of separation from hospital, details of the episode itself are recorded. Consequently, hospital inpatient data collections are based on separations. In this paper, the more commonly used term of 'admission' has been used. In an analysis such as this, which excludes long stay patients (other than the relatively small number of long stay acute patients), there is little difference between the number of admissions and the number of separations in a year.

2. The technical term describing a completed hospital episode is a 'separation'. At the time of admission to hospital, the age, sex, address of usual resi-

dence and other personal details of the patient are recorded. At the end of the episode, at the time of separation from hospital, details of the episode itself are recorded, including the date, time and method (discharge, death or transfer of a patient) of separation. Consequently, hospital inpatient data collections are based on separations. In this paper, the more commonly used term of 'admission' has been used. In an analysis such as this, which excludes long stay patients (other than the relatively small number of long stay acute patients), there is little difference between the number of admissions and the number of separations in a year.

3. The SLA is generally equivalent to a local government area, with additional codes allocated to areas outside local government areas (eg. unincorporated areas) and to local government areas which have been split for statistical purposes.

4. The IRSD is one of five Socio-Economic Indexes for Areas (SEIFA) produced by the Australian Bureau of Statistics from data collected at the 1996 Population Census.

5. People were recorded as having 'moved' if the CD of their address changed between the first and last admission over the period from 1994 to 1998. Movement to a different address within a CD was not included.

6. Moved from the quintile of socioeconomic disadvantage of area of the CD of their address.