

Statistical methods

Where possible, crude rates and simple averages and percentages have been used in this report to describe rural health issues. However, in a number of situations, simple statistics such as these could be misleading. For example, because the risk of death is age-related, direct comparisons of the crude mortality rates between remote areas and Major Cities could be misleading because of the younger age distribution of people in remote areas.

Consequently, comparison statistics have usually been age-standardised to largely remove the distorting effects that can result from differences in the age structure of the populations in each of the areas.

The other major statistical issue is the statistical significance of the results. For example, compared with Major Cities, are rates, averages and percentages *really* different in regional or remote areas, or is the apparent difference a consequence of chance only? This issue mainly pertains to survey data, but can also be an issue for census-type data (e.g. mortality data).

Census-type data

Comparison of rates calculated from census-type data (i.e. data sets that capture all events occurring in a certain period – e.g. the ABS mortality database) is typically unambiguous. For example, it may be apparent that in the period 1997–99 death rates were 1.19 times as high in hypothetical area A as in area B.

However, in this example, whereas the rate in area A may have been based on 1,000 deaths that occurred in the period, the rate in area B may have been based on only 10 (supposing area A has a much larger population than area B). Is the true underlying risk of death in area B really 1.19 times that in area A, or could chance have played a part?

It is possible that this comparison does not exactly reflect reality over a longer time span. Deaths within a population do not occur regularly (e.g. on a particular date of each month), and so the death rate calculated over different time periods but within the same population will vary; the smaller the population, the greater the potential for variation.

It is entirely possible that, in the following 3-year period (2000–02), without any fundamental change in the likelihood of death, and due to chance alone, there could have been 1,012 deaths in area A and 7 deaths in area B. In the total 6-year period 1997–2002, there would therefore have been 2,012 deaths in area A and 17 in area B. Based on the longer period, the calculated rate in area B may now be 0.99 times that in area A – at odds with the comparison for the period 1997–99 (1.19 times that in area A). For this reason, inter-regional comparisons of rates have used 95% confidence intervals where possible. The values inside the 95% confidence interval are plausible values for the true underlying risk ratio, and the reader can be 95% sure that significant differences identified within these boundaries are likely to be true differences, and not differences that have occurred by chance.

Survey data

Survey data describe rates for a group of people believed to be representative of a larger population (usually, the national or state population), and may not as effectively reflect the population within specific areas (e.g. Inner Regional areas).

Also, the limited size of the sample increases the variability of the calculated rate. For this reason (unless standard errors were unavailable), all inter-regional comparisons in this report based on sample data use 95% confidence intervals to identify potentially significant

differences. To avoid cumbersome expression in the text, where rates, percentages or means are significantly different at the 95% level of confidence, they have been described simply as 'significantly' different.

The problem of multiple comparisons

Significant differences identified in this report are best viewed as different and 'worthy of further investigation', not necessarily as unambiguous evidence of inter-regional differences. One of the problems with making many comparisons in the absence of an initial hypothesis is that, on average, 1 in 20 of the significantly different results will be different simply because of chance. Significant results should be interpreted with this in mind and as part of the overall weight of evidence, somewhat in line with Sir Austin Bradford Hill's nine criteria for assessing causation (Bradford Hill 1967). For example, a comparison indicating a significantly higher rate in one area over another, echoed in other related comparisons and demonstrated in analyses of other data sets is more likely to indicate a truly higher rate than if the comparison is not supported in this manner. Interpretations of this 'hypothesis generating' work should be made with this in mind.

Indirect age-standardisation

This method has been used in this report to make inter-regional comparisons of death rates, non-hospital specialist consultations and a raft of National Health survey and other ABS survey data.

Description of the relative rates of death in the different areas was made by comparing the number of deaths that actually occurred with the number that would have been expected if Major Cities rates had applied in each area. 'Excess' deaths have been expressed as the difference between the number of deaths observed and the number expected (Armitage & Berry 1987: 403-5).

When reporting age-standardised rates, it is usual for AIHW to directly age-standardise rates to the Australian population as it was in 2001. This involves applying the rates of disease or death for each sex and age group in the population of interest to the number of people in the whole Australian population in 2001; the total number is then expressed as a rate. This approach works well when the population of interest is large, but works less well with small populations (such as those in remote areas), especially if the event of interest is relatively rare. In such situations it is better to use indirect rather than direct age-standardisation.

For this report, the indirect method of standardisation has been used, where possible, because several of the populations of interest are small and the counts of events or services in these areas are also relatively small. This method involves the following steps:

- calculation of age-specific rates for the standard population (usually the contemporary Major Cities population)
- calculation of the number of events (e.g. deaths) expected to occur, if the standard age-specific rates applied to the population in each area
- comparison of the total number of events (e.g. deaths) observed in the population of each area to the number expected (i.e. the ratio of observed to expected events).

Because the ratio of the observed to expected deaths is exactly the same as the ratio of the 'indirect age-standardised rates' in each area to that in Major Cities, the difference between the mortality in one area and that in Major Cities can be expressed either as:

- one rate is 'so many times as high as another'; or

- there are 'so many times more events (e.g. deaths or consultations) than expected'.

For example, if 2,000 GP consultations were observed in an area, and 1,000 were expected, then there were 2 times as many consultations as expected, or the adjusted rate of consultation in the area was 2 times that in Major Cities.

Confidence intervals

Confidence intervals for indirect age-standardised rates (ratios of observed to expected cases) have been calculated using the two methods described below.

Where confidence intervals overlap, the rates are assumed to be not significantly different, but where they miss each other completely, the differences are considered to be 'significant'.

Calculation of confidence intervals for census-type (e.g. mortality) data

Confidence intervals for death rates were calculated on the basis of the number of observed deaths using the square-root transform described in Breslow and Day (Breslow and Day 1987: 70-1).

This method has been used where observed and expected cases have been actual counts.

Calculation of confidence intervals for expanded survey data

This method has been used where the available data are weighted estimates based on survey data (e.g. National Health Survey and Survey of Mental Health and Wellbeing of Adults).

The standard error of the estimate for O/E (Kendall & Stuart 1969) is calculated as:

$$SE = \sqrt{[(O/E)^2 \times VAR_e] + VAR_o} / E^2$$

where:

O/E = the ratio of the observed to expected number of cases

O = the number of synthetic observed rates. The ABS provided weighted estimates of the total number of cases (synthetic numbers), based on the number of cases in the survey and a weighting factor

E = the number of synthetic expected cases (based on the numbers of synthetic observed cases)

VAR_o = the variance for the synthetic total number of observed cases.

The variance is the square of the standard error associated with the observed or expected number, calculated by the ABS and provided with the base data they had provided.

$$VAR_e = \sum (pop/POP)^2 \times (SE_e)^2$$

where:

pop = the population in each area in a specific age group

POP = the standard population in a specific age group

SE_e = the standard error of the expected synthetic number of cases in the area in a specific age group.

The lower 95% confidence limit (L95%CL) = (O/E) - (1.96*SE)

The upper 95% confidence limit (U95%CL) = (O/E) + (1.96*SE)

These estimates of the upper and lower confidence limits are approximations, but have been used for simplicity. Confidence limits calculated using Fieller's theorem are identical to these estimates to the third decimal place.

Other statistical methods

A range of other statistical methods were used throughout the report.

Direct age-standardised rates

This method of age standardisation was used for indicator 3.5.4 – Primary care medical consultations, because of the need to sum consultations from different sources (this would not have been possible using the indirect method). Fortunately, the large number of consultations that occurred in all of the Remoteness Areas meant that the method remained robust in all of these areas.

The method involves:

- calculation of local age-specific rates (in this case, of GP consultation)
- application of these rates to the numbers of people in each age group in the total Australian population in 2001 to yield a total standardised number (essentially the number expected if local rates had applied to the Australian population in 2001)
- division of the total standardised number for each local area by the total Australian population in 2001 to yield rates (direct age-standardised rates).

Direct age-standardised percentages

This method of age-standardisation was used for indicators 1.1.6 – Birthweights and 2.2.4 – Employment.

Direct age-standardised percentages were calculated by applying the age-specific percentages exhibiting a certain characteristic in each area to each age group of the 1991 or 2001 Australian population. The resultant 'expected' numbers of people exhibiting the characteristic in each age group in the 2001 Australian population were summed for all age groups. This total 'expected' number exhibiting the characteristic was then divided by the total 2001 Australian population to yield the direct age-standardised percentage. In effect, the direct age-standardised percentage is a weighted percentage.

Direct age-standardised means

This method of age-standardisation was used for indicators 1.2.2 – Reduced activity due to illness and 3.5.4 – Dental consultations.

Direct standardised means are weighted averages of age-specific means, with weights equal to the proportion of the 2001 Australian population in each age group.

Death rate time trends

The slopes of trend lines for describing the change in death rates over time were calculated using weighted least squares. Confidence intervals for the slope were calculated using the standard error of the slope.

The relative contributions of each of the broad causes of death to the overall decrease in the death rate were calculated using linear regression of the number of 'excess' deaths attributed to each cause, over time, using the method described in Armitage & Berry (1987: 143–150).

Life expectancy

Life expectancy was calculated using life tables (Pollard et al. 1975: 30–47).

Glossary

Age standardisation A method of removing the influence of age when comparing populations with different age structures. This is usually necessary because the rates of many diseases vary strongly (usually increasing) with age. The age structures of the different populations are converted to the same 'standard' structure, then the disease rates that would have occurred with that structure are calculated and compared. Age standardisation can be achieved by either the direct or indirect methods (see methods section on page 302).

ARIA (categoric) (Accessibility/Remoteness Index of Australia) A five-level classification of geographical remoteness, based on road distance from service centres developed by the Commonwealth Department of Health and Ageing, based on GISCA's continuous ARIA classification.

ARIA (continuous) A continuous measure of accessibility/remoteness, ranging from 0 (most accessible/least remote) to 12 (least accessible/most remote) derived by GISCA.

ARIA+ An improved continuous measure of accessibility/remoteness, ranging from 0 (most accessible/least remote) to 15 (least accessible/most remote) derived by GISCA.

ASGC (Australian Standard Geographic Classification) An ABS classification which provides a hierarchy of geographic area codes used to classify a wide range of social and economic data. The ASGC 'Main Structure' code to which a locality is coded has nine digits. It comprises codes representing the top four hierarchical levels of the 'Main Structure':

State/Territory (S/T)

Statistical Division (SD)

Statistical Subdivision (SSD)

Statistical Local Area (SLA).

In this structure, the SLAs aggregate to form SSDs which in turn aggregate to form SDs and the SDs aggregate to form S/Ts. All levels cover the whole of Australia without gaps or overlaps.

The ASGC also classifies locations according to 'Section of state' and 'Remoteness' (ASGC Remoteness Areas).

Details of the ASGC are available in the publication *Australian Standard Geographical Classification* (ASGC) (cat. no. 1216.0).

ASGC Remoteness Areas A five-level classification of geographical remoteness, based on road distance from service centres developed by the Australian Bureau of Statistics, based on GISCA's continuous ARIA+ classification.

BEACH (Bettering the Education and Care of Health) A rolling survey of GP activity conducted by the AIHW General Practice Statistics and Classification Unit.

BMI – body mass index The most commonly used method of assessing whether a person is normal weight, underweight, overweight or obese. It is calculated by dividing the person's weight (in kilograms) by their height (in metres) squared, that is, $\text{kg} \div \text{m}^2$. For both men and women, underweight is a BMI below 18.5, acceptable weight is from 18.5 to less than 25, overweight is 25 to less than 30, and obese is 30 and over.

Bulk-billed doctor consultations A practitioner who bulk bills and undertakes to accept the relevant Medicare benefit as full payment for the service. The patient eligible for a benefit

under the Medicare program assigns his or her right to the benefit to the practitioner. The practitioner then bills the Health Insurance Commission (HIC) instead of the patient. This was previously referred to as 'direct billing'.

CD (census collectors district) The smallest geographical area defined in the Australian Standard Geographical Classification (ASGC). CDs serve as the basic building block in the ASGC and are used for the aggregation of statistics to larger ASGC areas, such as statistical local areas (SLAs).

The area and population delimited by a CD boundary must be small enough to allow one collector to deliver and collect census forms within about 10 days. It should be readily identifiable on the ground and be defined in terms of permanent features; and it should conform where possible to existing/gazetted suburb boundaries, must not cross statistical local area (SLA) boundaries and contain, where possible, at least 100 persons at the next census.

Cold chain A system of protection against high environmental temperatures (generally involving refrigerators and eskies) for vaccines, serums and other biological preparations. Typically the cold chain is the system of transporting and storing vaccines within the temperature range of 2°C to 8°C from the place of manufacture to the point of vaccination.

Confidence interval A statistical term describing a range (interval) of values within which we can be 'confident' that the true value lies, usually because it has a 95% or higher chance of doing so.

Coronary artery bypass graft (CABG) A surgical procedure using blood vessel grafts to bypass blockages in the coronary arteries and restore adequate blood flow to the heart muscle.

Crowding Dwellings with insufficient bedrooms. Of the several crowding standards available, the Canadian National Occupancy Standard has been used to define crowding in this report (see technical details on page 199).

Dependency ratio The ratio of the number of either children to adults (childhood dependency ratio) or of the number of elderly people to adults (aged dependency ratio) in a population.

DVA patient A patient who is an Australian war veteran, or their spouse or dependent who is eligible for medical services billed to the Commonwealth Department of Veterans' Affairs.

DVA-billed consultation A medical consultation that is billed to the Department of Veterans' Affairs, on behalf of the patient who is an Australian war veteran, their spouse or dependent.

Enrolled nurse A nurse who is on the roll maintained by the state or territory nurses' board or nursing council to practise nursing in that state or territory. The minimum educational requirement for an enrolled nurse is a 1-year diploma from a tertiary institution or equivalent from a recognised hospital-based program. It is necessary for a nurse to have practised for a specified minimum period in the past 5 years to maintain enrolment. Enrolled nurses include mothercraft and dental nurses where the educational course requirements may be greater than 1 year but less than a 3-year degree course or equivalent.

Episode of care The period of admitted patient care between a formal or statistical admission and a formal or statistical separation, characterised by only one care type.

Equivalised after-tax household income What is left of the household income, after tax has been paid, adjusted on the basis of the number of adults and children in the household.

Fertility rate The number of live births per 1,000 women (generally expressed for women aged 15–49).

Foetal death The death of a foetus of at least 20 weeks gestation or 400 grams weight before birth. Sometimes referred to as stillbirth.

Full-time equivalent (FTE) The number of practitioners multiplied by the average weekly hours worked, divided by the number of hours in a 'standard' full-time working week. Although a 35-hour or 38-hour week is the standard in many industries, the 'typical' working week varies between occupations. In this report, the 35-hour standard has been adopted.

GP (VRGP – vocationally registered general practitioner) A primary care practitioner who has been registered by the Health Insurance Commission as a recognised general practitioner.

Hospital non-specialist Medical practitioners mainly employed in a salaried position in a hospital who do not have a recognised specialist qualification and who are not undertaking a training program to gain a recognised specialist qualification. They include resident medical officers (RMOs) and interns, as well as career and other salaried hospital practitioners.

Household A group of two or more related or unrelated people who usually reside in the same dwelling, who regard themselves as a household and who make common provision for food or other essentials for living; or a person living in a dwelling who makes provision for his/her own food and other essentials for living, without combining with any other person.

Indigenous (identification) A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal person and/or Torres Strait Islander and is accepted as such by the community with which he or she is associated.

Life expectancy An indication of how long a person can expect to live. Technically it is the number of years of life remaining to a person at a particular age if death rates do not change.

Mammogram An X-ray of the breast. It may be used to assess a breast lump or as a screening test in women with no evidence of cancer.

Medicare A national, government-funded scheme that subsidises the cost of personal medical services for all Australians and aims to help them afford medical care.

Medicare-billed A medical consultation that is billed to Medicare, either directly (when a medical practitioner bulk bills), or indirectly (when the patient pays the medical practitioner and then claims the rebate for the consultation from Medicare).

Mortality Death.

Neonatal Pertaining to or occurring in the 28-day period after birth.

Non-remote areas Those areas classified as Major Cities, Inner Regional and Outer Regional areas under the ASGC Remoteness Area structure.

Occasion of service Occurs when a patient receives some form of service from a functional unit of the hospital, but is not admitted.

Outpatient Another term for non-admitted hospital patient.

Pap-smear test Papanicolaou smear, a procedure to detect cancer and pre-cancerous conditions of the female genital tract.

Perinatal Pertaining to or occurring in the period shortly before or after birth (if after birth, usually 28 days afterwards).

Primary health care The first level contact with a health practitioner by people taking action to improve health.

Primary care medical practitioner A medical practitioner, such as a general practitioner (GP), consulted by people seeking primary health care.

Referred non-hospital consultations Typically a consultation with a specialist in-rooms, rather than in-hospital.

Registered nurse A nurse who is on the register maintained by the state or territory nurses board or nursing council to practise nursing in that state or territory. The minimum educational requirement for a registered nurse is a 3-year degree from a higher education institution, or equivalent from a recognised hospital-based program. To maintain registration, it is necessary for a nurse to have practised for a specified minimum period in the field of nursing in the preceding 5 years.

Remote areas Those areas classified as Remote or Very Remote under the ASGC Remoteness Area structure.

Separation (hospital separation) The formal process by which a hospital records the completion of treatment and/or care for an admitted patient.

Significant(ly) Statistically significant(ly) at the 95% level of confidence.

SMR (standardised mortality ratio) The ratio of the observed and expected numbers of deaths. The expected number of deaths is calculated as the number that would be expected if age-specific rates from the 'standard' population applied to the population of interest. The standard population is the one with which comparisons are to be made. Variations of the SMR are the SSR (standardised separation ratio), SNR (standardised notification ratio) and so on. Refer to statistical methods section, page 302).

Specialist A medical practitioner with a qualification awarded by, or which equates to that awarded by, the relevant specialist professional college in Australia to treat certain conditions.

Specialist-in-training A medical practitioner who has been accepted by a specialist medical college into a training position supervised by a member of the college.

Statistical local area (SLA) Areas defined in the Australian Standard Geographical Classification (ASGC) which consist of one or more collection districts (CDs). They can be based on legal local government areas (legal LGAs), or parts thereof, or any unincorporated area. They cover, in aggregate, the whole of Australia without gaps or overlaps.

Temporary resident doctor A citizen of another country who has an immigration visa allowing employment as a medical practitioner in Australia. The person's qualifications must be recognised for conditional registration by the relevant state medical board.

Vector (relating to vectorborne diseases) An insect or other organism that transmits infectious microorganisms from animal to human or human to human.

The Rural Health Information Framework

Notes to the Rural Health Information Framework (AIHW 2003b)

A number of issues can have a substantial effect on, or be affected by, health status, determinants of health and health system performance in a rural environment.

- An individual's sex and age affect the health status, the likelihood of engaging in risky behaviour and the use of health services. Older people may migrate to less remote centres so as to access services.
- Many Indigenous people have poor health outcomes and they constitute a large proportion of the population in more remote areas, and consequently strongly affect health statistics in those areas. Although it is important to describe any overall changes across geography of the population as a whole, it is also important to try to differentiate between the effects of Indigenous health and that of remoteness. In other words, is poorer health in more remote areas a result of poor Indigenous health or related to remoteness (or both)?

Consequently, indicators have been designed, where possible, to report:

- by broad geographical area such as ASGC Remoteness Area, ARIA or RRMA category
- over time
- by sex and age group
- by Indigenous status.

Other factors, frequently difficult to measure in health statistics (which have not been considered in the development of the indicators), need to be considered in the interpretation of indicator statistics:

- socioeconomic status
- population density (i.e. whether the local setting is a large regional centre or an isolated farm or a small and remote community).

In addition to these criteria, there are groups of people who should, where possible, be examined more closely because of the relevance of their characteristics to a rural health information framework:

- Indigenous people
- all age groups (especially the aged and youth)
- people with disabilities
- farmers and farm workers
- miners
- the health workforce.

Finally, in developing the indicators, we have specially taken care to cover the following areas:

- National Health Priority Areas (cardiovascular disease, cancer, diabetes, mental health, injury, asthma)
- specific rural health issues (occupational health, suicide, motor vehicle accidents, mental health)
- Indigenous health issues (renal disease, diabetes, early death).

The Rural Health Information Framework

Health status and outcomes				
How healthy are Australians? Is it the same for everyone? Where is the most opportunity for improvement?				
Health conditions	Human function	Life expectancy and wellbeing	Deaths	
Prevalence of disease, disorder, injury or trauma or other health-related states. <i>Chronic diseases, injury, mental health, oral health, communicable diseases and birth outcomes.</i>	Alterations to body, structure or function (impairment), activities (activity limitation) and participation (restrictions in participation). <i>Disability and days away from usual activity sick.</i>	Broad measures of physical, mental and social wellbeing of individuals and other derived indicators such as disability-adjusted life expectancy (DALE). <i>Disability-adjusted life expectancy, life expectancy, disability-adjusted life years, self-assessed health status and self-assessed happiness.</i>	Age and/or condition-specific mortality rates. <i>Perinatal mortality, age-specific mortality, overall death rates, premature mortality, burden in each area.</i>	
Determinants of health				
Are the factors determining health changing for the better? Is it the same for everyone? Where and for whom are they changing?				
Environmental factors	Socioeconomic factors	Community capacity	Health behaviours	Person-related factors
Physical, chemical and biological factors such as air, water, food and soil quality resulting from chemical pollution and waste disposal. <i>Water, sewerage, food availability, housing, recreational and cultural facilities, the workplace, environmental hazards.</i>	Socioeconomic factors such as education, employment, per-capita expenditure on health, and average weekly earnings. <i>Education, employment, after-tax income.</i>	Characteristics of communities and families such as population density, age distribution, health literacy, housing, community support services and transport. <i>Population characteristics, social issues and social capital, services, health literacy, perception of risk, housing, transport, cost of living, regional business health.</i>	Attitudes, beliefs, knowledge and behaviours, e.g. patterns of eating, physical activity, excess alcohol consumption and smoking. <i>Smoking, alcohol consumption, illicit drugs, physical activity, nutrition, sexual practices, driving practices.</i>	Genetic-related susceptibility to disease and other factors such as blood pressure, cholesterol levels and body weight. <i>Genetically determined diseases, specific birth defects, blood pressure, cholesterol and body weight.</i>

(continued)

The Rural Health Information Framework (continued)

Health system performance How well is the health system performing in delivering quality health actions to improve the health of all Australians? Is it the same for everyone?		
Effective Care, intervention or action achieves desired outcome. <i>Effectiveness of retrieval for victims of trauma, STI education, immunisation, breast cancer and cervical screening and medical/surgical intervention.</i>	Appropriate Care/intervention/action provided is relevant to the client's needs and based on established standards. <i>Female GPs, surgical procedure, specialist consultations, post surgical care and rehabilitation, aged care, accreditation, waiting times for elective surgery, reasons for visiting a GP.</i>	Efficient Achieving desired results with most cost-effective use of resources. <i>Cost of providing services in each area, cost of providing services to people from each area, cost of screening in each area, ratio of expenditure to positive outcomes.</i>
Responsive Service provides respect for persons and is client-orientated and includes respect for dignity, confidentiality, participation in choices, promptness, quality of amenities, access to social support networks, and choice of provider. <i>Culturally appropriate, confidentiality, choice of GP, waiting times for elective surgery, response time in hospital emergency departments, bulk billing, waiting times to consult allied health workers and test results, closed books and level of satisfaction of the population.</i>	Accessible Ability of people to obtain health care at the right place and right time irrespective of income, physical location, cultural background, age and sex. <i>Physical distance to health services, reduced access due to discrimination, lack of access because of cost, ratio of health workers and health facilities to population, occasions of service per person per year, times when health services are not available.</i>	Safe The avoidance or reduction of acceptable limits of actual or potential harm from health care management or the environment in which health care is delivered. <i>Rate of medical and surgical misadventure, survival rates in intensive care units.</i>
Continuous Ability to provide uninterrupted, coordinated care or service across programs, practitioners, organisations and levels over time. <i>Rate of case-care conferencing.</i>	Capable An individual's or service's capacity to provide a health service based on skills and knowledge. <i>Accreditation and rates of admission for surgical medical misadventure (also covered under 'safe' dimension).</i>	Sustainable System's or organisation's capacity to provide infrastructure such as workforce, facilities and equipment, and be innovative and respond to emerging needs (research, monitoring). <i>Health students from rural areas, recruitment and turnover of GPs, hours worked and time on call.</i>

Note: Based on the National Health Performance Framework. Text in italics refers to specific rural, regional and remote issues considered in the Rural Health Information Framework.

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