



# **SUICIDE IN SOUTH AUSTRALIA: SPECIFIC FEATURES, TRENDS AND REASONS FOR DISPARITIES IN NUMBERS**

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## **DECLARATION**

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another individual, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide.

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# **PUBLICATIONS AND PRESENTATIONS**

The following reviews, original papers, case reports, editorial and abstracts were published, or accepted for publication or presentation during the period of my candidature. \*Denotes papers included in the present thesis.

## **i. REVIEWS**

**Austin AE**, van den Heuvel C, Byard RW. Suicide in forensic practice – an Australian perspective. *Aust J Forensic Sci.* 2011;43:65–76.

**Austin AE**, Byard RW. ‘Suicide in the young’. In: *Encyclopedia of Forensic and Legal Medicine*, 2<sup>nd</sup> ed. Eds. Payne-James J, Byard RW. Elsevier | Academic Press. 2015 (In press).

## **ii. ORIGINAL PAPERS**

Byard RW, **Austin AE**, van den Heuvel C. Characteristics of asphyxial deaths in adolescence. *J Forensic Leg Med.* 2011;18:107–9.

**Austin AE**, van den Heuvel C, Byard RW. Causes of community suicides among indigenous South Australians. *J Forensic Leg Med.* 2011;18:299–301.\*

**Austin AE**, Winskog C, van den Heuvel C, Byard RW. Recent trends in suicides utilizing helium. *J Forensic Sci.* 2011;56:649–51.

**Austin AE**, van den Heuvel C, Byard RW. Cluster hanging suicides in the young in South Australia. *J Forensic Sci.* 2011;56:1528–30.

**Austin AE**, van den Heuvel C, Byard RW. Physician suicide. *J Forensic Sci.* 2013;58 Suppl 1:S91–3.\*

**Austin AE**, van den Heuvel C, Byard RW. Suicide and fatal single occupant motor vehicle collisions. *Aust J Forensic Sci.* 2013;45:43–8.\*

**Austin AE**, van den Heuvel C, Byard RW. Prison suicides in South Australia: 1996–2010. *J Forensic Sci.* 2014;59:1260–2.\*

**Austin AE**, van den Heuvel C, Byard RW. Body mass index and suicide. *Am J Forensic Med Pathol.* 2014;35:145–7.\*

### **iii. CASE REPORTS**

**Austin AE**, van den Heuvel C, Heath KJ, Gilbert JD, Byard RW. Recent firing range suicides in South Australia. *J Forensic Sci.* 2012;57:1495–6.\*

**Austin AE**, Heath KJ, Gilbert JD, Byard RW. Head impalement – an unusual form of suicide. *J Forensic Leg Med.* 2012;19:264–6.\*

**Austin AE**, Guddat SS, Tsokos M, Gilbert JD, Byard RW. Multiple injuries in suicide simulating homicide: report of three cases. *J Forensic Leg Med.* 2013;20:601–4.\*

**Austin AE**, Byard RW. Skin messages in suicide – an unusual occurrence. *J Forensic Leg Med.* 2013;20:618–20.\*

#### **iv. EDITORIAL**

Byard RW, **Austin AE**. The role of forensic pathology in suicide. *Forensic Sci Med Pathol.* 2011;7:1–2.

#### **v. PRESENTATIONS**

**Austin AE**, van den Heuvel C, Byard RW. Indigenous Australians, suicide and the autopsy. 19<sup>th</sup> Triennial Meeting of the International Association of Forensic Sciences; 2011 Sep 12–7; Madeira, Portugal.

**Austin AE**, van den Heuvel C, Heath KJ, Gilbert JD, Byard RW. Firing range suicide – a notable occurrence. 21<sup>st</sup> International Symposium on the Forensic Sciences; 2012 Sep 23–7; Hobart, Australia.

**Austin AE**, van den Heuvel C, Byard RW. Body mass index and suicide – is there an association? 21<sup>st</sup> International Symposium on the Forensic Sciences; 2012 Sep 23–7; Hobart, Australia.

**Austin AE**, van den Heuvel C, Byard RW. Community suicides among indigenous people in South Australia. The National Suicide Prevention Conference; 2013 Jul 24–6; Melbourne, Australia.

**Austin AE**, van den Heuvel C, Byard RW. Prison suicides in South Australia: retrospective review of deaths and contemporary analyses. The National Suicide Prevention Conference; 2013 Jul 24–6; Melbourne, Australia.

**Austin AE**, van den Heuvel C, Byard RW. Body mass index and suicide in South Australia. The National Suicide Prevention Conference; 2013 Jul 24–6; Melbourne, Australia.

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## **ABSTRACT**

Suicide constitutes a significant and yet under-recorded component of preventable mortality in many communities. Prevalent methods of suicide vary over time, and are influenced by the availability of noxious agents as well as ideas of what constitutes lethal techniques. Despite indications of self-destructive acts in many instances, it is sometimes difficult to accurately designate the manner of death as suicide, resulting in misclassifications among individual records. For example, deaths due to drug overdose, a fall from a height and drowning may be 'accidental', intentional or homicidal. Such ambiguities are carefully considered in forensic medicolegal investigations, through integration of death scene and autopsy findings. Thus, single forensic centres that service an explicit geographical area and have direct access to case information may produce more valid suicide data than larger and less specific national registers which rely upon records that may be incomplete or inaccurate. The following study was undertaken to examine suicide among medicolegal deaths in South Australia, to compare this with South Australian data on national registers and to delineate the characteristics of such cases.

A manual and electronic search was undertaken of pathology files at Forensic Science SA in Adelaide, Australia, for cases of suicide. All cases had undergone full police and coronial investigations. Case details were examined and the sex, age and race of victims, as well as reports on toxicology, the circumstances of death and/or means of suicide were collated.

Significant changes in the sex-, age- and method-specific patterns of suicide over recent years were identified. Specifically, there was a general decline in the rates of male suicides although, no statistically significant changes were observed in the registered rates for females. Available data from national registers were also reviewed from the National Coronial Information System and from the Australian Bureau of Statistics. After separating victims by sex, an overall under-reporting of suicides of 5.4% of local male cases as well as 13.5% of local female cases in the National Coronial Information System, and of 4.9% of local male cases as well as 14.0% of local female cases by the Australian Bureau of Statistics, was recorded, with a progressive increase in differences between reported numbers of suicides over time and particularly in recent years. Also, when cases were sub-classified according to the method used or specific groups of victims, further trends were discerned over time, including a decrease in overall deaths by carbon monoxide inhalation and male hangings, whereas hangings preponderated among Aboriginal as well as incarcerated people in South Australia. Additionally, overall drug-related deaths, asphyxial deaths using helium and female hangings, all showed increases compared to previous years. This study has demonstrated that despite a modest decline in the overall rate of suicide in South Australia, there have been marked and rapid alterations in the means of specific forms of suicide and among particular victim subgroups identified from local datasets. Such trends were not identifiable in national reports of death.

## ABBREVIATIONS

ABS	—	Australian Bureau of Statistics
CO	—	Carbon monoxide
FSSA	—	Forensic Science SA
ICD-10	—	International Statistical Classification of Diseases and Related Health Problems, 10 <sup>th</sup> revision
LPG	—	Liquefied petroleum gas
NCIS	—	National Coronial Information System
NSW	—	New South Wales
NT	—	Northern Territory
BDM	—	Registrar of Births, Deaths and Marriages
SA	—	South Australia

# **CHAPTER 1: OVERVIEW OF GENERAL POPULATION SUICIDE**

## **1.1 INTRODUCTION**

Suicide, or the act of killing oneself, varies across countries and within populations. Patterns in suicides over time are considered indicators of the quality of health services, as well as the physical, emotional and spiritual profiles of communities.

The overall features of population self-destruction, including the sex and age of aggregated victims, are documented in the literature. However, suicide trends and particular forms of self-killing often go unreported. Although the Australian Bureau of Statistics (ABS) is a national data repository of information on registered deaths, including suicides, in Australia, the interpretation of available data is not always straightforward. Whilst some empirical work has been carried out overseas, for example in countries such as England, Wales, Greece and the United States, little research into the specific characteristics of suicide victims has been conducted in Australia. Much of the research effort has focused on understanding suicidal behaviour in young Australians aged 15–24 years, rather than acknowledging the need to also examine other age groups. Often lacking in the literature is research exploring suicide trends in smaller populations, such as South Australia (SA). Since 1979, no detailed analyses of the specific characteristic features of, and temporal changes in, suicides in the overall South Australian population have been published.

This introductory chapter provides an overview of population suicide, including the characteristic features of deaths, as well as the potential means. It provides the

necessary background information for the following studies, which specifically evaluate suicide in SA.

### 1.1.1 *History of reported victims*

Around one million people die by suicide each year, with an estimated global death rate of 11.4 per 100,000 population, according to the World Health Organisation ([www.who.int](http://www.who.int)). However, national rates of suicide vary greatly (Table 1). Records in Australia have suggested an overall rate of suicide that is similar to that of Singapore (1), Chile (2) as well as the United States (3), but somewhat higher than reports from Brazil (4) and Canada (5), and lower than that from Russia (6). However, it is difficult to reliably compare suicide rates in Australia with rates in other countries because data and what constitutes it, is recorded in different ways. Furthermore, with suicide even being illegal in some jurisdictions, such as that under the *Penal Code* (Singapore) as well as the *Criminal Code, 1960* (Ghana), and until allegedly repealed (7, 8), under the *Penal Code* (India); it is likely that such deaths are seriously under-reported. Thus, suicides are medicolegal cases and constitute a significant proportion of forensically investigated deaths.

TABLE 1—*Suicide rates per 100,000 population in males and females by country and period reported.* Adapted from (2–6, 9–15, [www.abs.gov.au](http://www.abs.gov.au), [www.health.govt.nz](http://www.health.govt.nz), [www.ons.gov.uk](http://www.ons.gov.uk), [www.who.int](http://www.who.int)).

Country	Year/s	Male	Female
India	2002–2007	44.7	26.8
Lithuania	2007	53.9	9.8
Belarus	2005	53.8	7.8
Russia	2007	51.6	9.6
Japan	2007	35.8	13.7
Finland	2009	35.2†	11.9†
France	2006	25.5	9.0
China	2006–2010	15.3	12.8
Singapore	1991–2000	15.8	9.4
Germany	2010	18.6	6.1
New Zealand	2012	18.1	6.4
United States	2009	19.2	5.0
Chile	2010	19.1	4.4
Australia	2012	16.7	5.5
Norway	2009	16.2†	6.0†
Ireland	2007	17.4	3.8
England	2010	15.1	4.7
Canada	2004–2007	13.2	4.1
Spain	2005	12.0	3.8
Italy	2006	9.9	2.8
Brazil	2004–2006	7.3	1.9
Greece	2006	5.9	1.2
Georgia	2001	3.4	1.1
Peru	2000	1.1	0.6
Egypt	2009	0.5	0.2

†Only includes suicides among those aged 15 years and above.

Much of the forensic literature on suicide originates from Germany, Finland, Singapore and the United States. Although, data from other countries is sometimes skewed by the incomplete recording of deaths due to excessive numbers of inadequately investigated cases (16) which also tend to be cases among particular groups of victims, such as the misreporting of specific sex and age categories (17).

In Australia, the overall annual suicide rate increased steadily during the 1990's and peaked in 1997, with a rate of 14.7 deaths per 100,000 population (2,723 suicides). Subsequently, the national rates appear to have been decreasing, with an overall decline of reports of suicide in 2012 (2,535 suicides or 11.1 per 100,000 population) being 24.5% lower than the rate reported in 1997 ([www.abs.gov.au](http://www.abs.gov.au)). However, due to varying practices as well as criteria for recording suicides (18), including possible misclassifications of such deaths over time, ABS reports may not be as useful for research purposes. Caution should therefore be exercised when interpreting national data over time.

## **1.2 GENERAL CHARACTERISTICS OF SUICIDE**

### *1.2.1 Sex of victims*

A considerable number of males die by suicide but females are more often recorded attempters (19–21). In 2012, males accounted for three-quarters (75.0%) of registered suicides in Australia, with an overall rate of 16.7 deaths per 100,000 population (1,901 suicides) versus that for females being significantly lower, at 5.5 deaths per 100,000 population (634 suicides). This predominance of male victims is consistent throughout

documented suicides across most countries (9, 10, 15, 24–26). However, a distinguishing feature of suicide in China was the male-to-female ratio whereby more females than males suicided, although this trend has reportedly since reversed (14, 27).

### 1.2.2 *Age of victims*

Whilst reported suicides represent a relatively small proportion (1.7%) of the total number of registered deaths in Australia (which includes deaths due to natural causes), suicide accounts for a much greater proportion of deaths within specific age categories (Fig. 1 and 2). In 2012, the age-specific suicide rates were highest for people aged 80–84 years (17.5 deaths per 100,000 population), with suicide being more common in the elderly and among the middle-aged, than in those in slightly younger age groups (Fig. 1). Suicide as a proportion of deaths, however, is considerably more frequent in young people aged 20–24 years, with the proportion of deaths attributed to suicide dropping in the very young (Fig. 2). Such overwhelming numbers of young adult deaths being suicides has also been recently noted in Germany (10).

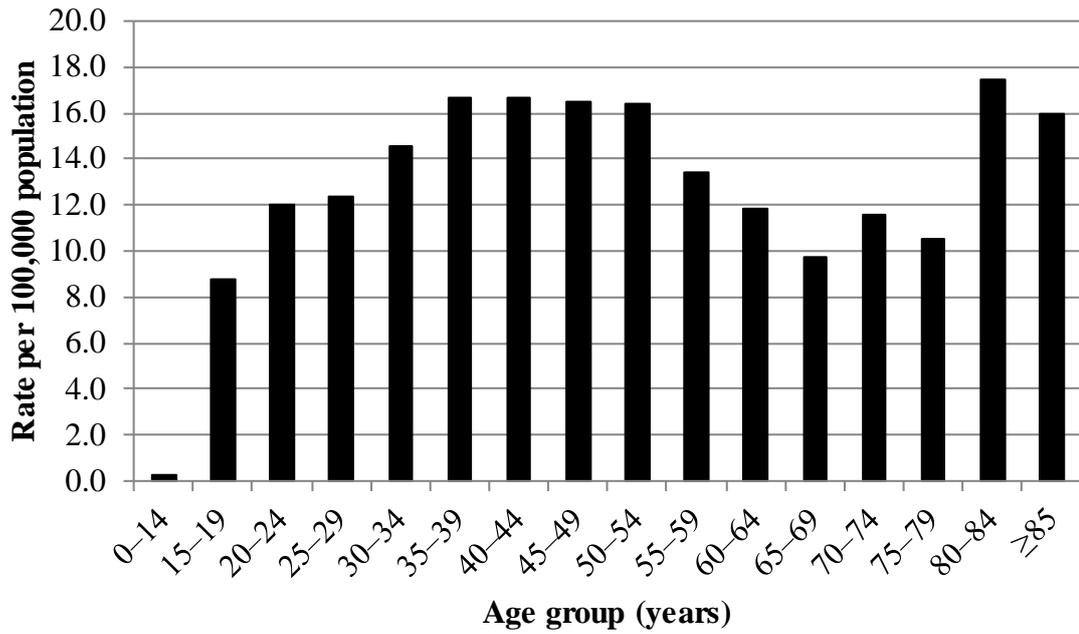


FIGURE 1—Age-specific suicide rates per 100,000 population in Australia registered in 2012 by the ABS. Adapted from ABS cat. no. 3303.0 – 2012.

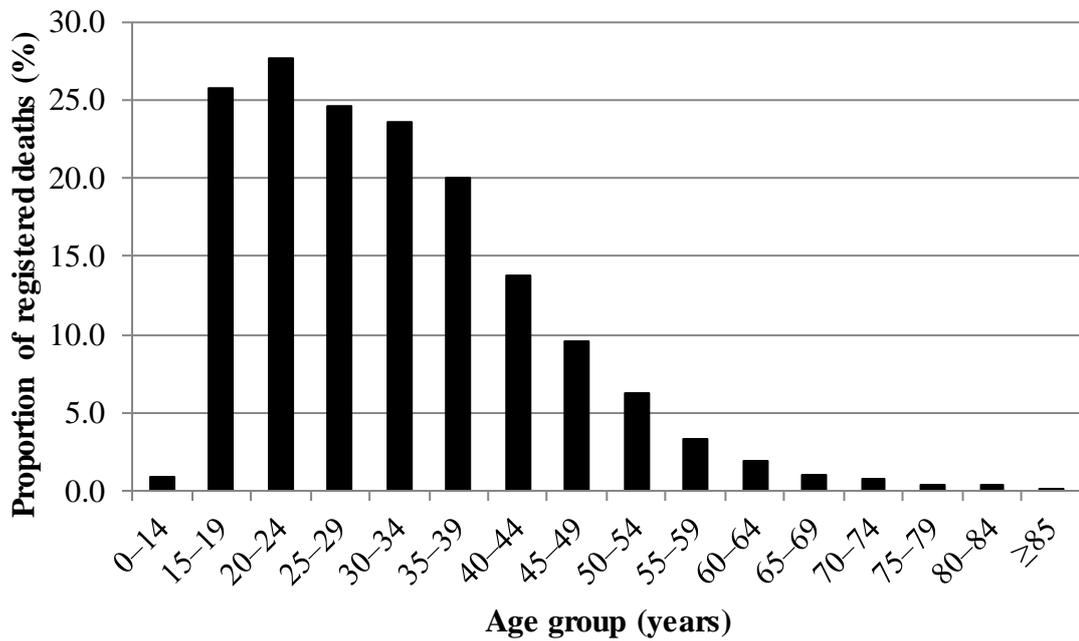


FIGURE 2—Suicide as a proportion of deaths by age group in Australia registered in 2012 by the ABS. Adapted from ABS cat. no. 3303.0 – 2012.

### 1.2.3 *Methods of suicide*

Suicide in Australia most often involves hanging, drug overdose and other types of poisoning (28, [www.abs.gov.au](http://www.abs.gov.au)). Furthermore, methods used for self-killing often have particular patterns of injury and characteristic features at autopsy that include abrasions, bruises, gunshot and incised and stab wounds, ligature marks, and cherry-pink skin and tissue discoloration. Multiple methods may also be used, but these are not recorded in national data and are rarely reported internationally. The forensic investigation of a possible suicide includes the systematic study of injury patterns and medicolegal autopsy features in order to determine the material/s or device/s used to inflict any injuries, the mechanism of death, as well as whether the findings are consistent with self-infliction. On occasion, no anatomical cause of death may be found at autopsy. However, such cases can still be suicides, with deaths from selected methods with no resulting or characteristic injuries (29).

When analysing suicide, a classification system is required and this can be based on the methods used to produce fatal injuries, such as: hanging, drug overdose, carbon monoxide (CO) toxicity, gunshot wounds, plastic bag asphyxia, incised and/or stab wounds, lying or stepping into the path of a moving motor vehicle or train, jumping from a height, drowning, motor vehicle collisions, burning, poisoning by other noxious substances, electrocution, strangulation, gas asphyxia and blunt object trauma. Thus, means of suicide vary and are influenced by the availability of materials required for the fatal episode (30–33) as well as ideas of what constitutes an appropriate and effective lethal technique (34, 35).

Reported method choices often vary according to the population group and the means available to them, with more disparities apparent in the types of methods

between countries, than between sexes (Table 2). For example, death by shooting is the most common method of suicide in the United States (36–38), as opposed to hanging in Australia ([www.abs.gov.au](http://www.abs.gov.au)), Canada (5), Dubai (39), Germany (40), Poland (41), Lithuania (42), Norway (15) and Turkey (43). Poisoning by pesticides is the most common means of suicide in China (14) as well as Sri Lanka (44, 45), whereas jumping from a height is commonest in Singapore (46) and in Hong Kong (47). Further findings regarding method availability and associated mortality include those by Lester (1994) as well as Telisinghe and Colombage (2014) both reporting that individuals of the same nationality, but in different countries, used different methods of suicide (48, 49).

TABLE 2—Preferred methods of male and female suicides by country and period reported. Adapted from (5, 9, 15, 50, 40–43, 47, 51–54, www.abs.gov.au, www.health.govt.nz, www.ons.gov.uk).

Country	Year/s	Males	Females
United States	2000–2010	Gunshot wounds	Poisoning
Australia	2012	Hanging	Hanging
Canada	2004–2007	Hanging	Hanging
Germany	1991–2002	Hanging	Hanging
India	2009–2013	Hanging	Hanging
Lithuania	1984–2003	Hanging	Hanging
New Zealand	2012	Hanging†	Hanging†
Norway	2009	Hanging‡	Hanging‡
Poland	2000–2009	Hanging	Hanging
Turkey	2007–2012	Hanging	Hanging
England	2012	Hanging§	Poisoning
Finland	2009	Hanging‡	Poisoning‡
Scotland	1996–1999	Hanging	Poisoning
Hong Kong	2002–2007	Jumping from a height	Jumping from a height
Singapore	2000–2004	Jumping from a height	Jumping from a height
China	2001–2002	Poisoning	Poisoning
Egypt	2005–2009	Poisoning	Poisoning

†Includes hanging, strangulation and suffocation. ‡Only includes suicides among those aged 15 years and above. §Includes suffocation.

Different patterns of suicide are also evident within the same country, but in different regions. For example, in Australia, between the years 2001 and 2007, hanging was reported to be the most common method of self-destruction (47.8% of cases), followed by drug overdose and other types of poisoning (including the inhalation of motor vehicle exhaust gases) (29.0%), with 8.8% of cases of suicide being by gunshot

wounds ([www.abs.gov.au](http://www.abs.gov.au)). However, this was not the case in parts of Victoria over the same period, where gunshot wound suicides predominated (39.0%) followed by hangings (34.6%) (55).

In addition, preferred methods of suicide by females used to differ from that of males, with females traditionally favouring less violent and rather non-disfiguring methods, such as drug overdose and other types of poisoning, compared to males who tended to use hanging and guns. However, local data review has since demonstrated that females in SA are increasingly using hanging (56). Such a dramatic trend was then subsequently indicated in national data of registered suicides in 2012 ([www.abs.gov.au](http://www.abs.gov.au)).

Methods used may also depend on the age as well as the race of victims, with another study from SA also noting hanging being commonly used by the young (in 89.9% of suicides among 10–19 year olds) as well as by a disproportionately high number of Aboriginal victims (30).

### **1.3 SUICIDE AMONG FIRST PEOPLES**

#### *1.3.1 Suicide among Aboriginal people in Australia*

Suicide is markedly higher among Aboriginal people in Australia than in defined non-Aboriginal counterparts (57). However, research on Aboriginal suicide is incomplete. In 2012, at least 117 deaths among Aboriginal Australians in New South Wales (NSW), Queensland, SA, Western Australia and the Northern Territory (NT), were attributed to suicide. Of these, 69.2% were males. The overall rate of registered

Aboriginal suicide over this time was 22.4 deaths per 100,000 population, with suicide being more than twice as common than that of the rest of the population (11.0 deaths per 100,000 population). Similarly, suicide accounted for 4.7% of all registered deaths of indigenous Australians, compared to 1.7% of deaths of non-indigenous Australians (www.abs.gov.au). However, due to problems with identifying Aboriginality on death certificates (58) as well as the possibility of misclassification of indigenous status in various data registers, these figures are almost certainly an underestimate. This subsequently makes comparisons of suicide rates among indigenous and non-indigenous populations as well as communities, problematic. Furthermore, population data used to indicate Aboriginal suicide nationally, are only available from a select number of jurisdictions and thus, may not be representative of Aboriginal people generally in Australia.

### *1.3.2 Suicide among first peoples internationally*

Suicide constitutes not only a significant component of indigenous mortality in Australia, but also internationally. Many indigenous groups in other countries are to experiencing higher suicide rates than associated population counterparts. For example, the indigenous Nenets population in Russia (59), Native Americans in the United States (60), indigenous people in Brazil (61, 62), and Māoris in New Zealand (63), all have significantly higher suicide rates than comparable non-indigenous groups. The extent of such differences in racial-specific suicide rates is similar to that reported in Australia, with rates among Nenets (59) as well as Native Americans (60) also being

approximately two times higher than the rates of the general Russian and American populations, respectively.

Higher suicide rates have also been reported among young indigenous individuals aged 15–24 years (61, 62, 64, 65). Factors that may contribute to this disturbing trend include a loss of ethnic identity and cultural values, such as connections to ‘Country’ or land, persistent socioeconomic disadvantage (66) and substance abuse in these communities (67). However, it is interesting to note that older indigenous males and females have lower suicide rates when compared to defined non-indigenous counterparts. For example, suicide amongst the Māori population is uncommon after the age of 45 (63) and is just as rare among indigenous people aged 55 years and above in Brazil (61). This is thought to result from older individuals being generally more valued with distinguished roles in indigenous groups (63), as opposed to those in non-indigenous groups where the elderly are often regarded more as a burden on society, than an asset. Thus, future research focusing on the reasons for the lower suicide rates among older indigenous populations would be valuable in order to further understand the context of indigenous suicides as well as possibly helping to establish how population suicide may be prevented.

#### **1.4 CLASSIFICATIONS OF SELF-HARM**

There are various other forms of suicidal behaviour, such as suicidal ideation, or thoughts of harming oneself, assisted suicide as well as attempted suicide. Further acts of murder-suicide and parasuicide have been found to have distinct motivations that

differ from that of other population suicides, and reportedly involve issues of power, jealousy, revenge, loss and a desire to seek attention (68, 69).

#### 1.4.1 *Murder-suicide*

Murder-suicide, also known as dyadic death, refers to a homicide that is followed by the suicide of the perpetrator (70), usually immediately after the murder/s but on occasion, this may occur days later (71, 72). Most murder-suicides are spousal, although familial (73) and extrafamilial cases (74, 75), even those including mass murders, have also been reported (68, 72). The majority of perpetrators are male, and most victims are female (69, 76–80). The average age of identified perpetrators is around 45–49 years (81), although age ranges from those as young as 16 years have also been reported (69, 76). The overwhelming weapon of choice in murder-suicides is a firearm (69, 76, 77, 79, 80). However, murderous females tend to use less violent methods of self-, family- and acquaintance-destruction than that used by males (73). Surprisingly, such cases apparently do not usually result from impulsive acts of rage, but are rather carefully planned (77, 82). Murder-suicides may also be classified by the relationships of the perpetrators to the victims (Table 3).

TABLE 3—*Classifications of murder-suicide*. Adapted from (83).

Term for the act	Relationship to victim/s
Filicide-suicide	One's child
Familicide-suicide	One's family
Genocide-suicide	Specific religious, ethnic or racial groups

Filicide-suicide is an act where a mother or a father kills their offspring, and then themselves (83). Alleged perpetrators tend to suffocate, stab or gas a child, and often use the same means to self-destruct (84). However, differences exist between murderous mothers and fathers, with a local study in SA reporting that mothers murdered only their children, whereas fathers also killed or attempted to kill their partners (73).

Familicide-suicides typically involve males who are severely depressed (77), paranoid (78) or intoxicated (75). Such perpetrators have been called ‘family annihilators’ (85), as they will murder not only children, but also their spouse, other relatives and even their pets (73).

#### 1.4.2 *Parasuicide*

Parasuicide is a nonfatal act, where an individual harms him or herself but lacks the intention to die. This type of behaviour may lead to a sudden and pleasurable release of tension, although it is however, a major risk factor for eventual suicide (86). The sight of blood is often gratifying, and the immediate relief from pre-existing distress may reinforce this type of self-mutilation (87, 88). Such gestures may also be deliberately undertaken as a means of eliciting attention and support, particularly when there is a known high potential for rescue (89).

TABLE 4—*Characteristic features of parasuicide versus suicidal behaviour*. Adapted from (88–91).

Characteristics	Parasuicide	Suicidal behaviour
Intention	Relieve psychological pain	End unbearable pain
	Manipulate the behaviour of others	To kill oneself
Method	Often non-lethal (e.g. shallow cutting and poisoning)	Lethal (e.g. hanging and gunshot wounds)

The age distribution of parasuicide is distinctly different to that of suicide. The sex ratio is also reversed (19, 92) with suicide rates tending to increase with age, however rates of parasuicide are highest among younger ages, with reports often among those aged around 15–34 years (91, 93). Thus, differences exist in the motivations for each of the forms of suicidal behaviour. A myriad of factors can trigger suicidal acts, and in any one case, these can be multiple, although there is often evidence of interpersonal conflict, such as a separation or an argument in these types of events (94). Other potential triggers include loss, especially through bereavement (95), as well as financial and legal issues (96).

However, a number of problems exist when attempting to differentiate between a suicide, ‘accidental’ death, homicide or death by other self-inflicted injuries, with the diagnosis of suicide being likely in only non-ambiguous deaths. A high suicidal intent may be presumed in cases where there is an effort to avoid discovery. For example, a suicidal individual might isolate him or herself, choose a time and a place which will reduce the chance of being rescued, or not seek help after the act. Recent activities such as making funeral arrangements or preparing a will, also suggest serious suicidal intent (87).

## **1.5 CONTRIBUTING FACTORS TO SUICIDE**

Suicide results from a range of personal, cultural and environmental factors collectively impacting upon an individual. The act does not have a particular association with any one precipitating factor or state of mind, but preceding emotions commonly reported include hopelessness, shame, anger and low self-esteem (44, 97–99). Thus, it is rare for suicide to occur in the absence of any psychological suffering.

### *1.5.1 Substance abuse*

A high correlation between suicide and alcohol intoxication has also been noted (100–103). Alcohol is a potent risk factor for self-harm as it can increase impulsiveness and subsequent risk-taking behaviour. Thus, it can provoke self-destructive acts in an individual who otherwise, may not have engaged in this type of behaviour had they not been intoxicated (104). Several studies have reported that the amount and type of beverage consumed, as well as the pattern of drinking, such as the excessive consumption of spirits, profoundly impact on suicidal behaviour (105–107).

In Australia, between 2000 and 2010, alcohol intoxication and/or drug abuse was recorded in an alarming 63.5% of all suicides in the NT (108). Furthermore, 49.4% of cases of suicide by means other than overdose registered in NSW, between 1997 and 2006, were also reportedly associated with concurrent substance abuse (109). Similarly, according to certain international studies, at least 25% of all suicides are associated with alcohol and/or drug use (110, 111). Intoxicated individuals are also reportedly more likely to attempt suicide by more lethal methods, such as gunshot wounds or hanging

(112). Therefore, given the current extent of high-risk drinking, particularly among youths (113), this is of great concern and also warrants future monitoring as well as research.

### 1.5.2 *Mental illness*

Psychiatric illness is often documented as a major risk factor for suicide (28, 44), and the presence and attempted psychiatric treatment of multiple mental disorders, greatly increases this risk (25, 114, 115). Studies from Europe and the United States have suggested that psychiatric disorders, including schizophrenia and bipolar disorder, are evident in up to 90% of individuals who have succumbed to suicide (116–119). Severe mental illness is also reportedly common among those choosing the most painful and/or disfiguring means of self-destruction, including jumping from a height, or lying or stepping into the path of a moving object, such as a motor vehicle or train (120, 121). These associations have often been attributed to sufferers' non-compliance with 'treatment', such as those who discontinue taking prescribed drugs due to side effects, as well as a subsequent loss of contact with health services. However, the majority of such studies were conducted in countries that have relatively similar Western cultural backgrounds. Therefore, any conclusions derived from these studies may not be valid in comparison to other countries. For example in certain non-Western countries, such as China, impulsiveness is a crucial factor in suicides and differences have been reported by Yang *et al.* (2005), who suggested that a substantial proportion of suicide victims did not have a psychiatric disorder (122). Although, all of these findings depend on if, how and when such information is recorded.

Nonetheless, a study in Singapore reported that among those with a mental illness, a considerable percentage killed themselves soon after discharge from a psychiatric hospital. Thong *et al.* (2008) reported a significant clustering of suicides in the first month after discharge, with 15.1% suiciding within the first week, 20.8% within two weeks, 26.4% within four weeks, and an alarmingly 63.2% within one year (Fig. 3) (123). However, as the patients studied only had psychiatric disorders severe enough to require hospital admission, interpretations of such data are somewhat limited and may not be able to be generalised to comparable institutionalised groups elsewhere.

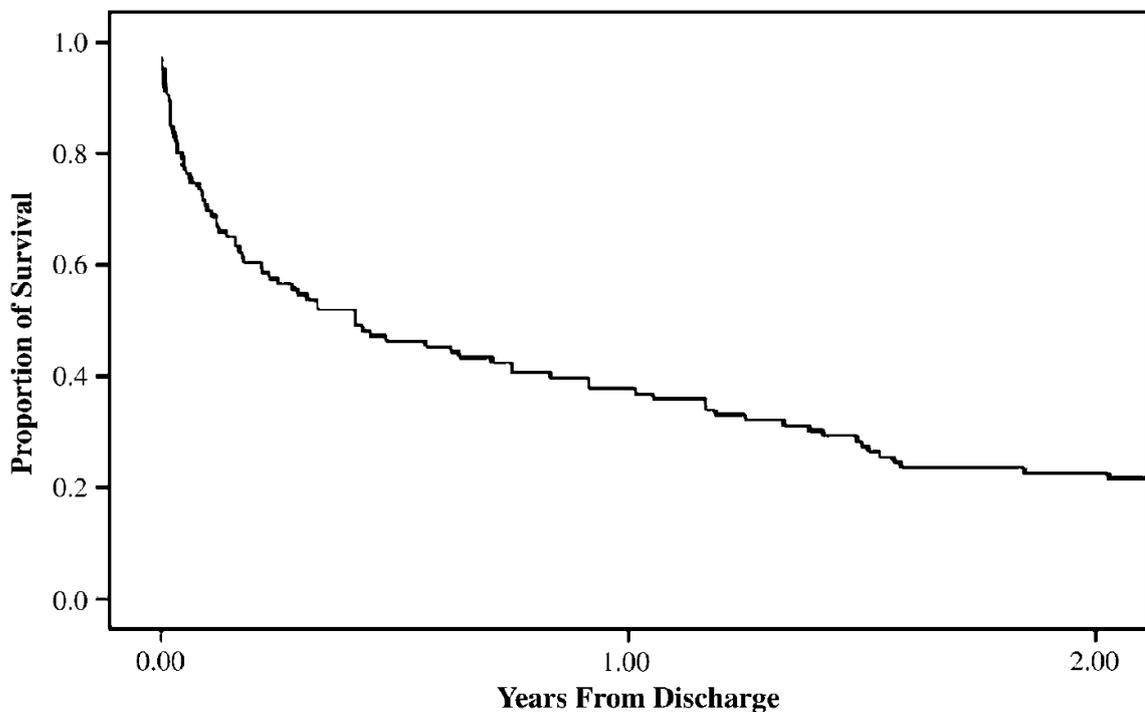


FIGURE 3—*The proportion of survival among patients discharged from a psychiatric hospital in Singapore between 2003 and 2004 (123).*

### 1.5.3 *Other miscellaneous factors*

Other predictors for suicide include a sense of failure, feeling alienated and a history of attempted suicide (124, 125). Suicide has also been associated with a range of physical conditions, including cancer (126, 127), human immunodeficiency virus/acquired immunodeficiency disease (128), multiple sclerosis (129) and spinal cord injury (130).

Strong associations between suicide and isolation, unemployment (131–135) and/or low socioeconomic status have also been demonstrated (136). Furthermore, disruptions of personal relationships or career-related problems can evoke intolerable stress and the inability to cope (137) and thus, predispose an individual to self-harm.

Suicide rates also vary among those who are employed, with particular occupational groups allegedly being at a greater risk. Previous studies have indicated that medical practitioners have a lower general mortality rate compared to the rest of the population (138–140). However, in terms of suicide, it has been proposed that doctors are at an increased risk (138, 140–142), with suicide rates reportedly being highest in female physicians as well as anaesthetists, and particularly among associated trainees (141). In related fields, dentists (142), pharmacists and nurses also allegedly have elevated rates (143). A study of medical graduate suicides in the United States, found that the majority (at least 42%) of male graduates died by barbiturate overdose, (meaning overdose by a sedative drug), and gunshot wounds (at least 23%) (140), methods that are both likely to be available to doctors in America. Thus, possible explanations for the higher suicide rates in such professions are that practitioners have access to otherwise restricted drugs, and also considerable knowledge about their use and effect. High performance expectations (142, 144) and a tendency for obsessive-compulsive behaviour in these

occupational groups have also been proposed as possibly representing important factors in determining the higher suicide rates (145).

The risk factors outlined above are by far exhaustive, and there is emerging evidence of an array of other factors, such as homosexuality in completed (146) as well as attempted suicides (147, 148), also being reported. Conversely, a number of 'protective factors' exist. For example, religious affiliations have been associated with a decreased risk of suicide (149). Potential causes of this association include traditional religious beliefs and moral objections to suicide, social support and a sense of belonging (150–152). Being pregnant is also allegedly 'protective' against deliberate self-destruction (153–155), possibly due to hormonal influences such as increased central nervous system serotonin levels during pregnancy (156), the hormone thought to relieve states of depression, or to a future mother's feeling of responsibility towards her child. However, it is also worth noting that any alleged factors preceding or protecting population self-harm are again dependent on if, how and when such factors are recorded.

## **1.6 SUICIDE NOTES**

Suicide notes often represent an individual's last attempt to communicate with friends, family members and other acquaintances. Although suicide notes are only found in a minority of cases (around 10–30%) (44, 132, 157, 158), they may provide an insight into the factors that led to the death, and the thoughts of the victim before the fatal act.

Very few gender differences in suicide notes exist, however age differences are marked. Older individuals tend to write less emotive suicide notes, and apologise for their actions in seeking escape from physical pain and chronic illness (159). On the other hand, profane language and anger towards others, are often evident in the notes of younger groups (160, 161). Younger victims also tend to now format, distribute, as well as leave, such messages on mobile phones or in email and other ‘social networking’ accounts (162).

Adults who successfully die by suicide are also allegedly more likely than those who fail, to have written a suicide note. In a study by Dejong, Overholser and Stockmeier (2010), more than half of those who suicided had left a note, compared to just 20.0% of those who reportedly survived an attempt (112). Thus, the presence of a suicide note is thought to reflect the seriousness of an attempt, with note leavers apparently utilising more lethal methods of self-harm, such as hanging and CO toxicity (158). However, the existence of a note does not necessarily imply that a case is a suicide or that the act was not impulsive, as a note may have been written by the decedent a long time prior to death, or it may have been forged in an attempt to conceal a homicide or other means of sudden death. Furthermore, the absence of such notes may be due to removal by friends, family members and other acquaintances who are often at death scenes before investigators.

## **1.7 CAVEATS**

Various issues arise when conducting a literature review on suicide. Firstly, data must be analysed and reviewed with caution, as different countries have different

population demographics and trends. This also applies to interstate comparisons within Australia, as each jurisdiction varies in size and has different procedures, reporting systems, as well as personnel for gathering population data. Inadequate training of personnel, a lack of standardised criteria for distinguishing suicides from ‘accidental’ deaths, not to mention classification changes over time (such as the use of the official ‘undetermined intent’ category by the national register, the ABS), have also had an impact on reports of suicide in Australia.

Secondly, current research examining suicide tends to rely on national, international and large population databases. This is of concern, as local data review is required in order to understand specific issues in a particular community.

Thirdly, care should be taken when interpreting national suicide data over time due to issues affecting data quality, such as the ‘under-counting’ of suicides relative to local records. For example, for deaths registered in Australia, in 2008, 561 cases allegedly had insufficient information recorded on national databases in order to determine suicide and were therefore, excluded from counts when the ABS data were finalised and state-based statistics were published ([www.abs.gov.au](http://www.abs.gov.au)).

Finally, the conduct and quality of autopsies in different countries is inconsistent. In Australia, specific guidelines and protocols are usually followed when investigating a death, but this is not necessarily the case elsewhere (104, 163, 164). When crucial information regarding the possible manner of death is unobtainable via post-mortem examinations, this may result in an under-reporting of cases of suicide due to the classification of deaths as either of ‘undetermined intent’ or as ‘accidental’. There may also be a general unwillingness to report deaths, particularly those of younger individuals and/or among cultural groups, as suicides. Reasons for this may include a reluctance to upset families or those recently associated with victims, or sensitivity to

various cultural practices and religious beliefs. Therefore, when procedures are not consistent, discrepancies may occur, making the comparison of data and interpretation of results, difficult. All of these issues must be considered when data are analysed and apparent suicide trends discerned.

## **1.8 SYNOPSIS**

The following study provides contemporary data on suicides in SA, with a focus on particular means of self-harm. Such novel information will assist in analysing the prevalence of ‘hidden’ suicide deaths, and also help to establish criteria for distinguishing possible suicides from ‘accidental’ deaths and even homicides. Furthermore, the resulting data may help to identify local needs that are amendable to intervention.

### **i. AIMS**

- To examine the specific contribution of suicide to medicolegal deaths occurring in SA and to compare this with South Australian data on national registers.
- To examine specific forms of suicide in SA, in order to delineate any trends among victims in relation to sex, age, race and toxicological findings.
- To scrutinise any changes in the pattern of suicidal deaths in this population by alterations in the methods used, as well as identifying various circumstances that influence self-destruction in individual communities.

## **ii. HYPOTHESES**

It is suggested that studies from single forensic institutions that service specific geographical areas, such as Forensic Science SA (FSSA), may produce more reliable data than studies that have relied upon a larger body of electronic information that has been compiled from subsets where different diagnostic and classification criteria have been used, and where capture of all cases may not be complete. Furthermore, local trends involving small numbers may be lost if data are inappropriately pooled. Specific changes to the rates and means of self-destruction in this population will also be identified.

## 1.9 REFERENCES

1. Chia BH, Chia A, Yee NW, Choo TB. Suicide trends in Singapore: 1955–2004. *Arch Suicide Res.* 2010;14:276–83.
2. Otzen T, Sanhueza A, Manterola C, Escamilla-Cejudo JA. Trends in suicide mortality in Chile from 1998 to 2011. *Rev Med Chil.* 2014;142:305–13.
3. Crosby AE, Ortega L, Stevens MR; Centers for Disease Control and Prevention (CDC). Suicides – United States, 2005–2009. *MMWR Surveill Summ.* 2013;62 Suppl 3:S179–83.
4. Lovisi GM, Santos SA, Legay L, Abelha L, Valencia E. Epidemiological analysis of suicide in Brazil from 1980 to 2006. *Rev Bras Psiquiatr.* 2009;31 Suppl 2:S86–94.
5. Burrows S, Auger N, Tamambang L, Barry AD. Suicide mortality gap between Francophones and Anglophones of Quebec, Canada. *Soc Psychiatry Psychiatr Epidemiol.* 2013;48:1125–32.
6. Jukkala T, Mäkinen IH, Stickley A. The historical development of suicide mortality in Russia, 1870–2007. *Arch Suicide Res.* 2015;19:117–30.
7. Bagcchi S, Chaudhuri P. Suicide and the law in India. *BMJ.* 2013 doi:10.1136/bmj.f6975.
8. Suicide in India: from criminalisation to compassion. *Lancet.* 2014 doi:10.1016/S0140-6736(14)62414-4.
9. Abdel Moneim WM, Yassa HA, George SM. Suicide trends in Upper Egypt. *J Forensic Sci.* 2012;57:1247–51.
10. Lukaschek K, Erazo N, Baumert J, Ladwig KH. Suicide mortality in comparison to traffic accidents and homicides as causes of unnatural death. An analysis of 14,441 cases in Germany in the year 2010. *Int J Environ Res Public Health.* 2012;9:924–31.
11. Ng DW, Lau G. Suicide trends in Singapore: two decades down the road. *Med Sci Law.* 2003;43:141–7.

12. Razvodovsky Y, Stickley A. Suicide in urban and rural regions of Belarus, 1990–2005. *Public Health*. 2009;123:27–31.
13. Soman CR, Safraj S, Kutty VR, Vijayakumar K, Ajayan K. Suicide in South India: a community-based study in Kerala. *Indian J Psychiatry*. 2009;51:261–4.
14. Sun J, Guo X, Zhang J, Jia C, Xu A. Suicide rates in Shandong, China, 1991–2010: rapid decrease in rural rates and steady increase in male–female ratio. *J Affect Disord*. 2013;146:361–8.
15. Titelman D, Oskarsson H, Wahlbeck K, Nordentoft M, Mehlum L, Jiang GX, Erlangsen A, Nrugham L, Wasserman D. Suicide mortality trends in the Nordic countries 1980–2009. *Nord J Psychiatry*. 2013;67:414–23.
16. Berman AL, Bergeron CE. ‘Suicide predictors and statistics’. In: *Encyclopedia of Forensic and Legal Medicine*, 1<sup>st</sup> ed. Eds. Byard RW, Payne-James J, Corey T, Henderson C. Elsevier; 2005 p. 378–88.
17. Madge N, Harvey JG. Suicide among the young—the size of the problem. *J Adolesc*. 1999;22:145–55.
18. Walker S, Chen L, Madden R. Deaths due to suicide: the effects of certification and coding practices in Australia. *Aust N Z J Public Health*. 2008;32:126–30.
19. Lahti A, Harju A, Hakko H, Riala K, Räsänen P. Suicide in children and young adolescents: a 25-year database on suicides from Northern Finland. *J Psychiatr Res*. 2014;58:123–8.
20. O'Neill S, Corry CV, Murphy S, Brady S, Bunting BP. Characteristics of deaths by suicide in Northern Ireland from 2005 to 2011 and use of health services prior to death. *J Affect Disord*. 2014;168:466–71.
21. Walker X, Lee J, Koval L, Kirkwood A, Taylor J, Gibbs J, Ng S, Steele L, Thompson P, Celi LA. Predicting ICU admissions from attempted suicide presentations at an Emergency Department in Central Queensland. *Australas Med J*. 2013;6:536–41.
22. Azmak AD. Suicides in Trakya region, Turkey, from 1984 to 2004. *Med Sci Law*. 2006;46:19–30.

23. Dias D, Mendonça MC, Real FC, Vieira DN, Teixeira HM. Suicides in the Centre of Portugal: seven years analysis. *Forensic Sci Int.* 2014;234:22–8.
24. Omalu BI, Macurdy KM, Koehler SA, Nnebe-Agumadu UH, Shakir AM, Rozin L, Wecht CH. Forensic pathology and forensic epidemiology of suicides in Allegheny County, Pennsylvania: a 10-year retrospective review (1990–1999). *Forensic Sci Med Pathol.* 2005;1:125–37.
25. Paraschakis A, Michopoulos I, Christodoulou C, Koutsaftis F, Lykouras L, Douzenis A. A 2-year psychological autopsy study of completed suicides in the Athens Greater Area, Greece. *Psychiatry Investig.* 2015;12:212–7.
26. Zhjeqi V, Ramadani N, Gashi S, Mucaj S, Berisha M, Neziri L, Krasniqi S, Shahini M. Suicide prevalence in Kosova for the period 2007–2008. *Med Arh.* 2010;64:44–7.
27. Zhang J, Sun L, Liu Y, Zhang J. The change in suicide rates between 2002 and 2011 in China. *Suicide Life Threat Behav.* 2014;44:560–8.
28. Zardawi IM. Coronial autopsy in a rural setting. *J Forensic Leg Med.* 2013;20:848–51.
29. Austin AE, Winskog C, van den Heuvel C, Byard RW. Recent trends in suicides utilizing helium. *J Forensic Sci.* 2011;56:649–51.
30. Byard RW, Austin AE, van den Heuvel C. Characteristics of asphyxial deaths in adolescence. *J Forensic Leg Med.* 2011;18:107–9.
31. Byard RW, Markopoulos D, Prasad D, Eitzen D, James RA, Blackbourne B, Krous HF. Early adolescent suicide: a comparative study. *J Clin Forensic Med.* 2000;7:6–9.
32. Klitte Å, Gilbert JD, Lokan R, Byard RW. Adolescent suicide due to inhalation of insect spray. *J Clin Forensic Med.* 2002;9:22–4.
33. Tse R, Sims N, Byard RW. Alcohol ingestion and age of death in hanging suicides. *J Forensic Sci.* 2011;56:922–4.
34. Byard RW, James RA. Unusual motor vehicle suicides. *J Clin Forensic Med.* 2001;8:1–4.

35. Fernando T, Gilbert JD, Carroll CM, Byard RW. Ecstasy and suicide. *J Forensic Sci.* 2012;57:1137–9.
36. Hassamal S, Keyser-Marcus L, Crouse Breden E, Hobron K, Bhattachan A, Pandurangi A. A brief analysis of suicide methods and trends in Virginia from 2003 to 2012. *Biomed Res Int.* 2015 doi:10.1155/2015/104036.
37. Searles VB, Valley MA, Hedegaard H, Betz ME. Suicides in urban and rural counties in the United States, 2006–2008. *Crisis.* 2014;35:18–26.
38. Parks SE, Johnson LL, McDaniel DD, Gladden M; Centers for Disease Control and Prevention (CDC). Surveillance for violent deaths – National Violent Death Reporting System, 16 states, 2010. *MMWR Surveill Summ.* 2014;63:1–33.
39. Benomran FA. The medico-legal scene in Dubai: 2002–2007. *J Forensic Leg Med.* 2009;16:332–7.
40. Baumert J, Erazo N, Ruf E, Ladwig KH. Time trends in suicide mortality vary in choice of methods: an analysis of 145,865 fatal suicide cases in Germany 1991–2002. *Soc Psychiatry Psychiatr Epidemiol.* 2008;43:913–9.
41. Höfer P, Rockett IR, Värnik P, Etzersdorfer E, Kapusta ND. Forty years of increasing suicide mortality in Poland: undercounting amidst a hanging epidemic? *BMC Public Health.* 2012 doi:10.1186/1471-2458-12-644.
42. Tamosiunas A, Reklaitiene R, Virviciute D, Sopagiene D. Trends in suicide in a Lithuanian urban population over the period 1984–2003. *BMC Public Health.* 2006 doi:10.1186/1471-2458-6-184.
43. Enginyurt Ö, Özer E, Gümüş B, Demir EY, Çankaya S. Evaluation of suicide cases in Turkey, 2007–2012. *Med Sci Monit.* 2014;20:614–23.
44. Fernando R, Hewagama M, Priyangika WD, Range S, Karunaratne S. Study of suicides reported to the Coroner in Colombo, Sri Lanka. *Med Sci Law.* 2010;50:25–8.

45. Knipe DW, Metcalfe C, Fernando R, Pearson M, Konradsen F, Eddleston M, Gunnell D. Suicide in Sri Lanka 1975–2012: age, period and cohort analysis of police and hospital data. *BMC Public Health*. 2014 doi:10.1186/1471-2458-14-839.
46. Wang M1, Ching CK. Pattern of coroner's autopsies at Health Sciences Authority, Singapore: a retrospective study (2009–2010). *Med Sci Law*. 2013;53:149–53.
47. Wong PW, Caine ED, Lee CK, Beautrais A, Yip PS. Suicides by jumping from a height in Hong Kong: a review of coroner court files. *Soc Psychiatry Psychiatr Epidemiol*. 2014;49:211–9.
48. Lester D. The epidemiology of suicide in Chinese populations in six regions of the world. *Chinese J Mental Health*. 1994;7:25–36.
49. Telisinghe PU, Colombage SM. Patterns of suicide in Brunei Darussalam and comparison with neighbouring countries in South East Asia. *J Forensic Leg Med*. 2014;22:16–9.
50. Badiye A, Kapoor N, Ahmed S. An empirical analysis of suicidal death trends in India: a 5-year retrospective study. *J Forensic Leg Med*. 2014;27:29–34.
51. Chia BH, Chia A, Ng WY, Tai BC. Suicide methods in Singapore (2000–2004): types and associations. *Suicide Life Threat Behav*. 2011;41:574–83.
52. Park S, Ahn MH, Lee A, Hong JP. Associations between changes in the pattern of suicide methods and rates in Korea, the US, and Finland. *Int J Ment Health Syst*. 2014 doi:10.1186/1752-4458-8-22.
53. Stark C, Hopkins P, Gibbs D, Rapson T, Belbin A, Hay A. Trends in suicide in Scotland 1981–1999: age, method and geography. *BMC Public Health*. 2004 doi:10.1186/1471-2458-4-49.
54. Zhang J, Conwell Y, Zhou L, Jiang C. Culture, risk factors and suicide in rural China: a psychological autopsy case control study. *Acta Psychiatr Scand*. 2004;110:430–7.
55. Guiney R. Farming suicides during the Victorian drought: 2001–2007. *Aust J Rural Health*. 2012;20:11–5.

56. Byard RW, Klitte A, Gilbert JD. Changing patterns of female suicide: 1986–2000. *J Clin Forensic Med.* 2004;11:123–8.
57. Pridmore S, Kuipers P, Appleton J. The ‘Operationalized Predicaments of Suicide’ (OPS) applied to Northern Territory coroners’ reports. *Asian J Psychiatr.* 2013;6:214–7.
58. Graham A, Reser J, Scuderi C, Zubrick S, Smith M, Turley B. Suicide: an Australian psychological society discussion paper. *Aust Psychol.* 2000; 35: 1–28.
59. Sumarokov YA, Brenn T, Kudryavtsev AV, Nilssen O. Suicides in the indigenous and non-indigenous populations in the Nenets Autonomous Okrug, northwestern Russia, and associated socio-demographic characteristics. *Int J Circumpolar Health.* 2014;73:24308.
60. Herne MA, Bartholomew ML, Weahkee RL. Suicide mortality among American Indians and Alaska Natives, 1999–2009. *Am J Public Health.* 2014;104 Suppl 3:S336–42.
61. Orellana JD, Basta PC, de Souza ML. Mortality by suicide: a focus on municipalities with a high proportion of self-reported indigenous people in the state of Amazonas, Brazil. *Rev Bras Epidemiol.* 2013;16:658–69.
62. Souza ML, Orellana JD. Suicide mortality in São Gabriel da Cachoeira, a predominantly indigenous Brazilian municipality. *Rev Bras Psiquiatr.* 2012;34:34–7.
63. Beautrais AL, Fergusson DM. Indigenous suicide in New Zealand. *Arch Suicide Res.* 2006;10:159–168.
64. Boothroyd LJ, Kirmayer LJ, Spreng S, Malus M, Hodgins S. Completed suicides among the Inuit of northern Quebec, 1982–1996: a case-control study. *CMAJ.* 2001;165:749–55.
65. Silviken A, Haldorsen T, Kvernmo S. Suicide among indigenous Sami in Arctic Norway, 1970–1998. *Eur J Epidemiol.* 2006;21:707–13.

66. Luke JN, Anderson IP, Gee GJ, Thorpe R, Rowley KG, Reilly RE, Thorpe A, Stewart PJ. Suicide ideation and attempt in a community cohort of urban aboriginal youth: a cross-sectional study. *Crisis*. 2013;34:251–61.
67. Parker R, Ben-Tovim DI. A study of factors affecting suicide in Aboriginal and ‘other’ populations in the Top End of the Northern Territory through an audit of coronial records. *Aust N Z J Psychiatry*. 2002;36:404–10.
68. Bossarte RM, Simon TR, Barker L. Characteristics of homicide followed by suicide incidents in multiple states, 2003–04. *Inj Prev*. 2006 doi:10.1136/ip.2006.012807.
69. De Koning E, Piette MH. A retrospective study of murder-suicide at the Forensic Institute of Ghent University, Belgium: 1935–2010. *Med Sci Law*. 2014;54:88–98.
70. Berman AL. Dyadic death: murder-suicide. *Suicide Life Threat Behav*. 1979;9:15–23.
71. Travis AR, Johnson LJ, Milroy CM. Homicide-suicide (dyadic death), homicide, and firearms use in England and Wales. *Am J Forensic Med Pathol*. 2007;28:314–8.
72. Verzeletti A, Russo MC, Bin P, Leide A, De Ferrari F. Homicide in Brescia County (Northern Italy): a thirty-year review. *J Forensic Leg Med*. 2014;22:84–9.
73. Byard RW, Knight D, James RA, Gilbert J. Murder-suicides involving children: a 29-year study. *Am J Forensic Med Pathol*. 1999;20:323–7.
74. Hanzlick R, Koponen M. Murder-suicide in Fulton County, Georgia, 1988–1991. Comparison with a recent report and proposed typology. *Am J Forensic Med Pathol*. 1994;15:168–73.
75. Somander LK, Rammer LM. Intra- and extrafamilial child homicide in Sweden 1971–1980. *Child Abuse Negl*. 1991;15:45–55.
76. Cengija M, Cuculic D, Petaros A, Sosa I, Bosnar A. Homicide-suicide events in Southwestern Croatia, 1986–2009. *Med Sci Law*. 2012;52:217–22.

77. Dogan KH, Demirci S, Gunaydin G, Buken B. Homicide-suicide in Konya, Turkey between 2000 and 2007. *J Forensic Sci.* 2010;55:110–5.
78. Hatters Friedman S, Hrouda DR, Holden CE, Noffsinger SG, Resnick PJ. Filicide-suicide: common factors in parents who kill their children and themselves. *J Am Acad Psychiatry Law.* 2005;33:496–504.
79. Logan J, Hill HA, Black ML, Crosby AE, Karch DL, Barnes JD, Lubell KM. Characteristics of perpetrators in homicide-followed-by-suicide incidents: National Violent Death Reporting System—17 US States, 2003–2005. *Am J Epidemiol.* 2008;168:1056–64.
80. Verzeletti A, Russo MC, De Ferrari F. Homicide-suicide in Brescia County (Northern Italy): a retrospective study from 1987 to 2012. *J Forensic Leg Med.* 2014;25:62–6.
81. Jensen LL, Gilbert JD, Byard RW. Coincident deaths: double suicide or murder-suicide? *Med Sci Law.* 2009;49:27–32.
82. Yip PS, Wong PW, Cheung YT, Chan KS, Beh SL. An empirical study of characteristics and types of homicide-suicides in Hong Kong, 1989–2005. *J Affect Disord.* 2009;112:184–92.
83. Marzuk PM, Tardiff K, Hirsch CS. The epidemiology of murder-suicide. *JAMA.* 1992;267:3179–83.
84. Behera C, Rautji R, Sikary AK, Kumar R, Vidua RK, Millo T, Gupta SK. Triple hanging in filicide-suicide: an unusual case report. *Med Sci Law.* 2015;55:50–3.
85. Milroy CM. The epidemiology of homicide-suicide (dyadic death). *Forensic Sci Int.* 1995;71:117–22.
86. Crandall C, Fullerton-Gleason L, Agüero R, LaValley J. Subsequent suicide mortality among emergency department patients seen for suicidal behavior. *Acad Emerg Med.* 2006;13:435–42.
87. Nathan R, Rix KJB. ‘Parasuicide’. In: *Encyclopedia of Forensic and Legal Medicine*, 1<sup>st</sup> ed. Eds. Byard RW, Payne-James J, Corey T, Henderson C. Elsevier; 2005 p. 244–50.

88. Turner BJ, Chapman AL, Layden BK. Intrapersonal and interpersonal functions of non-suicidal self-injury: associations with emotional and social functioning. *Suicide Life Threat Behav.* 2012;42:36–55.
89. Söderberg S, Kullgren G, Renberg ES. Life events, motives, and precipitating factors in parasuicide among borderline patients. *Arch Suicide Res.* 2004;8:153–62.
90. Lloyd-Richardson EE, Perrine N, Dierker L, Kelley ML. Characteristics and functions of non-suicidal self-injury in a community sample of adolescents. *Psychol Med.* 2007;37:1183–92.
91. Poma SZ, Magno N, Belletti S, Toniolo E. Parasuicide in Rovigo (North of Italy) during the period 2000–2005. *J Prev Med Hyg.* 2007;48:79–82.
92. Farmer RD. Assessing the epidemiology of suicide and parasuicide. *Br J Psychiatry.* 1988;153:16–20.
93. Džúrová D, Vevera J, Motlová L, Dragomirecká E. Analysis of parasuicide, psychiatric care and completed suicides, implications for intervention strategy (Czech Republic, 1996–2000). *Int J Public Health.* 2008;53:139–49.
94. Mok PL, Leyland AH, Kapur N, Windfuhr K, Appleby L, Platt S, Webb RT. Why does Scotland have a higher suicide rate than England? An area-level investigation of health and social factors. *J Epidemiol Community Health.* 2013;67:63–70.
95. Rostila M, Saarela J, Kawachi I. Suicide following the death of a sibling: a nationwide follow-up study from Sweden. *BMJ Open.* 2013 doi:10.1136/bmjopen-2013-002618.
96. Shields LB, Hunsaker DM, Hunsaker JC III. Suicide: a ten-year retrospective review of Kentucky medical examiner cases. *J Forensic Sci.* 2005;50:613–7.
97. Berman AL, Sundararaman R, Price A, Au JS. Suicide on railroad rights-of-way: a psychological autopsy study. *Suicide Life Threat Behav.* 2014;44:710–22.
98. Chia BH, Chia A, Tai BC. Suicide letters in Singapore. *Arch Suicide Res.* 2008;12:74–81.

99. Foster T. Suicide note themes and suicide prevention. *Int J Psychiatry Med.* 2003;33:323–31.
100. Darke S, Duflou J, Torok M, Prolov T. Characteristics, circumstances and toxicology of sudden or unnatural deaths involving very high-range alcohol concentrations. *Addiction.* 2013;108:1411–7.
101. Holmgren A, Jones AW. Demographics of suicide victims in Sweden in relation to their blood-alcohol concentration and the circumstances and manner of death. *Forensic Sci Int.* 2010;198:17–22.
102. Jones AW, Holmgren A, Ahlner J. Toxicology findings in suicides: concentrations of ethanol and other drugs in femoral blood in victims of hanging and poisoning in relation to age and gender of the deceased. *J Forensic Leg Med.* 2013;20:842–7.
103. Skibin L, Bilban M, Balazic J. Harmful alcohol use of those who died a violent death (the extended region of Ljubljana 1995–1999). *Forensic Sci Int.* 2005;147 Suppl:S49–52.
104. Austin AE, van den Heuvel C, Byard RW. Suicide in forensic practice – an Australian perspective. *Aust J Forensic Sci.* 2011;43:65–76
105. Kerr WC, Subbaraman M, Ye Y. Per capita alcohol consumption and suicide mortality in a panel of US states from 1950 to 2002. *Drug Alcohol Rev.* 2011;30:473–80.
106. Norström T, Stickley A, Shibuya K. The importance of alcoholic beverage type for suicide in Japan: a time-series analysis, 1963–2007. *Drug Alcohol Rev.* 2012;31:251–6.
107. Razvodovsky YE. The effects of beverage type on suicide rate in Russia. *Psychiatr Danub.* 2011;23:378–83.
108. Kuipers P, Appleton J, Pridmore S. Thematic analysis of key factors associated with indigenous and non-indigenous suicide in the Northern Territory, Australia. *Rural Remote Health.* 2012;12:2235.
109. Darke S, Duflou J, Torok M. Toxicology and circumstances of completed suicide by means other than overdose. *J Forensic Sci.* 2009;54:490–4.
110. Tormey WP, Srinivasan R, Moore T. Biochemical toxicology and suicide in Ireland: a laboratory study. *Ir J Med Sci.* 2013;182:277–81.

111. Tőro K, Dunay G, Róna K, Klausz G, Fehér S. Alcohol-related mortality risk in natural and non-natural death cases. *J Forensic Sci.* 2009;54:1429–32.
112. DeJong TM, Overholser JC, Stockmeier CA. Apples to oranges?: a direct comparison between suicide attempters and suicide completers. *J Affect Disord.* 2010;124:90–7.
113. Degenhardt L, O'Loughlin C, Swift W, Romaniuk H, Carlin J, Coffey C, Hall W, Patton G. The persistence of adolescent binge drinking into adulthood: findings from a 15-year prospective cohort study. *BMJ Open.* 2013 doi:10.1136/bmjopen-2013-003015.
114. Fang YX, He M, Lin JY, Ma KJ, Zhao H, Hong Z, Li BX. Suicidal drownings with psychiatric disorders in shanghai: a retrospective study from 2010 to 2014. *PLoS One.* 2015 doi:10.1371/journal.pone.0121050.
115. Sharifi V, Eaton WW, Wu LT, Roth KB, Burchett BM, Mojtabai R. Psychotic experiences and risk of death in the general population: 24–27 year follow-up of the Epidemiologic Catchment Area study. *Br J Psychiatry.* 2015 doi:10.1192/bjp.bp.113.143198.
116. Fekadu A, Medhin G, Kebede D, Alem A, Cleare AJ, Prince M, Hanlon C, Shibre T. Excess mortality in severe mental illness: 10-year population-based cohort study in rural Ethiopia. *Br J Psychiatry.* 2015;206:289–96.
117. Foster T, Gillespie K, McClelland R. Mental disorders and suicide in Northern Ireland. *Br J Psychiatry.* 1997;170:447–52.
118. Khan A, Faucett J, Morrison S, Brown WA. Comparative mortality risk in adult patients with schizophrenia, depression, bipolar disorder, anxiety disorders, and attention-deficit/hyperactivity disorder participating in psychopharmacology clinical trials. *JAMA Psychiatry.* 2013;70:1091–9.
119. Rantanen H, Koivisto AM, Salokangas RK, Helminen M, Oja H, Pirkola S, Wahlbeck K, Joukamaa M. Five-year mortality of Finnish schizophrenia patients in the era of deinstitutionalization. *Soc Psychiatry Psychiatr Epidemiol.* 2009;44:135–42.

120. Cooper PN, Milroy CM. Violent suicide in South Yorkshire, England. *J Forensic Sci.* 1994;39:657–67.
121. Sinyor M, Schaffer A, Remington G. Suicide in schizophrenia: an observational study of coroner records in Toronto. *J Clin Psychiatry.* 2015 doi:10.4088/JCP.14m09047.
122. Yang GH, Phillips MR, Zhou MG, Wang LJ, Zhang YP, Xu D. Understanding the unique characteristics of suicide in China: national psychological autopsy study. *Biomed Environ Sci.* 2005;18:379–89.
123. Thong JY, Su AH, Chan YH, Chia BH. Suicide in psychiatric patients: case-control study in Singapore. *Aust N Z J Psychiatry.* 2008;42:509–19.
124. Cavanagh JT, Owens DG, Johnstone EC. Suicide and undetermined death in south-east Scotland. A case-control study using the psychological autopsy method. *Psychol Med.* 1999;29:1141–9.
125. Christiansen E, Jensen BF. Risk of repetition of suicide attempt, suicide or all deaths after an episode of attempted suicide: a register-based survival analysis. *Aust N Z J Psychiatry.* 2007;41:257–65.
126. Jia CX, Wang LL, Xu AQ, Dai AY, Qin P. Physical illness and suicide risk in rural residents of contemporary China: a psychological autopsy case-control study. *Crisis.* 2014;35:330–7.
127. Vyssoki B, Gleiss A, Rockett IR, Hackl M, Leitner B, Sonneck G, Kapusta ND. Suicide among 915,303 Austrian cancer patients: who is at risk? *J Affect Disord.* 2015;175:287–91.
128. Keiser O, Spoerri A, Brinkhof MW, Hasse B, Gayet-Ageron A, Tissot F, Christen A, Battgay M, Schmid P, Bernasconi E, Egger M; Swiss HIV Cohort Study; Swiss National Cohort. Suicide in HIV-infected individuals and the general population in Switzerland, 1988–2008. *Am J Psychiatry.* 2010;167:143–50.
129. Brønnum-Hansen H, Stenager E, Nylev Stenager E, Koch-Henriksen N. Suicide among Danes with multiple sclerosis. *J Neurol Neurosurg Psychiatry.* 2005;76:1457–9.

130. Cao Y, Massaro JF, Krause JS, Chen Y, Devivo MJ. Suicide mortality after spinal cord injury in the United States: injury cohorts analysis. *Arch Phys Med Rehabil.* 2014;95:230–5.
131. Blakely TA, Collings SC, Atkinson J. Unemployment and suicide. Evidence for a causal association? *J Epidemiol Community Health.* 2003;57:594–600.
132. Jung H, Matei DB, Hecser L. Biostatistical study of suicide features in Mures County (Romania). *Leg Med (Tokyo).* 2009;11 Suppl 1:S95–7.
133. Poorolajal J, Rostami M, Mahjub H, Esmailnasab N. Completed suicide and associated risk factors: a six-year population based survey. *Arch Iran Med.* 2015;18:39–43.
134. Qi X, Hu W, Page A, Tong S. Associations between climate variability, unemployment and suicide in Australia: a multicity study. *BMC Psychiatry.* 2015 doi:10.1186/s12888-015-0496-8.
135. Taylor R, Page A, Morrell S, Harrison J, Carter G. Mental health and socio-economic variations in Australian suicide. *Soc Sci Med.* 2005;61:1551–9.
136. Qi X, Hu W, Mengersen K, Tong S. Socio-environmental drivers and suicide in Australia: Bayesian spatial analysis. *BMC Public Health.* 2014 doi:10.1186/1471-2458-14-681.
137. Loh M, Tan CH, Sim K, Lau G, Mondry A, Leong JY, Tan EC. Epidemiology of completed suicides in Singapore for 2001 and 2002. *Crisis.* 2007;28:148–55.
138. Aasland OG, Hem E, Haldorsen T, Ekeberg Ø. Mortality among Norwegian doctors 1960–2000. *BMC Public Health.* 2011 doi:10.1186/1471-2458-11-173.
139. Shang TF, Chen PC, Wang JD. Mortality of doctors in Taiwan. *Occup Med (Lond).* 2011;61:29–32.
140. Torre DM, Wang NY, Meoni LA, Young JH, Klag MJ, Ford DE. Suicide compared to other causes of mortality in physicians. *Suicide Life Threat Behav.* 2005;35:146–53.
141. Fry RA, Fry LE, Castanelli DJ. A retrospective survey of substance abuse in anaesthetists in Australia and New Zealand from 2004 to 2013. *Anaesth Intensive Care.* 2015;43:111–7.

142. Petersen MR, Burnett CA. The suicide mortality of working physicians and dentists. *Occup Med (Lond)*. 2008;58:25–9.
143. Hem E, Haldorsen T, Aasland OG, Tyssen R, Vaglum P, Ekeberg O. Suicide rates according to education with a particular focus on physicians in Norway 1960–2000. *Psychol Med*. 2005;35:873–80.
144. Bauman KA. Physician suicide. *Arch Fam Med*. 1995;4:672–3.
145. A'Brook MF, Hailstone JD, McLaughlan IE. Psychiatric illness in the medical profession. *Br J Psychiatry*. 1967;113:1013–23.
146. Cochran SD, Mays VM. Mortality risks among persons reporting same-sex sexual partners: evidence from the 2008 General Social Survey-National Death Index data set. *Am J Public Health*. 2015;105:358–64.
147. Plöderl M, Kralovec K, Fartacek R. The relation between sexual orientation and suicide attempts in Austria. *Arch Sex Behav*. 2010;39:1403–14.
148. van Heeringen C, Vincke J. Suicidal acts and ideation in homosexual and bisexual young people: a study of prevalence and risk factors. *Soc Psychiatry Psychiatr Epidemiol*. 2000;35:494–9.
149. Elfawal MA. Cultural influence on the incidence and choice of method of suicide in Saudi Arabia. *Am J Forensic Med Pathol*. 1999;20:163–8.
150. Dervic K, Oquendo MA, Grunebaum MF, Ellis S, Burke AK, Mann JJ. Religious affiliation and suicide attempt. *Am J Psychiatry*. 2004;161:2303–8.
151. Robins A, Fiske A. Explaining the relation between religiousness and reduced suicidal behavior: social support rather than specific beliefs. *Suicide Life Threat Behav*. 2009;39:386–95.
152. Vougiouklakis T, Tsiligianni C, Boumba VA. Children, adolescents and young adults suicide data from Epirus, northwestern Greece. *Forensic Sci Med Pathol*. 2009;5:269–73.

153. Gissler M, Berg C, Bouvier-Colle MH, Buekens P. Injury deaths, suicides and homicides associated with pregnancy, Finland 1987–2000. *Eur J Public Health*. 2005;15:459–63.
154. Marzuk PM, Tardiff K, Leon AC, Hirsch CS, Portera L, Hartwell N, Iqbal MI. Lower risk of suicide during pregnancy. *Am J Psychiatry*. 1997;154:122–3.
155. Qin P, Mortensen PB. The impact of parental status on the risk of completed suicide. *Arch Gen Psychiatry*. 2003;60:797–802.
156. Cengiz H, Dagdeviren H, Caypinar SS, Kanawati A, Yildiz S, Ekin M. Plasma serotonin levels are elevated in pregnant women with hyperemesis gravidarum. *Arch Gynecol Obstet*. 2015;291:1271–6.
157. Cerel J, Moore M, Brown MM, van de Venne J, Brown SL. Who leaves suicide notes? A six-year population-based study. *Suicide Life Threat Behav*. 2014 doi:10.1111/sltb.12131.
158. Salib E, El-Nimr G, Yacoub M. Their last words: a review of suicide notes in the elderly. *Med Sci Law*. 2002;42:334–8.
159. Ho TP, Yip PS, Chiu CW, Halliday P. Suicide notes: what do they tell us? *Acta Psychiatr Scand*. 1998;98:467–73.
160. Byard RW, Heath KJ. Suicide notes, age and the impact of suicide guides. *Scand J Forensic Sci*. 2007;13:10–1.
161. Lester D, Wood P, Williams C, Haines J. Motives for suicide—a study of Australian suicide notes. *Crisis*. 2004;25:33–4.
162. Austin AE, van den Heuvel C, Byard RW. Cluster hanging suicides in the young in South Australia. *J Forensic Sci*. 2011;56:1528–30.
163. Larsen ST, Lynnerup N. Medico-legal autopsies in Denmark. *Dan Med Bull*. 2011;58:A4247.
164. Ylijoki-Sørensen S, Sajantila A, Lalu K, Bøggild H, Boldsen JL, Boel LW. Coding ill-defined and unknown cause of death is 13 times more frequent in Denmark than in Finland. *Forensic Sci Int*. 2014;244:289–94.

# CHAPTER 2: AN ANALYSIS AND EVALUATION OF SUICIDE IN SA

## 2.1 INTRODUCTION

In 2012, suicide was ranked as the 14<sup>th</sup> leading category of death in Australia, with 2,535 deaths coded as intentional self-harm ([www.abs.gov.au](http://www.abs.gov.au)). It is possible however, that publicly available data are likely significant underestimates of the true prevalence of suicide, with the degree of this varying between jurisdictions.

In SA, any deaths that are, or may be, unnatural, including all possible suicides, are required to be reported to the State Coroner. Under the *Coroners Act 2003*, the coroner will legally establish, wherever possible, the medical cause/s of a reportable death, or the circumstances surrounding the death. On being notified of a death, usually by a police officer or a physician, coronial clerks conduct an investigation on behalf of the coroner and, based on the information available, a classification is recorded about the manner of a reportable death and the suspected intent; for example, if a death is from natural or unknown causes, or presumed to be a suicide, ‘accident’ or homicide. The data are also entered into a national electronic database of information on coroner-certified deaths, the National Coronial Information System (NCIS) according to a number of NCIS codesets ([www.ncis.org.au](http://www.ncis.org.au)).

When coronial investigations are complete, information as to the registerable cause/s of a reportable death is provided to the Registrar of Births, Deaths and Marriages (BDM), under the *Births, Deaths and Marriages Registration Act 1996*. Final determinations about the manner of death and the suspected intent, such as suicide, may also be made at this time and are again, entered into the NCIS according to an NCIS

intent codeset with a range of responses, including ‘intentional self-harm’, ‘undetermined intent’, ‘other specified intent’ and ‘unlikely to be known’ ([www.ncis.org.au](http://www.ncis.org.au)).

For deaths by natural causes, however, that are not reportable under the act, a medical practitioner and of note, not a registrar or another student doctor, is legally required to notify the BDM as well as provide certificates accurately recording the natural causes of deaths to a funeral director or other person, for the dutiful removal of decedents.

Finally, information from coronial investigations on the NCIS is then provided to another national data repository, the ABS. In order to obtain aggregated national data for an annual causes of death publication and other statistical purposes, ABS coders manually code the categories of registered deaths from entries in the BDM as well as data held on the NCIS ([www.abs.gov.au](http://www.abs.gov.au)), according to the criteria of the 10<sup>th</sup> revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) ([www.who.int](http://www.who.int)).

However, the diagnosis of suicide is sometimes difficult to assign, resulting in misclassifications in recorded data. For example, deaths due to drug overdose, a fall from a height, drowning and single vehicle collisions may be variably recorded as intentional, ‘accidental’, or homicidal. In the absence of a suicide note, reports of previous suicide attempts or a history of suicidal ideation, there may be little to elucidate the motivation of these cases when such deaths are initially registered, ensuing less specific, non-suicide classifications. These ambiguities and evaluations for other possible manners of death are, however, carefully considered in local forensic medicolegal investigations, through integration of death scene and autopsy findings (1).

Under the *Coroners Act 2003*, after receiving notification of possible suicides and in order to ascertain the information required by regulation, the coroner will direct post-mortem examinations to be performed at the state forensic facility, FSSA. Prior to autopsy, information from coronial investigations, including police narratives of the circumstances preceding deaths, statements from witnesses, medical reports and other investigative findings, are all provided to FSSA, for staff to enter data into the local case management system, CaseMan. In order to establish the mechanism of death, systematically detailed external and internal examinations are performed with ancillary testing, which may include toxicological testing of blood and tissues, and sampling for DNA analyses, in addition to searching for any underlying illness/es and other factors that may have caused or contributed to death. All injuries and scars, especially if consistent with self-infliction, are photographed, sketched and described at autopsy. The information gained from examinations is then provided to the coroner to assist with timely findings being made for the BDM and the successive return of the body for funeral arrangements.

Suicide is a public health, policy and community concern. However, few studies have attempted to test the reliability of existing registers for reporting suicides, despite this information being crucial for health surveillance. The following study was undertaken to examine the specific contribution of suicide to medicolegal deaths occurring in SA, to compare this with South Australian data on national registers, and to delineate the characteristics of such cases over time.

## 2.2 MATERIALS AND METHODS

A manual and electronic search was undertaken of pathology files at FSSA for all cases of possible suicide registered in SA, Australia, over a 10-year period, from January 2003 to December 2012. All cases had undergone full police and coronial investigations, with autopsy examinations. Case post-mortem reports were examined and information grouped into 1-year periods, with the anonymity of all cases observed by data de-identification.

All mortuary case records and the included narratives of the circumstances around each death were examined for reports of possible triggers, alleged histories of depression, suicidal ideation and previous suicide attempts, as well as the presence of suicide notes. Ambiguous cases where death may have been due to an ‘accident’, assault, or to natural or unknown causes, were excluded from the study. However, it is acknowledged that in a minority of cases, accurate assessment of the presence or absence of antemortem trauma was not possible due to incineration as well as significant post-mortem changes including putrefaction, animal predation and mummification.

The total number of suicides over the 10 years of the study was ascertained. Details of the date of death, sex, age and race of victims, as well as reports on toxicology and ballistics were extracted from the records and tabulated in an Excel<sup>®</sup> worksheet [Microsoft<sup>®</sup> Office Excel<sup>®</sup> 2010].

Cases were divided into categories according to the principal method of self-harm used to produce the fatal injury, determined from scrutinising available details from the death scene, autopsy and laboratory work-ups, as well as the medical cause/s of death determined by the examining pathologist. Major categories included: hanging, drug

overdose, CO toxicity, gunshot wound/s, plastic bag asphyxia, incised and/or stab wounds, lying or stepping into the path of a moving motor vehicle or train, jumping from a height, and a ‘miscellaneous’ group (including deaths due to drowning, motor vehicle collisions, burning, poisoning by other noxious substances, electrocution, strangulation, gas asphyxia and blunt object trauma).

Available suicide data, from January 2003 and on national registers at the time of information capture, was also accessed for comparison purposes. The data consisted of closed coronial cases with an electronic record of findings coded as intentional self-harm on the NCIS, as well as the ABS coded data with an external cause of death code, intentional self-harm (suicide) (X60–X84, Y87.0), according to the ICD-10 criteria ([www.abs.gov.au](http://www.abs.gov.au)).

Statistical analyses were conducted using IBM<sup>®</sup> SPSS<sup>®</sup> Statistics for Windows<sup>®</sup> [version 20.0] and Microsoft<sup>®</sup> Office Excel<sup>®</sup> 2010. Categorical variables of interest were compared via binomial and Pearson’s Chi-square ( $\chi^2$ ) tests to determine differences by sex, age category, method of suicide and year of death. The rates of suicide for individual and total categories per 100,000 population were calculated from published ABS estimated resident population of SA data for each year, ranging from 1,520,399 in 2003 to 1,656,299 in 2012 ([www.abs.gov.au](http://www.abs.gov.au)). Individual *z*-tests for rate ratios (2) were calculated to crudely assess changes in suicide rates. Differences were considered statistically significant when  $p < 0.05$ .

This study was approved by the FSSA Management Ethics Committee.

## 2.3 RESULTS

### 2.3.1 Prevalence of suicide in SA

A total of 2,105 cases of suicide registered at FSSA were identified from January 2003 to December 2012, representing a death rate of 13.3 per 100,000 population. There were significantly more male than female victims (M:F = 3.2:1;  $p < 0.001$ ) (Table 1). Despite the fluctuating sex-specific trends, there was a statistically significant decrease in the rates of male, but not female suicides from 2005 to 2010 ( $p < 0.05$ ), although the decline in male suicides appears to have plateaued and did not reach statistical significance in 2012 ( $p = 0.09$ ) (Fig. 1).

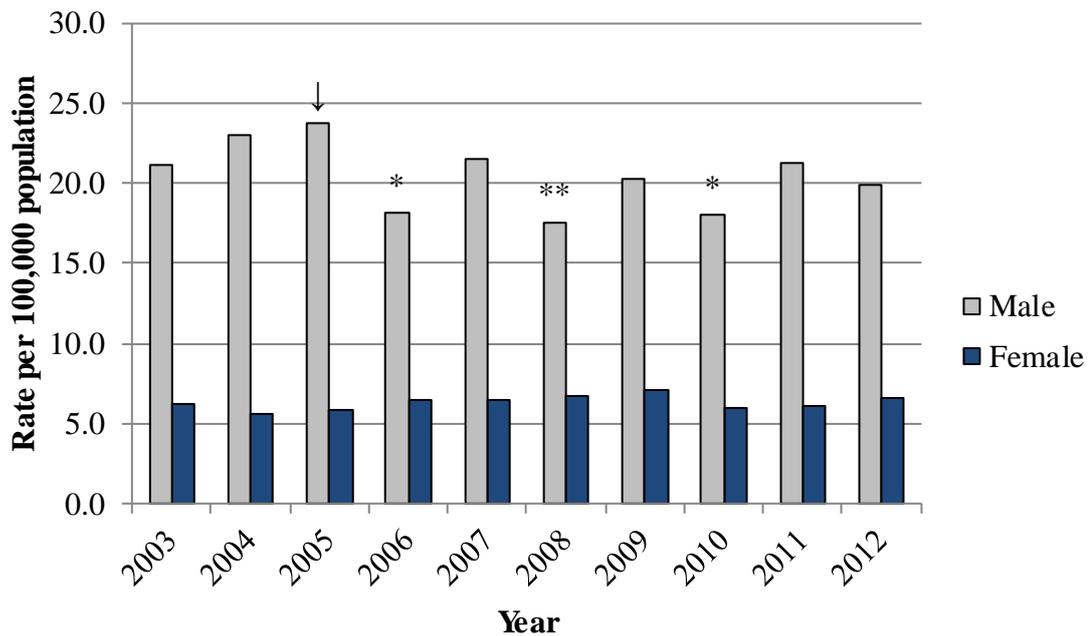


FIGURE 1—Suicide rates per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA. ↓ = male rates for 2005 versus for 2006, 2008 and 2010. \* $p < 0.05$ ; \*\* $p < 0.01$ .

Data were available from 2003 to 2010 from the NCIS. In the reported 8-year period, there were 1,542 suicides registered (12.3 per 100,000 population). Numbers of suicides for 2011 and 2012 were not reported by the NCIS as coding of such deaths was incomplete. However, available data did indicate a statistically significant decrease in the rates of male suicides from 2005 to 2010 ( $p < 0.001$ ). The rates of female deaths recorded as suicide also seemed to be decreasing, with the lowest rates reported in 2010 (Fig. 2).

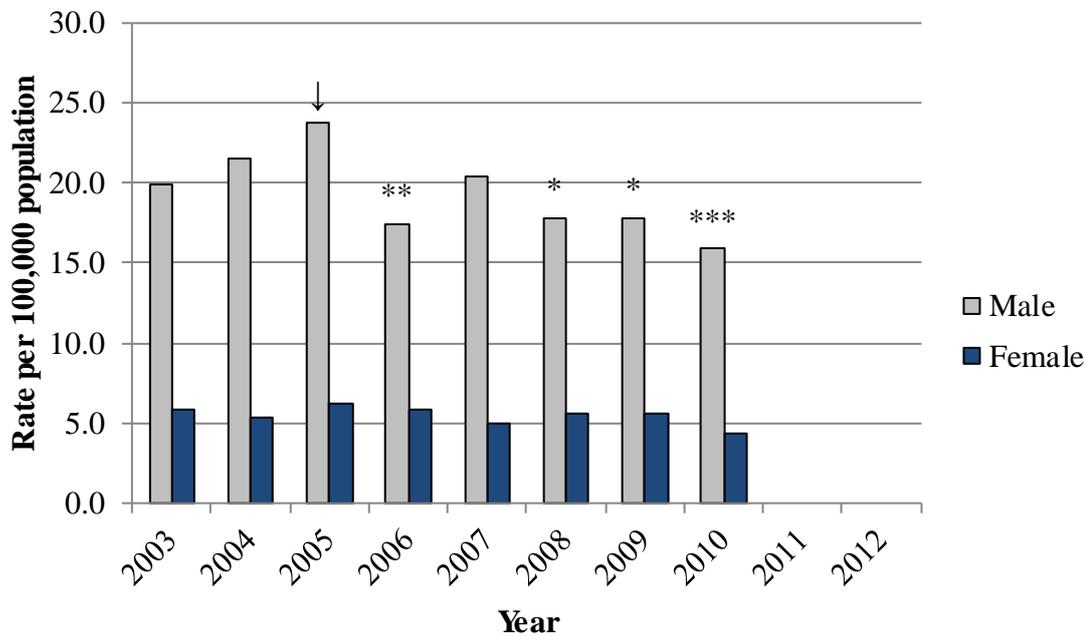


FIGURE 2—Suicide rates per 100,000 population in males and females in SA registered over an 8-year period (2003 to 2010) on the NCIS. ↓ = male rates for 2005 versus for 2006, 2008, 2009 and 2010. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . Adapted from NCIS, unpublished data – 2012.

Data from the ABS were available for the years 2003 to 2011. Over that time, there were 1,366 deaths coded as suicide (12.4 per 100,000 population). Official numbers of suicides for 2012 were not reported by the ABS. However, published data indicated a statistically significant increase in the rate of male suicides from 2004 to 2005 ( $p < 0.05$ ), followed by a statistically significant decrease in such deaths from 2005 to 2009 ( $p < 0.01$ ) (Fig. 3).

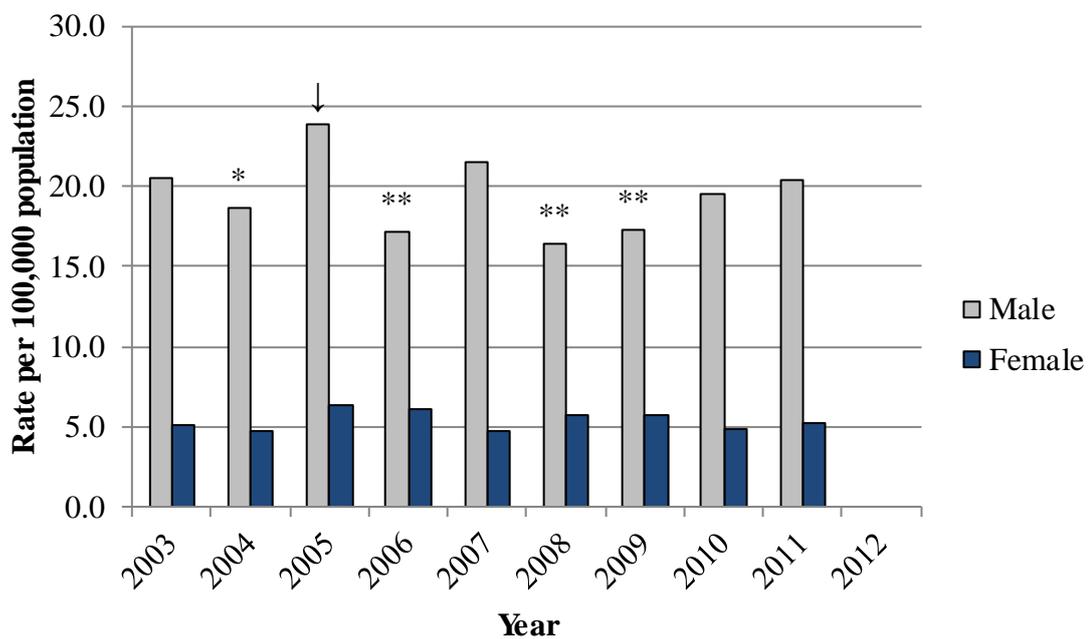


FIGURE 3—Suicide rates per 100,000 population in males and females in SA registered over a 9-year period (2003 to 2011) by the ABS. ↓ = male rates for 2004, 2006, 2008 and 2009 versus for 2005. \* $p < 0.05$ ; \*\* $p < 0.01$ . Adapted from ABS cat. no. 3303.0 – 2011.

No statistically significant differences in the aggregate rates of suicides over time were found between the three registers (Table 1). However, after separating victims by sex, differences in the reported annual rates of male (Fig. 4) and female suicides were marked (Fig. 5). An overall under-reporting of suicide of 5.4% of local male cases as well as 13.5% of local female cases between 2003 and 2010 in the NCIS, and of 4.9% of local male cases as well as 14.0% of local female cases between 2003 and 2011 by the ABS, was recorded. Only in the years 2005, 2008 and 2010 were more suicides reported on the national registers than were captured locally (Table 1).

TABLE 1—*Prevalence of male and female suicides in SA per register over a 10-year period (2003 to 2012). Suicide rates and the percentages of local capture were calculated including only the available years. Adapted from NCIS, unpublished data – 2012 and ABS cat. no. 3303.0 – 2011.*

Year	FSSA			NCIS			ABS		
	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined
	<i>n</i> , rate	<i>n</i> , rate	<i>n</i> , rate	<i>n</i> , rate, % of local capture					
2003	159, 21.2	48, 6.2	207, 13.6	150, 20.0, 94.3	45, 5.8, 93.8	195, 12.8, 94.2	154, 20.5, 96.9	39, 5.1, 81.3	193, 12.7, 93.2
2004	174, 23.0	43, 5.6	217, 14.2	163, 21.6, 93.7	41, 5.3, 95.3	204, 13.3, 94.0	141, 18.7, 81.0	37, 4.8, 86.0	178, 11.6, 82.0
2005	181, 23.8	46, 5.9	227, 14.8	181, 23.8, 100.0	48, 6.2, 104.3	229, 14.9, 100.9	182, 24.0, 100.6	49, 6.3, 106.5	231, 15.0, 101.8
2006	139, 18.1	51, 6.5	190, 12.2	134, 17.5, 96.4	46, 5.9, 90.2	180, 11.6, 94.7	132, 17.2, 95.0	48, 6.1, 94.1	180, 11.6, 94.7
2007	167, 21.5	51, 6.4	218, 13.9	158, 20.4, 94.6	40, 5.0, 78.4	198, 12.6, 90.8	167, 21.5, 100.0	38, 4.8, 74.5	205, 13.1, 94.0
2008	138, 17.6	54, 6.7	192, 12.1	140, 17.8, 101.4	45, 5.6, 83.3	185, 11.6, 96.4	129, 16.4, 93.5	46, 5.7, 85.2	175, 11.0, 91.1
2009	161, 20.2	58, 7.1	219, 13.6	142, 17.8, 88.2	45, 5.5, 77.6	187, 11.6, 85.4	138, 17.3, 85.7	47, 5.8, 81.0	185, 11.5, 84.5
2010	145, 18.0	49, 6.0	194, 11.9	128, 15.9, 88.3	36, 4.4, 73.5	164, 10.1, 84.5	157, 19.5, 108.3	40, 4.9, 81.6	197, 12.1, 101.5
2011	173, 21.3	50, 6.0	223, 13.6	–, –, –	–, –, –	–, –, –	166, 20.4, 96.0	43, 5.2, 86.0	209, 12.7, 93.7
2012	163, 19.9	55, 6.6	218, 13.2	–, –, –					
Total	1,600, 20.4	505, 6.3	2,105, 13.3	1,196, 19.3, 94.6	346, 5.5, 86.5	1,542, 12.3, 92.7	1,366, 19.5, 95.1	387, 5.4, 86.0	1,753, 12.4, 92.9

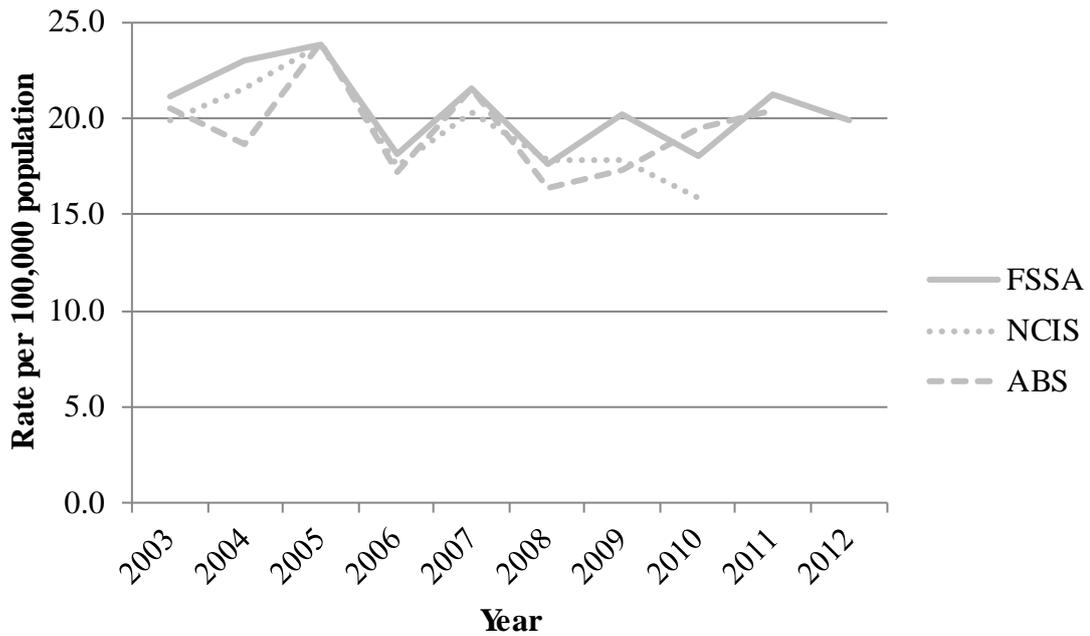


FIGURE 4—Rates of registered suicides per 100,000 population in males in SA over a 10-year period (2003 to 2012). Adapted from NCIS, unpublished data – 2012 and ABS cat. no. 3303.0 – 2011.

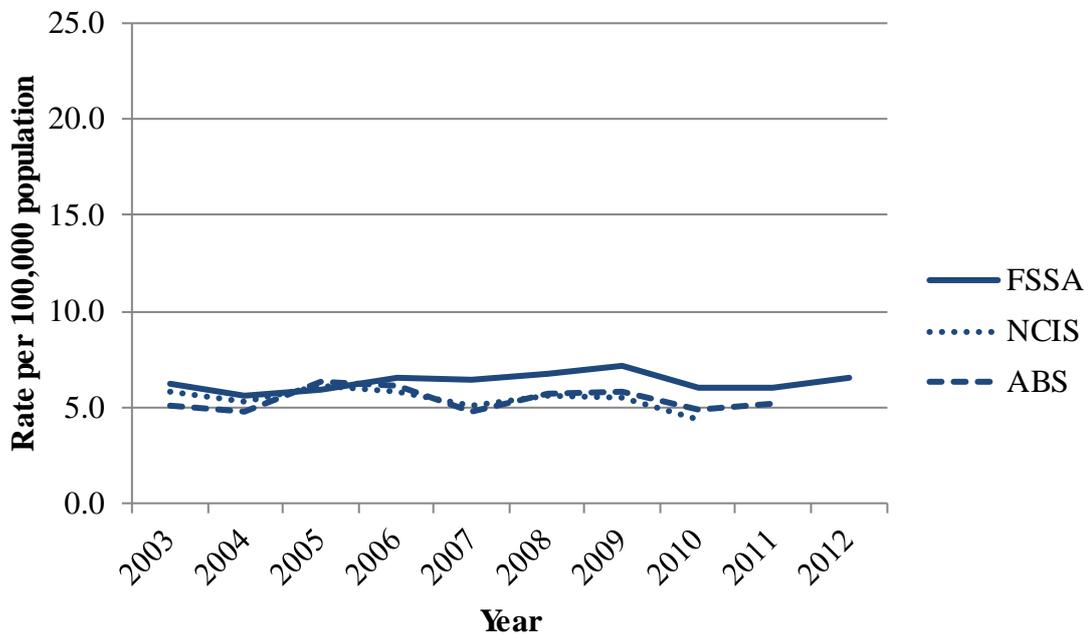


FIGURE 5—Rates of registered suicides per 100,000 population in females in SA over a 10-year period (2003 to 2012). Adapted from NCIS, unpublished data – 2012 and ABS cat. no. 3303.0 – 2011.

### 2.3.2 Age distribution and methods of suicide in SA

The equivalence of local data with the reported age distribution of suicides registered between 2003 and 2010 on the NCIS can be judged from Fig. 6. After stratifying victims by age category, suicides registered at FSSA over this time exceeded those coded in the NCIS across ages, with 10 more cases (12.8% more) identified in the range 9–19 years, seven more cases (2.6% more) in the range 20–29 years, 27 more cases (7.3% more) in the range 30–39 years, 38 more cases (10.4% more) in the range 40–49 years, 24 more cases (9.0% more) in the range 50–59 years, 15 more cases (10.3% more) in the range 60–69 years and one more case (1.3% more) in the range 80–99 years. Although no statistically significant differences in the age-specific rates of suicides were found between the two registers, when cases were sub-classified according to the method used, the rate of drug overdoses registered in the NCIS was noted to be significantly lower than what was captured locally at FSSA (with 204 cases or 1.6 deaths per 100,000 population versus 301 cases or 2.4 deaths per 100,000 population, respectively;  $p < 0.001$ ). Only in the two categories of an impact by a motor vehicle or train, and jumping from a height, were more cases reported in the NCIS than in local data (Table 2).

ABS data were not available by age category, although data were stratified by method. However, published data are subject to ‘confidentialisation’ whereby particular categories of self-harm with few victims coded as suicide by the ABS are assigned random values higher than what was actually recorded.



FIGURE 6—Distributions of registered suicides by age group in SA between 2003 and 2010 at FSSA and on the NCIS. Adapted from NCIS, unpublished data – 2012.

TABLE 2—Distributions of the preferred methods of registered suicides in SA between 2003 and 2010 at FSSA and on the NCIS. FSSA versus NCIS. \*\*\* $p < 0.001$ . Adapted from NCIS, unpublished data – 2012.

	FSSA	NCIS
Method of suicide	<i>n</i> , rate	<i>n</i> , rate, % of local capture
Hanging	735, 5.9	723, 5.8, 98.4
Drug overdose	301, 2.4***	204, 1.6***, 67.8
CO toxicity	204, 1.6	170, 1.4, 83.3
Gunshot wound/s	137, 1.1	128, 1.0, 93.4
Plastic bag asphyxia	58, 0.5	47, 0.4, 81.0
Incised and/or stab wounds	40, 0.3	37, 0.3, 92.5
Impact by a motor vehicle/train	36, 0.3	38, 0.3, 105.6
Jumping from a height	34, 0.3	40, 0.3, 117.6
Misc.	119, 0.9	155, 1.2, 130.3
Total	1,664, 13.3	1,542, 12.3, 92.7

### 2.3.3 *Specific characteristics of suicide in SA*

Suicides represented 15.0% of all deaths registered at FSSA over the period of the study (2,105/14,037). Full autopsies had been performed in 2,085/2,105 cases (99.0%), with only an external examination and toxicology, or a pathology review, being performed in 20 cases (1.0%). The mean age at death for all cases was 44.6 years (median = 43.0 years; range = 9–97 years) with most victims (460/2,105; 21.9%) being in the 30–39 year age category; 76.3% (1,606/2,105) were aged 20–59 years (Tables 3 and 6). The sexes did not differ statistically significantly in age ( $\chi^2 = 14.79$ ;  $p = 0.10$ ) (Fig. 7), and there were no statistically significant changes in the sex or age distributions of cases over time ( $\chi^2 = 7.97$ ;  $p = 0.54$  and  $\chi^2 = 62.83$ ;  $p = 0.93$ , respectively). Although despite numbers being low, the suicide rates for males aged 20–29 years and 30–39 years have decreased by 34.7% and 14.9%, respectively over the 10 years studied, while the rates for those aged 50–59 years have increased by 63.9%. However, there has been little change in the rates of female suicides across all age groups over time (Table 3).

TABLE 3—Prevalence of suicide per age group in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

Year	Age group (years)									
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
Male										
2003	0, 0.0	10, 9.5	31, 31.4	38, 34.8	34, 30.2	20, 20.5	12, 18.8	9, 18.8	4, 20.7	1, 44.5
2004	0, 0.0	7, 6.7	32, 32.1	34, 31.5	36, 31.8	29, 29.3	16, 24.5	12, 25.1	7, 34.7	1, 42.3
2005	0, 0.0	6, 5.7	36, 35.5	45, 42.1	40, 35.3	23, 22.8	14, 20.8	7, 14.7	10, 47.2	0, 0.0
2006	0, 0.0	7, 6.7	21, 20.3	34, 31.9	29, 25.5	22, 21.5	8, 11.5	10, 21.0	7, 31.4	1, 38.2
2007	0, 0.0	8, 7.6	26, 24.7	42, 39.5	33, 29.0	26, 25.4	15, 20.4	9, 18.8	6, 25.7	2, 72.6
2008	0, 0.0	6, 5.7	23, 21.2	35, 33.1	26, 22.8	30, 29.0	7, 9.1	9, 18.7	1, 4.1	1, 34.5
2009	0, 0.0	6, 5.7	28, 24.9	38, 36.0	42, 36.8	20, 19.1	13, 16.3	8, 16.4	5, 20.0	1, 32.5
2010	0, 0.0	7, 6.6	15, 13.0	37, 35.1	28, 24.5	24, 22.7	17, 20.5	10, 20.3	5, 19.4	2, 60.3
2011	0, 0.0	15, 14.4	26, 22.3	32, 30.6	37, 32.3	34, 31.6	15, 17.5	5, 9.9	8, 30.4	1, 28.2
2012	0, 0.0	6, 5.8	24, 20.5	31, 29.6	34, 29.6	35, 32.1	10, 11.4	11, 21.2	12, 45.0	0, 0.0
Female										
2003	0, 0.0	2, 2.0	8, 8.5	9, 8.3	13, 11.4	6, 6.0	5, 7.6	2, 3.5	3, 9.2	0, 0.0
2004	0, 0.0	5, 5.0	9, 9.5	8, 7.5	10, 8.7	6, 5.9	2, 2.9	1, 1.8	1, 3.0	1, 14.2
2005	0, 0.0	2, 2.0	9, 9.3	8, 7.6	13, 11.3	3, 2.9	5, 7.1	3, 5.4	3, 8.7	0, 0.0
2006	0, 0.0	5, 5.0	4, 4.0	7, 6.7	10, 8.7	8, 7.6	9, 12.3	3, 5.4	3, 8.4	2, 26.4
2007	0, 0.0	1, 1.0	5, 4.9	5, 4.7	12, 10.4	15, 14.2	7, 9.1	4, 7.3	2, 5.4	0, 0.0
2008	0, 0.0	1, 1.0	9, 8.7	9, 8.6	15, 13.0	9, 8.5	6, 7.5	4, 7.2	1, 2.6	0, 0.0
2009	0, 0.0	3, 3.0	5, 4.7	13, 12.4	10, 8.7	17, 15.8	5, 6.0	2, 3.6	3, 7.8	0, 0.0
2010	0, 0.0	2, 2.0	10, 9.1	8, 7.7	13, 11.3	8, 7.3	4, 4.7	1, 1.8	3, 7.7	0, 0.0
2011	0, 0.0	1, 1.0	7, 6.3	17, 16.4	9, 7.8	10, 9.1	6, 6.7	0, 0.0	0, 0.0	0, 0.0
2012	1, 1.0	3, 3.0	7, 6.2	10, 9.6	14, 12.2	8, 7.1	8, 8.7	2, 3.5	2, 5.1	0, 0.0

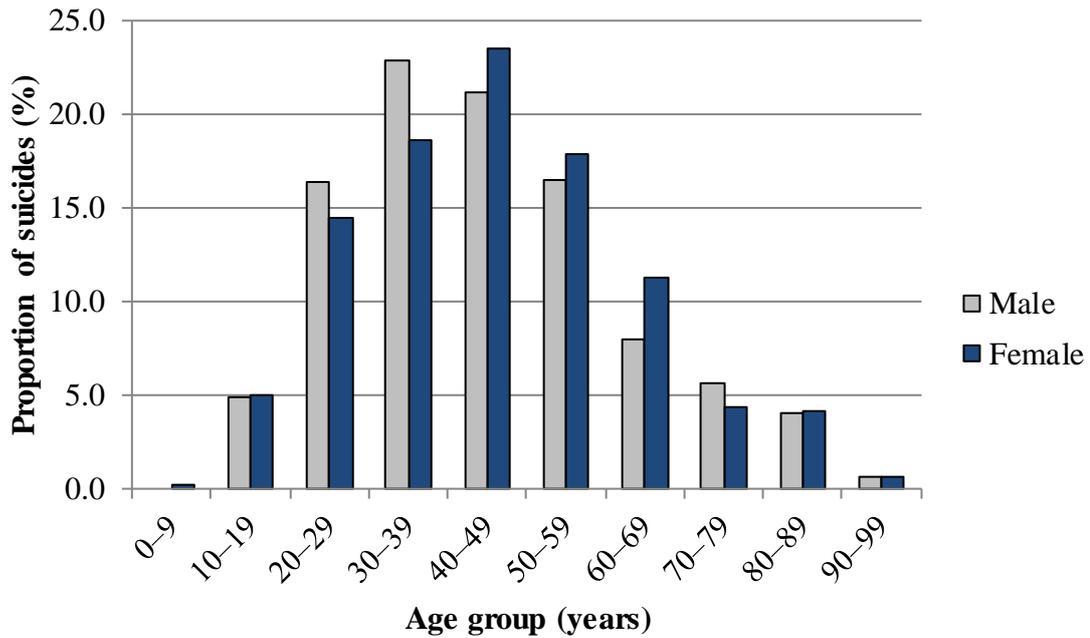


FIGURE 7—Distribution of suicides by sex and age group in SA registered between 2003 and 2012 at FSSA.

#### 2.3.4 Specific methods of suicide in SA

Hanging accounted for the highest proportion of deaths (952/2,105 cases; 45.2%), followed by drug overdose (391/2,105; 18.6%), CO toxicity (236/2,105; 11.2%), gunshot wounds (165/2,105; 7.8%), plastic bag asphyxia (76/2,105; 3.6%), incised and/or stab wounds (52/2,105; 2.5%), an impact by a motor vehicle or train (44/2,105; 2.1%), and jumping from a height (43/2,105; 2.0%). A ‘miscellaneous’ group (including deaths due to drowning, motor vehicle collisions, burning, poisoning by other noxious substances, electrocution, strangulation, gas asphyxia or blunt object trauma) accounted for 146 of 2,105 cases, or 0.1% of the total. Table 4 illustrates the numbers and rates of suicides per method category. Significant male–female discrepancies were observed for different methods of suicide ( $\chi^2 = 252.5$ ;  $p < 0.001$ ). Males were more likely to use

gunshot wounds or hanging when compared to females, while females were more likely to use drug overdose or plastic bag asphyxia. The distribution and male–female ratio for each method of suicide is shown in Table 5.

TABLE 4—Prevalence of suicide per method category in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

Method of suicide									
Year	Hanging <i>n</i> , rate	Drug overdose <i>n</i> , rate	CO toxicity <i>n</i> , rate	Gunshot wound/s <i>n</i> , rate	Plastic bag asphyxia <i>n</i> , rate	Incised and/or stab wounds <i>n</i> , rate	Impact by a MV/train <i>n</i> , rate	Jumping from a height <i>n</i> , rate	Misc. <i>n</i> , rate
<b>Male</b>									
2003	73, 9.7	24, 3.2	25, 3.3	15, 2.0	3, 0.4	5, 0.7	2, 0.3	2, 0.3	10, 1.3
2004	74, 9.8	24, 3.2	30, 4.0	20, 2.6	4, 0.5	4, 0.5	4, 0.5	3, 0.4	11, 1.5
2005	104, 13.7	16, 2.1	25, 3.3	11, 1.4	2, 0.3	3, 0.4	5, 0.7	6, 0.8	9, 1.2
2006	69, 9.0	13, 1.7	21, 2.7	17, 2.2	3, 0.4	3, 0.4	3, 0.4	1, 0.1	9, 1.2
2007	83, 10.7	14, 1.8	19, 2.4	18, 2.3	6, 0.8	6, 0.8	6, 0.8	6, 0.8	9, 1.2
2008	69, 8.8	17, 2.2	17, 2.2	19, 2.4	5, 0.6	0, 0.0	4, 0.5	2, 0.3	5, 0.6
2009	82, 10.3	23, 2.9	16, 2.0	16, 2.0	4, 0.5	4, 0.5	3, 0.4	3, 0.4	10, 1.3
2010	73, 9.1	11, 1.4	13, 1.6	15, 1.9	7, 0.9	6, 0.7	3, 0.4	4, 0.5	13, 1.6
2011	99, 12.2	22, 2.7	12, 1.5	13, 1.6	3, 0.4	2, 0.2	4, 0.5	4, 0.5	14, 1.7
2012	76, 9.3	26, 3.2	15, 1.8	14, 1.7	9, 1.1	7, 0.9	3, 0.4	3, 0.4	10, 1.2
<b>Female</b>									
2003	13, 1.7	15, 1.9	7, 0.9	0, 0.0	5, 0.6	3, 0.4	1, 0.1	0, 0.0	4, 0.5
2004	16, 2.1	9, 1.2	5, 0.6	0, 0.0	2, 0.3	0, 0.0	1, 0.1	2, 0.3	8, 1.0
2005	13, 1.7	12, 1.5	8, 1.0	2, 0.3	1, 0.1	2, 0.3	1, 0.1	0, 0.0	7, 0.9
2006	10, 1.3	23, 2.9	5, 0.6	1, 0.1	4, 0.5	1, 0.1	1, 0.1	1, 0.1	5, 0.6
2007	14, 1.8	24, 3.0	1, 0.1	0, 0.0	2, 0.3	0, 0.0	1, 0.1	2, 0.3	7, 0.9
2008	9, 1.1	28, 3.5	3, 0.4	2, 0.2	4, 0.5	2, 0.2	0, 0.0	2, 0.2	4, 0.5
2009	17, 2.1	28, 3.4	5, 0.6	1, 0.1	4, 0.5	1, 0.1	0, 0.0	0, 0.0	2, 0.2
2010	16, 1.9	20, 2.4	4, 0.5	0, 0.0	2, 0.2	0, 0.0	1, 0.1	0, 0.0	6, 0.7
2011	24, 2.9	18, 2.2	2, 0.2	0, 0.0	1, 0.1	2, 0.2	0, 0.0	1, 0.1	2, 0.2
2012	18, 2.2	24, 2.9	3, 0.4	1, 0.1	5, 0.6	1, 0.1	1, 0.1	1, 0.1	1, 0.1

MV indicates motor vehicle.

TABLE 5—Distribution of the preferred methods of suicide by sex in SA registered between 2003 and 2012 at FSSA. M:F. \* $p < 0.05$ ; \*\*\* $p < 0.001$ .

Method of suicide	Male	Female	Combined	M:F
	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	
Hanging	802, 50.1	150, 29.7	952, 45.2	5.3:1***
Drug overdose	190, 11.9	201, 39.8	391, 18.6	1.9:2
CO toxicity	193, 12.1	43, 8.5	236, 11.2	4.5:1***
Gunshot wound/s	158, 9.9	7, 1.4	165, 7.8	22.6:1***
Plastic bag asphyxia	46, 2.9	30, 5.9	76, 3.6	1.5:1*
Incised and/or stab wounds	40, 2.5	12, 2.4	52, 2.5	3.3:1***
Impact by a motor vehicle/train	37, 2.3	7, 1.4	44, 2.1	5.3:1***
Jumping from a height	34, 2.1	9, 1.8	43, 2.0	3.8:1***
Misc.	100, 6.3	46, 9.1	146, 6.9	2.2:1***
Total	1,600, 100.0	505, 100.0	2,105, 100.0	3.2:1***

There were 802 male and 150 female deaths due to hanging with an age range of 10–97 years (mean = 41.1 years; median = 39.0 years) for males and 9–96 years (mean = 38.0 years; median = 37.0 years) for females. There was a significant increase in the rates of registered male hangings from 2003 to 2005 ( $p < 0.05$ ), although significant decreases in such rates were then observed from 2005 to 2012 ( $p < 0.01$ ). Conversely, there was a statistically significant increase in the rates of female hangings from 2006 to 2011 ( $p < 0.05$ ) (Fig. 8), however the male rates remained significantly higher than the female rates overall ( $p < 0.001$ ).

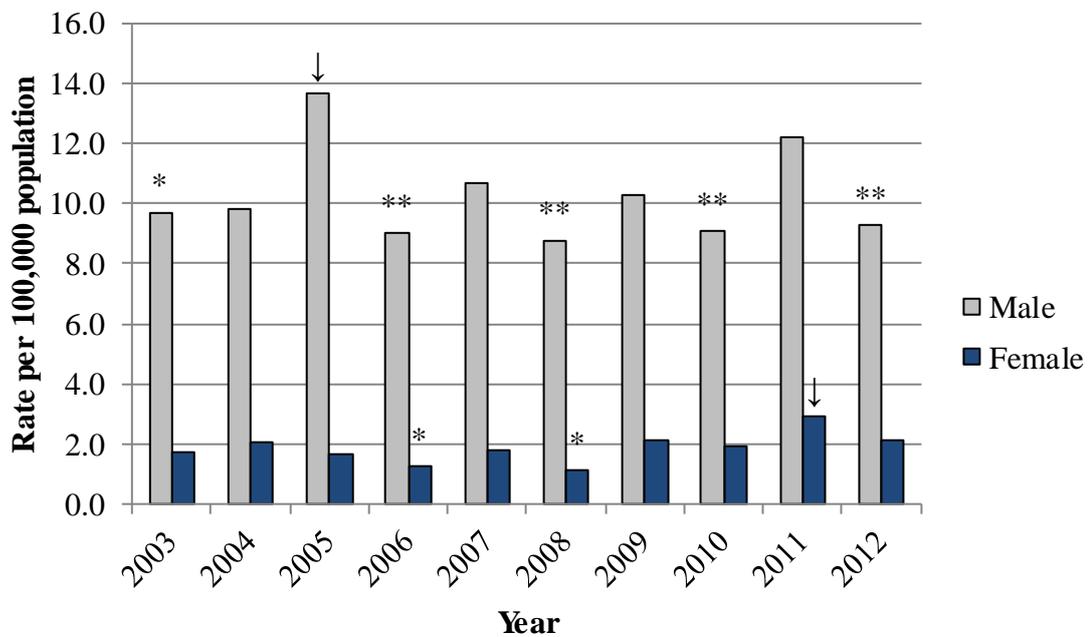


FIGURE 8—Suicide rates by hanging per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA. ↓ = male rates for 2003, 2006, 2008, 2010 and 2012 versus for 2005. ↓ = female rates for 2006 and 2008 versus for 2011. \* $p < 0.05$ ; \*\* $p < 0.01$ .

Deaths due to drug overdose constituted the next largest category with a total of 391 cases (190 males and 201 females), including 20 cases by insulin overdose. The overall age range for males was 16–88 years (mean = 46.0 years; median = 45.0 years) and 15–84 years (mean = 48.8 years; median = 48.0 years) for females. There was a significant decrease in the rate of male overdoses from 2003 to 2010 ( $p < 0.05$ ). However, this former pattern was immediately followed by an evident and statistically significant increase in the rate of male deaths from 2010 to 2012 ( $p < 0.05$ ) to then surpass a significantly increasing rate of female deaths from 2004 to 2012 ( $p < 0.05$ ) (Fig. 9).

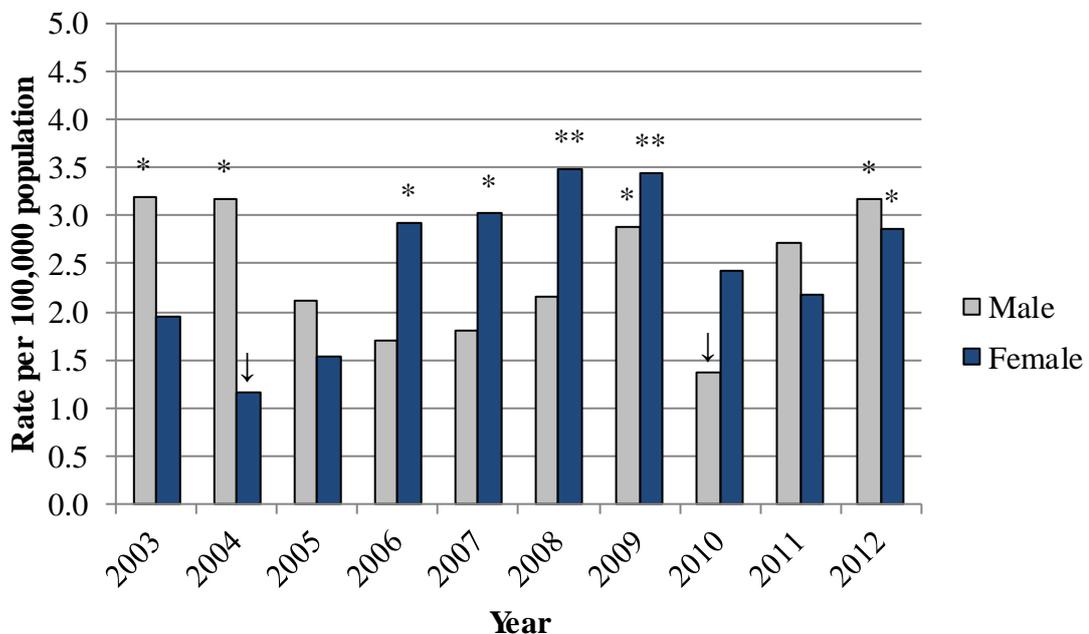


FIGURE 9—Suicide rates by drug overdose per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA. ↓ = male rates for 2003, 2004, 2009 and 2012 versus for 2010. ↓ = female rates for 2004 versus for 2006, 2007, 2008, 2009 and 2012. \* $p < 0.05$ ; \*\* $p < 0.01$ .

Suicides by CO toxicity represented the third largest category with a total of 236 cases and a marked male predominance (193 males and 43 females;  $p < 0.001$ ). The age range for males was 17–96 years (mean = 45.7 years; median = 43.0 years) and 17–86 years (mean = 44.6 years; median = 44.0 years) for females. Almost all cases (231/236; 97.9%) involved the inhalation of motor vehicle exhaust gases, with the remaining five cases, all of which were male, succumbing to a different method of attaining toxicity, by using a gas-powered generator (three cases) or by burning charcoal in a sealed space to create a CO chamber (two cases). There was a significant decrease in the rates of male deaths by CO inhalation from 2004 to 2012 ( $p < 0.05$ ) and a statistically significant decrease was also observed in the rates of female deaths from 2005 to 2007 ( $p < 0.05$ ) (Fig. 10).

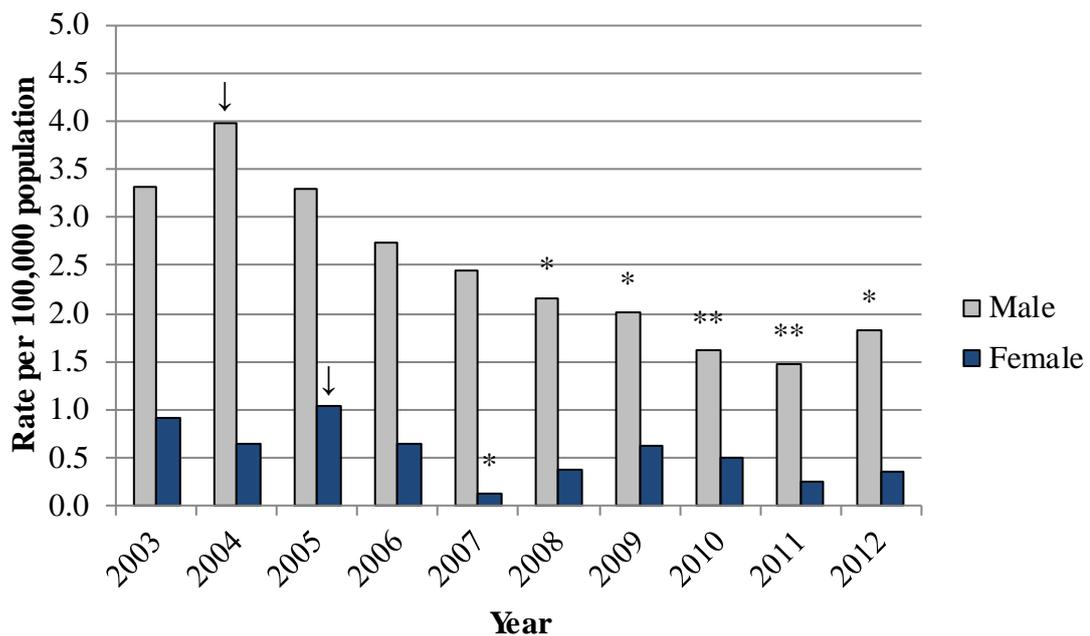


FIGURE 10—Suicide rates by CO toxicity per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA. ↓ = male rates for 2004 versus for 2008, 2009, 2010, 2011 and 2012. ↓ = female rates for 2005 versus for 2007. \* $p < 0.05$ ; \*\* $p < 0.01$ .

There were 158 male and 7 female cases of suicide by gunshot wounds ( $p < 0.001$ ), with the sex-specific rates being low and consistent over time (Fig. 11). Males had an age range of 12–91 years (mean = 52.0 years; median = 53.5 years) and females ranged from 19–57 years old (mean = 35.7 years; median = 42.0 years).

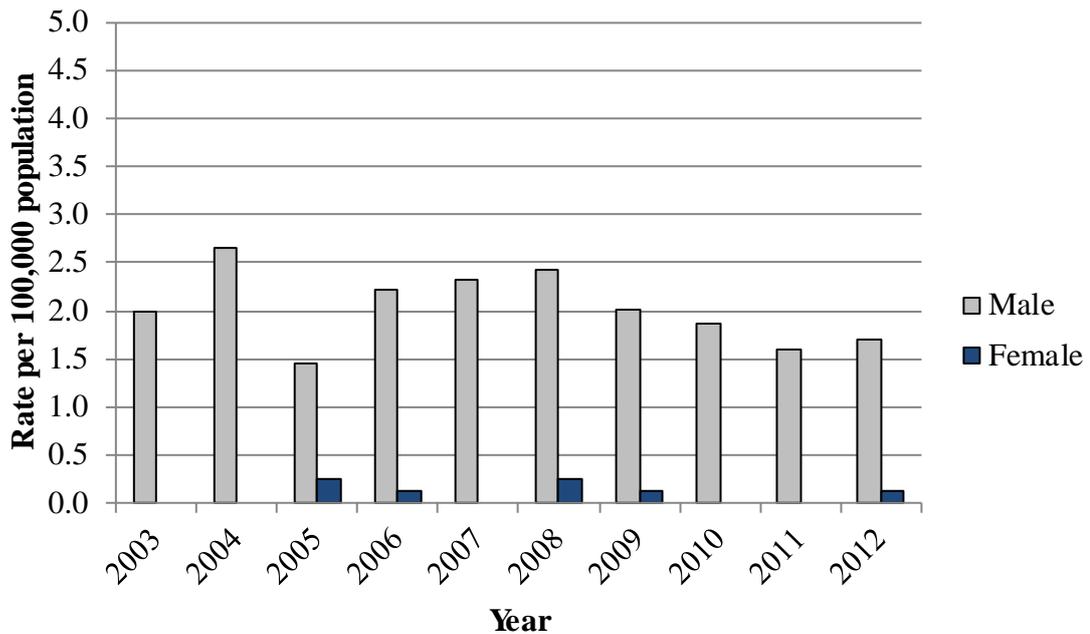


FIGURE 11—Suicide rates by gunshot wounds per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

Deaths due to plastic bag asphyxia accounted for 76 cases (46 males and 30 females;  $p < 0.05$ ) and occurred by a variety of methods, including complex cases (38/76; 50.0%) involving the inhalation of various gases or a solvent, namely helium (18/38; 47.4%), nitrogen (8/38; 21.1%), liquefied petroleum gas (LPG) (5/38; 13.2%), butane (2/38; 5.3%), methane (2/38; 5.3%), CO (1/38; 2.6%), chloroform, or a paint thinner (1/38; 2.6%), during the fatal episode. The age range for males was 19–97 years (mean = 53.0 years; median = 49.5 years) and 19–96 years (mean = 60.1 years; median = 64.5 years) for females. No statistically significant changes in the male or female rates were observed over time (Fig. 12). However, upon further analyses of complex asphyxial deaths, specific gas preferences were identified, with an apparent increase in the use of plastic bags with helium (Fig. 13).

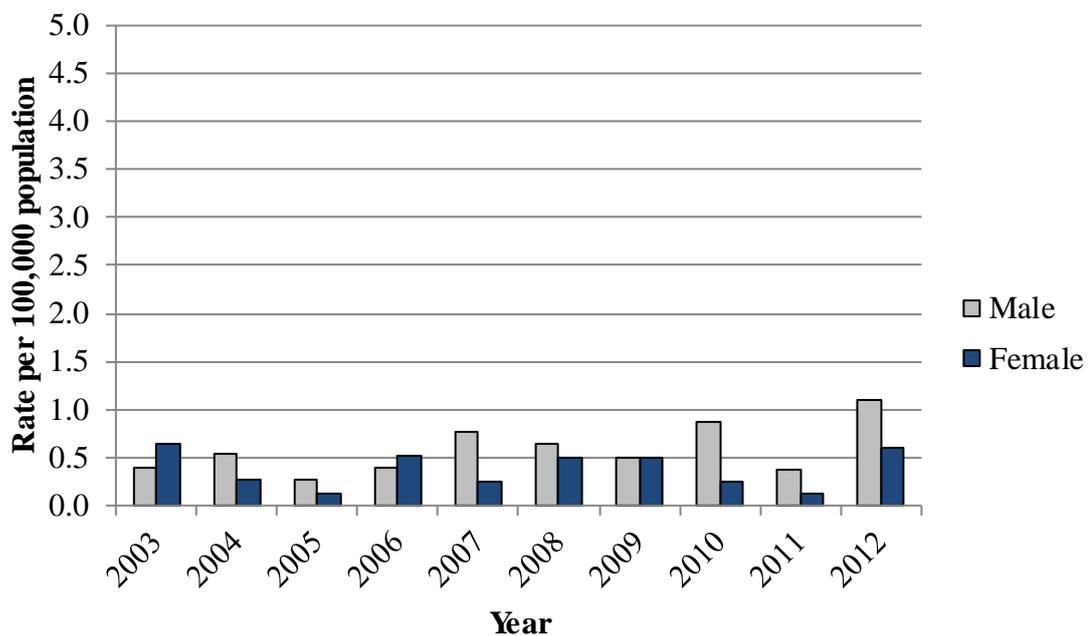


FIGURE 12—Suicide rates by plastic bag asphyxia per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

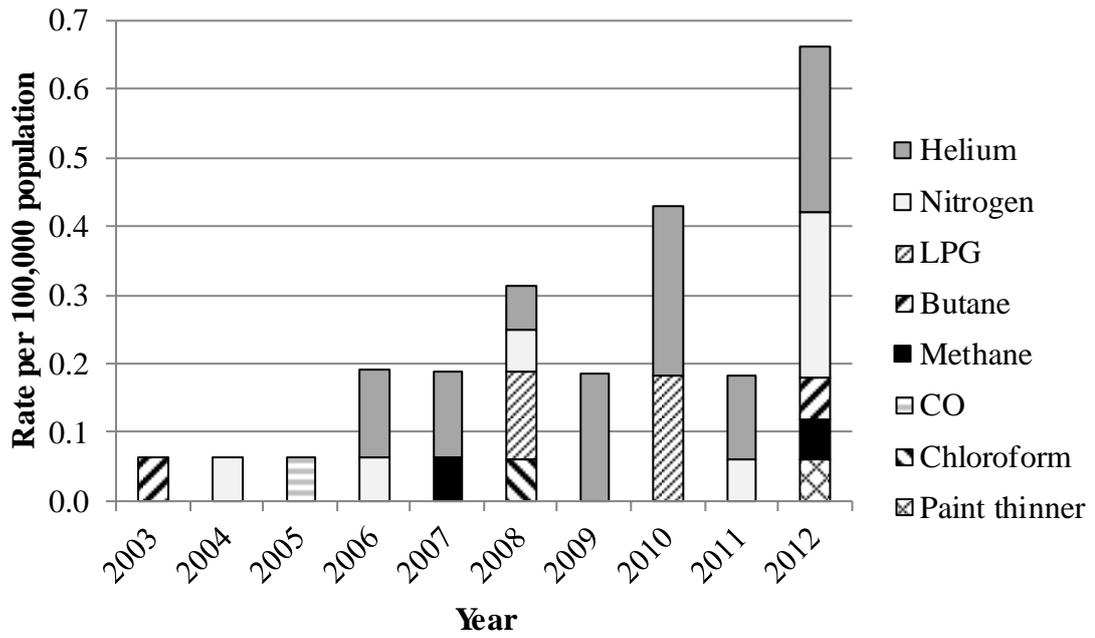


FIGURE 13—Suicide rates by complex cases of plastic bag asphyxia involving the inhalation of gases or a solvent in SA registered over a 10-year period (2003 to 2012) at FSSA.

There were 40 male and 12 female deaths due to incised and/or stab wounds with an age range of 18–94 years (mean = 49.0 years; median = 44.5 years) for males and 21–75 years (mean = 47.8 years; median = 44.0 years) for females, and a marked male predominance ( $p < 0.001$ ). Although being a rare means of suicide, no statistically significant annual trends were observed (Fig. 14).

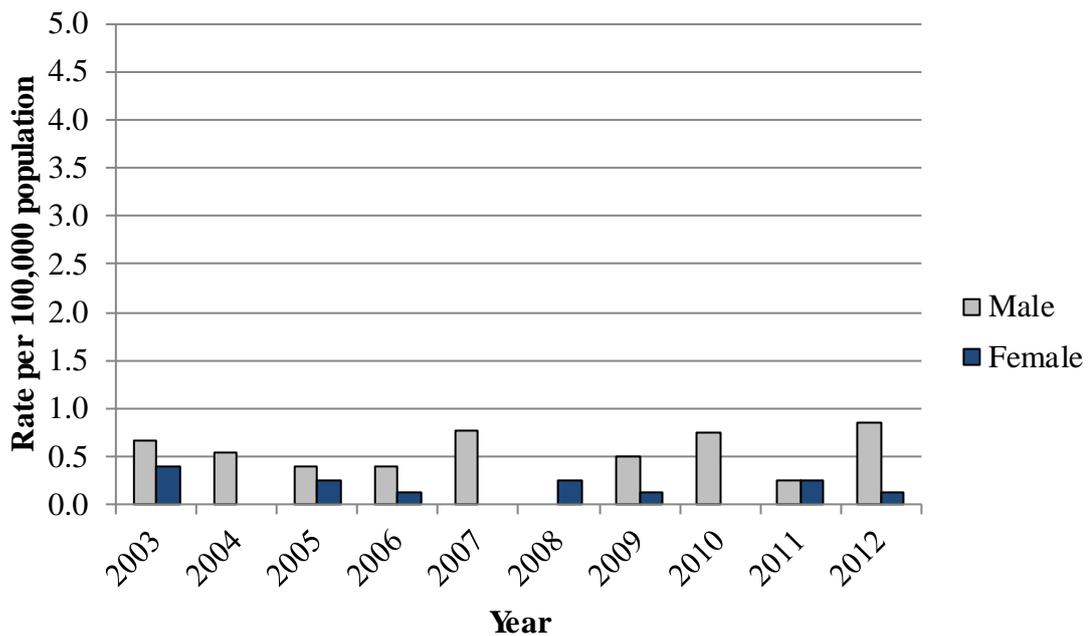


FIGURE 14—Suicide rates by incised and/or stab wounds per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

An impact by a motor vehicle or train accounted for 44 suicides (37 males and 7 females;  $p < 0.001$ ) thus, rates were too low for statistically significant changes to be discerned over time (Fig. 15). The age range for males was 16–80 years (mean = 35.6 years; median = 35.0 years) and 26–63 years (mean = 45.4 years; median = 47.0 years) for females. The majority of cases (23/44; 52.3%) were by train-related trauma, with the remaining 21 deaths involving an impact by a motor vehicle.

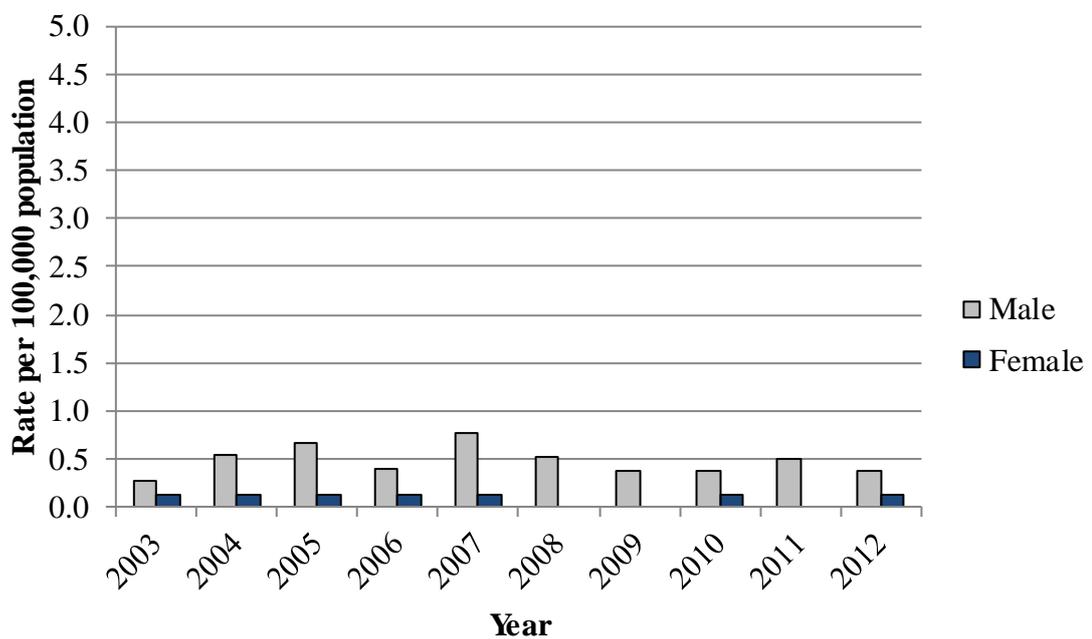


FIGURE 15—Suicide rates by an impact by a motor vehicle or train per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

Deaths due to jumping from a height accounted for 43 cases (34 males and 9 females;  $p < 0.001$ ), with rates not reaching statistical significance (Fig. 16). Males were aged between 17–81 years (mean = 43.1 years; median = 39.0 years) and females were between 26–64 years old (mean = 45.3 years; median = 47.0 years).

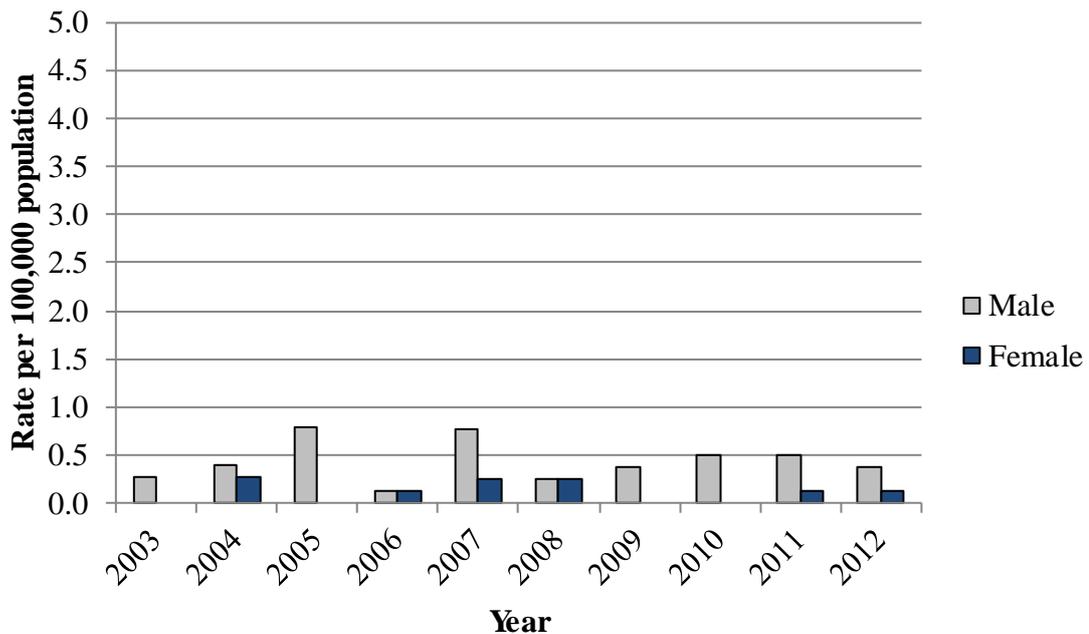


FIGURE 16—Suicide rates by jumping from a height per 100,000 population in males and females in SA registered over a 10-year period (2003 to 2012) at FSSA.

The ‘miscellaneous’ category was represented by 146 victims (100 males and 46 females;  $p < 0.001$ ) who used less common methods of suicide. The age range for males was 17–84 years (mean = 49.3 years; median = 49.5 years) and 18–84 years (mean = 49.0 years; median = 51.0 years) for females. The group consisted of 41 cases of drowning (age range 20–84 years; mean = 54.8 years; median = 54.0 years), 31 motor vehicle collisions (age range 17–81 years; mean = 36.1 years; median = 32.0 years), 30 self-immolations (age range 18–84 years; mean = 48.4 years; median = 47.5 years), 26 poisonings by other noxious substances (including pesticides, hydrogen sulphide,

ethylene glycol, arsenic, cyanide, iron, methanol, phosphine and turpentine) (age range 18–80 years; 52.2 years; median = 52.5 years), eight electrocutions (age range 20–80 years; mean = 54.9 years; median = 55.0 years), five strangulations (age range 37–73 years; mean = 52.2 years; median = 49.0 years), three non-CO gas asphyxias without involving a motor vehicle or a plastic bag (age range 61–64 years; mean = 63.0 years; median = 64.0 years), and two suicides by blunt object trauma (age range 36–80 years; mean = 58.0 years; median = 58.0 years). Thus, the numbers of suicides in each subgroup were too low to determine whether statistically significant trends were present.

The distribution of the preferred methods of suicide by sex and age group is summarised in Table 6.

TABLE 6—*Distribution of the preferred methods of suicide by sex and age group in SA between 2003 and 2012.*

Method of suicide	Age group (years)									
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %	<i>n</i> , %
<b>Male</b>										
Hanging	0, 0.0	54, 69.2	160, 61.1	196, 53.6	171, 50.3	115, 43.9	47, 37.0	37, 41.1	17, 26.2	5, 50.0
Drug overdose	0, 0.0	2, 2.6	18, 6.9	45, 12.3	58, 17.1	42, 16.0	13, 10.2	6, 6.7	6, 9.2	0, 0.0
CO toxicity	0, 0.0	2, 2.6	27, 10.3	51, 13.9	44, 12.9	35, 13.4	12, 9.4	13, 14.4	8, 12.3	1, 10.0
Gunshot wound/s	0, 0.0	5, 6.4	21, 8.0	23, 6.3	20, 5.9	24, 9.2	31, 24.4	20, 22.2	13, 20.0	1, 10.0
Plastic bag asphyxia	0, 0.0	1, 1.3	6, 2.3	8, 2.2	8, 2.4	7, 2.7	5, 3.9	2, 2.2	7, 10.8	2, 20.0
Incised and/or stab wounds	0, 0.0	1, 1.3	3, 1.1	9, 2.5	10, 2.9	7, 2.7	3, 2.4	2, 2.2	4, 6.2	1, 10.0
Impact by a motor vehicle/train	0, 0.0	5, 6.4	12, 4.6	8, 2.2	5, 1.5	5, 1.9	1, 0.8	0, 0.0	1, 1.5	0, 0.0
Jumping from a height	0, 0.0	2, 2.6	8, 3.1	7, 1.9	5, 1.5	5, 1.9	1, 0.8	4, 4.4	2, 3.1	0, 0.0
Misc.	0, 0.0	6, 7.7	7, 2.7	19, 5.2	19, 5.6	22, 8.4	14, 11.0	6, 6.7	7, 10.8	0, 0.0
<b>Total</b>	<b>0, 0.0</b>	<b>78, 100.0</b>	<b>262, 100.0</b>	<b>366, 100.0</b>	<b>340, 100.0</b>	<b>262, 100.0</b>	<b>127, 100.0</b>	<b>90, 100.0</b>	<b>65, 100.0</b>	<b>10, 100.0</b>
<b>Female</b>										
Hanging	1, 100.0	13, 52.0	37, 50.7	33, 35.1	37, 31.1	16, 17.8	5, 8.8	5, 22.7	2, 9.5	1, 33.3
Drug overdose	0, 0.0	4, 16.0	14, 19.2	35, 37.2	54, 45.4	48, 53.3	33, 57.9	6, 27.3	7, 33.3	0, 0.0
CO toxicity	0, 0.0	1, 4.0	7, 9.6	10, 10.6	12, 10.1	8, 8.9	1, 1.8	2, 9.1	2, 9.5	0, 0.0
Gunshot wound/s	0, 0.0	2, 8.0	1, 1.4	0, 0.0	3, 2.5	1, 1.1	0, 0.0	0, 0.0	0, 0.0	0, 0.0
Plastic bag asphyxia	0, 0.0	1, 4.0	3, 4.1	5, 5.3	1, 0.8	3, 3.3	5, 8.8	3, 13.6	7, 33.3	2, 66.7
Incised and/or stab wounds	0, 0.0	0, 0.0	1, 1.4	5, 5.3	1, 0.8	1, 1.1	3, 5.3	1, 4.5	0, 0.0	0, 0.0
Impact by a motor vehicle/train	0, 0.0	0, 0.0	1, 1.4	2, 2.1	1, 0.8	1, 1.1	2, 3.5	0, 0.0	0, 0.0	0, 0.0
Jumping from a height	0, 0.0	0, 0.0	2, 2.7	0, 0.0	3, 2.5	3, 3.3	1, 1.8	0, 0.0	0, 0.0	0, 0.0
Misc.	0, 0.0	4, 16.0	7, 9.6	4, 4.3	7, 5.9	9, 10.0	7, 12.3	5, 22.7	3, 14.3	0, 0.0
<b>Total</b>	<b>1, 100.0</b>	<b>25, 100.0</b>	<b>73, 100.0</b>	<b>94, 100.0</b>	<b>119, 100.0</b>	<b>90, 100.0</b>	<b>57, 100.0</b>	<b>22, 100.0</b>	<b>21, 100.0</b>	<b>3, 100.0</b>

## 2.4 DISCUSSION AND CONCLUSIONS

Suicide accounts for a significant number of medicolegal deaths each year in SA, with great variability in rates between sexes. In the present study, a total of 2,105 suicides registered at FSSA between the years 2003 and 2012 were identified, with annual numbers ranging from 190–227 cases. However, it is apparent that other registers involved in processing information about such deaths, including the NCIS as well as the ABS, collect, record and report suicide data in different ways.

An overall rate of suicide in SA of 13.3 deaths per 100,000 population, based on a careful review of local case information, was greater than that based on reports from the NCIS as well as the ABS databases (12.3 and 12.4 deaths per 100,000 population, respectively). The extent of this under-reporting between registers increased from 2009, with yearly patterns of both nationally accrued male and female suicides, being increasingly less consistent with trends in local data (Fig. 4 and 5). Similarly, another study from Australia (3) reported that differences between a locally gathered dataset in Queensland and ABS rates, has been increasing since 2002. Such disparities between locally identified suicides and externally collated and lesser numbers of cases have also been documented internationally in Spain, of note, where medicolegal autopsies are mandatory in such cases (4). Thus, forensic pathologists have intimate knowledge of case details and can make medically sound determinations of intent, despite, not being legally required to do so.

The overall distributions of reported male suicides according to each register were similar, with statistically significant decreases in the rates of male deaths identified in both locally derived and NCIS data ( $p < 0.05$ ) as well as in that from the ABS ( $p < 0.01$ ). Although local data indicated few obvious annual changes among females,

increasing proportions of female deaths were not noted in NCIS and ABS data over the latest years reported, with the NCIS reporting 90.2% of female suicides in 2006 to only 73.5% of such cases in 2010, and the ABS recording 94.1% of female suicides in 2006 to 81.6% of such cases in 2010.

It should be recognised that comparisons of local data with reports of suicide from national databases may be complicated by changes in systematic reporting of suicides over time. For example, what constituted a reportable death in SA from 2003, changed with the repeal of the *Coroners Act 1975* in 2005. The new act and all revised reporting procedures, may have given rise to more reports of suicide on each register for this year. Unpublished data of the numbers of medicolegal cases registered over time at FSSA supports this, with numbers peaking in 2005 and 2006 (1,518 and 1,526, respectively) and decreasing since, with 2011 being the year with the lowest number of cases registered (1,296 or a decrease of around 15% from earlier numbers of case registrations).

Furthermore, prior to 2006, ABS staff would inspect files at coronial offices in order to extract information on possible suicides, however the ABS now relies on electronic information held on the NCIS ([www.abs.gov.au](http://www.abs.gov.au)). This raises issues associated with coronial office staff now having to code electronic data according to NCIS codesets. Thus, there may also be differences in the approach to reviewing files and subsequent data reports. The yearly differences in local suicide numbers compared to corresponding numbers on national databases indicated in this study, have also been noted elsewhere in Australia (3, 5), being influenced by procedural changes.

Another difficulty with providing information regarding deaths in recent years is that some coronial files may still be pending enquiries at the time of data entry and classification of such cases in the NCIS. Therefore, suicides may be classified as deaths

of ‘undetermined intent’ or intent ‘unlikely to be known’. The ABS can also similarly code such deaths to non-suicide categories according to the ICD-10.

Particular subgroups of cases that may also be differently recorded include suicides among the young, with the greatest difference in age categories between the NCIS and locally derived data being in the numbers of reported cases aged 9–19 years. Also, ABS data of suicides in those under the age of 15 years was not being published at the time of data collection, possibly due to a reluctance to report deaths among those that young, as suicides, and the apparent rarity of such events (6, 7).

Further patterns in suicides in SA that were identified in local data included an increase in female hangings and drug-related deaths across sexes, although only 67.8% of local drug overdoses were recorded on the NCIS versus 98.4% of local hangings being registered (Table 2). Reasons for such disparities between registers may be that drug overdoses and other types of poisoning may have insufficient diagnostic information available at the time of case processing, such as reports on toxicology (8), in addition such deaths are often without external signs of injury. Therefore, despite self-poisonings constituting the majority of reports of attempted suicides (9–12), overdose fatalities may well be recorded as ‘accidental’ (13–16) or attributed to the NCIS category, deaths of ‘undetermined intent’. This lack of diagnostic features also relates to the local increase in helium suicides (Fig. 13) where plastic bags are easily lost and helium is not routinely checked for (17, 18). Thus, the use of less obvious methods of suicide, such as drug overdose among females, may conceal a minority of deaths, particularly those occurring in recent years.

In summary, this study has demonstrated that there are significant differences between local data on suicides in SA and related data accrued nationally, with local comparisons being more likely to reflect actual differences in rates of occurrences of

deaths. There are a number of potential reasons for this, including varying coding practices as well as the limitation of information that is available on individual cases, to national registers, all of which may bias suicide trend estimates. Therefore, given that a local database may provide more reliable data on suicide trends and particular characteristics of victims, the following studies detailed in Chapter 3 were performed to demonstrate the usefulness of community-specific datasets in the analysis of such complex cases.

## 2.5 REFERENCES

1. Byard RW, Austin AE. The role of forensic pathology in suicide. *Forensic Sci Med Pathol.* 2011;7:1–2.
2. Kirkwood BR, Sterne JAC. *Essential medical statistics*, 2<sup>nd</sup> ed. Malden: Blackwell Science Ltd; 2003 p. 242.
3. Williams RF, Doessel DP, Sveticic J, De Leo D. Accuracy of official suicide mortality data in Queensland. *Aust N Z J Psychiatry.* 2010;44:815–22.
4. Giner L, Guija JA. Number of suicides in Spain: differences between data from the Spanish Statistical Office and the Institutes of Legal Medicine. *Rev Psiquiatr Salud Ment.* 2014;7:139–46.
5. De Leo D, Dudley MJ, Aebersold CJ, Mendoza JA, Barnes MA, Harrison JE, Ranson DL. Achieving standardised reporting of suicide in Australia: rationale and program for change. *Med J Aust.* 2010;192:452–6.
6. Austin AE, Byard RW. ‘Suicide in the young’. In: *Encyclopedia of Forensic and Legal Medicine*, 2<sup>nd</sup> ed. Eds. Payne-James J, Byard RW. Elsevier | Academic Press. 2015 (In press).
7. Austin AE, van den Heuvel C, Byard RW. Cluster hanging suicides in the young in South Australia. *J Forensic Sci.* 2011;56:1528–30.
8. Langlois NE, Gilbert JD, Heath KJ, Winskog C, Kostakis C. An audit of the toxicology findings in 555 medico-legal autopsies finds manner of death changed in 5 cases. *Forensic Sci Med Pathol.* 2013;9:44–7.
9. Fairman N, Irwin SA. A retrospective case series of suicide attempts leading to hospice admission. *Palliat Support Care.* 2013;11:273–6.
10. Fedyszyn IE, Harris MG, Robinson J, Edwards J, Paxton SJ. Characteristics of suicide attempts in young people undergoing treatment for first episode psychosis. *Aust N Z J Psychiatry.* 2011;45:838–45.

11. Narishige R, Kawashima Y, Otaka Y, Saito T, Okubo Y1. Gender differences in suicide attempters: a retrospective study of precipitating factors for suicide attempts at a critical emergency unit in Japan. *BMC Psychiatry*. 2014 doi:10.1186/1471-244X-14-144.
12. Walker X, Lee J, Koval L, Kirkwood A, Taylor J, Gibbs J, Ng S, Steele L, Thompson P, Celi LA. Predicting ICU admissions from attempted suicide presentations at an Emergency Department in Central Queensland. *Australas Med J*. 2013;6:536–41.
13. Asnaes S, Paaske F. The significance of medicolegal autopsy in determining mode and cause of death. *Forensic Sci Int*. 1979;14:23–40.
14. Gunnell D, Bennewith O, Simkin S, Cooper J, Klineberg E, Rodway C, Sutton L, Steeg S, Wells C, Hawton K, Kapur N. Time trends in coroners' use of different verdicts for possible suicides and their impact on officially reported incidence of suicide in England: 1990–2005. *Psychol Med*. 2013;43:1415–22.
15. Onyeka IN, Beynon CM, Hannila ML, Tiihonen J, Föhr J, Tuomola P, Kuikanmäki O, Tasa N, Paasolainen M, Kauhanen J. Patterns and 14-year trends in mortality among illicit drug users in Finland: the HUUTI study. *Int J Drug Policy*. 2014;25:1047–53.
16. Ylijoki-Sørensen S, Boldsen JL, Boel LW, Bøggild H, Lalu K, Sajantila A. Autopsy rate in suicide is low among elderly in Denmark compared with Finland. *Forensic Sci Int*. 2014;244:158–65.
17. Austin AE, Winskog C, van den Heuvel C, Byard RW. Recent trends in suicides utilizing helium. *J Forensic Sci*. 2011;56:649–51.
18. Wick R, Gilbert JD, Felgate P, Byard RW. Inhalant deaths in South Australia: a 20-year retrospective autopsy study. *Am J Forensic Med Pathol*. 2007;28:319–22.

# **CHAPTER 3: PUBLICATIONS FROM SPECIFIC FINDINGS IN MEDICOLEGAL CASES**

## **3.1 CONTEXTUAL STATEMENT**

Chapter 3 includes papers from local datasets, submitted as separate manuscripts and published in specific journals. Therefore, in order to account for varying reader knowledge of suicides and other medicolegal deaths, some may have repetitive background and methodological elements. Also, due to the incompleteness of information regarding suicides in earlier years from different reporting requirements at such times and to increase sample cases for statistical purposes, individual studies required different approaches with slightly varied methodologies. Ensuing results are detailed in the following papers.

**i. ORIGINAL PAPERS**

**3.2** *Causes of community suicides among indigenous  
South Australians*

Published in *Journal of Forensic and Legal Medicine*. Editor: Dr. Jason Payne-James.

**Austin AE**, van den Heuvel C, Byard RW. Causes of community suicides among indigenous South Australians. *J Forensic Leg Med*. 2011;18:299–301.

### 3.2.1 AUTHOR CONTRIBUTIONS

The following people have contributed to authorship of this paper (in alphabetical order): Amy E. Austin, Roger W. Byard and Corinna van den Heuvel.

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Documentation of the work	Austin AE, Byard RW and van den Heuvel C

(Principal Author)

Contribution to this paper (%)	80.0%
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I give my consent for this paper, in which I am co-author, to be included in this thesis and the sum of all co-author contributions is equal to 100.0% less the candidate's stated contribution:

Austin, A.E., van den Heuvel, C. & Byard, R.W. (2011). Causes of community suicides among indigenous South Australians.

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NOTE:

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<http://dx.doi.org/10.1016/j.jflm.2011.06.002>

### 3.3 *Physician suicide*

Published in *Journal of Forensic Sciences*. Editor: Dr. Michael Peat.

**Austin AE**, van den Heuvel C, Byard RW. Physician suicide. *J Forensic Sci.* 2013;58  
Suppl 1:S91–3.

### 3.3.1 AUTHOR CONTRIBUTIONS

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Contribution to this paper (%)	80.0%
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### 3.4 *Suicide and fatal single occupant motor vehicle collisions*

Published in *Australian Journal of Forensic Sciences*. Editor: Prof. James Robertson.

**Austin AE**, van den Heuvel C, Byard RW. Suicide and fatal single occupant motor vehicle collisions. *Aust J Forensic Sci.* 2013;45:43–8.

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Contribution to this paper (%)	80.0%
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Austin, A.E., van den Heuvel, C. & Byard, R.W. (2013). Suicide and fatal single occupant motor vehicle collisions.

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<http://dx.doi.org/10.1080/00450618.2012.706318>

### 3.5 *Prison suicides in South Australia: 1996–2010*

Published in *Journal of Forensic Sciences*. Editor: Dr. Michael Peat.

**Austin AE**, van den Heuvel C, Byard RW. Prison suicides in South Australia: 1996–2010. *J Forensic Sci.* 2014;59:1260–2.

### 3.5.1 AUTHOR CONTRIBUTIONS

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Documentation of the work	Austin AE, Byard RW and van den Heuvel C

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Contribution to this paper (%)	80.0%
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I give my consent for this paper, in which I am co-author, to be included in this thesis and the sum of all co-author contributions is equal to 100.0% less the candidate's stated contribution:

Austin, A.E., van den Heuvel, C. & Byard, R.W. (2014). Prison suicides in South Australia: 1996–2010.

*Journal of Forensic Sciences*, v. 59 (5), pp. 1260-1262

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### 3.6 *Body mass index and suicide*

Published in *The American Journal of Forensic Medicine and Pathology*. Editor: Dr. Vincent DiMaio.

**Austin AE**, van den Heuvel C, Byard RW. Body mass index and suicide. *Am J Forensic Med Pathol*. 2014;35:145–7.

### 3.6.1 AUTHOR CONTRIBUTIONS

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Contribution to this paper (%)	80.0%
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I give my consent for this paper, in which I am co-author, to be included in this thesis and the sum of all co-author contributions is equal to 100.0% less the candidate's stated contribution:

Austin, A.E., van den Heuvel, C. & Byard, R.W. (2014). Body mass index and suicide.

*American Journal of Forensic Medicine and Pathology*, v. 35 (2), pp. 145-147

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## ii. CASE REPORTS

### 3.7 *Recent firing range suicides in South Australia*

Published in *Journal of Forensic Sciences*. Editor: Dr. Michael Peat.

**Austin AE**, van den Heuvel C, Heath KJ, Gilbert JD, Byard RW. Recent firing range suicides in South Australia. *J Forensic Sci.* 2012;57:1495–6.

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Austin, A.E., van den Heuvel, C., Heath, K.J., Gilbert, J.D. & Byard, R.W. (2012).  
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### 3.8 *Head impalement – an unusual form of suicide*

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**Austin AE**, Heath KJ, Gilbert JD, Byard RW. Head impalement – an unusual form of suicide. *J Forensic Leg Med*. 2012;19:264–6.

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Contribution to this paper (%)	80.0%
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I give my consent for this paper, in which I am co-author, to be included in this thesis and the sum of all co-author contributions is equal to 100.0% less the candidate's stated contribution:



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### 3.9 *Multiple injuries in suicide simulating homicide: report of three cases*

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### 3.10 *Skin messages in suicide – an unusual occurrence*

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Contribution to this paper (%)	80.0%
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I give my consent for this paper, in which I am co-author, to be included in this thesis and my contribution is equal to 100.0% less the candidate's stated contribution:

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## **CHAPTER 4: GENERAL CONCLUSIONS**

South Australia has seen changes in the sex-, age- and method-specific patterns of suicide over recent years, including a general decline in male suicides since 2003, particularly in rates of hangings since 2005. However, reverse patterns of hanging deaths were also apparent among particular groups of victims, including significant increases in female rates since 2006, and an increase in overall hanging suicides in the young since 1995. There have also been changes in suicides by poisoning, with rates of drug overdose significantly increasing in both sexes, with a concurrent reduction in deaths by CO inhalation.

The current study has identified and analysed such changes and has compared data accrued locally at FSSA with South Australian data compiled on two large national databases, the NCIS and the ABS.

### **Summary of findings:**

1. Significant differences have been identified in the numbers of suicides registered on local compared to national databases. The reasons for this are outlined in Chapter 2.
2. Given that a local database may provide more reliable and complete data on suicide trends and particular characteristics of victims, the following studies detailed in Chapter 3 were performed to demonstrate the usefulness of analyses based on community-specific datasets that may (despite relatively low numbers of cases):
  - i. provide significant and verifiable local data, and,

- ii. initiate studies into national and international data of potential new population suicide trends.
3. *Causes of community suicides among indigenous South Australians*—This study demonstrated that the method of suicide overwhelmingly preferred by indigenous victims in SA was hanging. Elderly victims were not encountered. The precise reasons for this preference were uncertain, however, if a case of an indigenous person in SA presenting as a suicide involves a means other than hanging, particularly if an elderly decedent, the possibility of alternative manners of death should be considered.
4. *Physician suicide*—A study of physician suicides in SA revealed a history of prescription drug abuse and a majority of cases from lethal drug self-administration. Such means of self-destruction contrasted with the general population where hanging, CO toxicity and gunshot wounds, were more common. Availability and knowledge of lethal effects have been shown to be important determinants in the choice of methods of suicide. Access to drugs should therefore, be carefully monitored in physicians with histories of depression and/or substance abuse.
5. *Suicide and fatal single occupant motor vehicle collisions*—Although it has been suggested that fatal single occupant, single motor vehicle collisions involving impacts with trees are likely to be suicides, this was not demonstrated in this study. A lack of seasonal similarity in the occurrence of fatal collisions and suicides, and differences in the most common ages, were instead supportive of these groups being aetiologically different. Other examined factors in favor of these crashes not being

intentional included intoxication and winter conditions. While the possibility of impulsive suicidal acts often cannot be excluded in fatal single motor vehicle collisions, the different demographic profile and seasonal differences in this study when compared to cases of known suicide would be in keeping with only a small number of these vehicle-related deaths being deliberate.

6. *Prison suicides in South Australia: 1996–2010*—The majority of suicides in prisons in SA were due to hanging (92.0%) with victims using bedding, belts or shoelaces attached to cell shelves, air vents, doors or other accessible projections. There were no suicides attributed to drug overdose or sharp force injury. Over a third of all suicides occurred during the first month of confinement, with such deaths often within the first week. Given that suicide in state prisons currently occurs at a rate approximately eight times that of the general South Australian community, it appears that the subset of incarcerated individuals represents a group in need of effective preventive strategies.
7. *Body mass index and suicide*—Although it has been suggested that there is a connection between depression and an increased BMI, this study did not demonstrate an association between suicide and high BMIs, but instead found that BMIs in hanging victims were significantly reduced. The reasons for this novel finding warrant further investigation.
8. *Recent firing range suicides in South Australia*—This report indicated that firing ranges may be utilized by individuals who are seeking weapons for suicide attempts, and suicide may be successfully undertaken at such locations, even while a victim is

under direct supervision. In jurisdictions where firearm ownership is strictly legislated, it may be that clubs can inadvertently provide access to firearms for this type of activity.

9. *Head impalement – an unusual form of suicide*—A case involving a very complex suicide apparatus indicated a considerable degree of premeditation. The finding of a complex apparatus at a death scene may, therefore, provide useful information in ascertaining the manner of death and also give some indication as to a decedent's level of determination to succeed.
  
10. *Multiple injuries in suicide simulating homicide: report of three cases*—Multiple inflicted injuries in traumatic deaths usually indicate homicide but can occur in suicide, as demonstrated in this study. Although multiple self-inflicted wounds are most often caused by sharp objects such as knives, on occasion, multiple gunshot wounds and rarely, blunt trauma may also be encountered. Careful integration of scene and autopsy findings may therefore, be required to avoid misinterpretation of the circumstances and manner of deaths.
  
11. *Skin messages in suicide – an unusual occurrence*—Suicide notes are found in only a minority of deaths, and rarely may involve writing messages on skin surfaces, as shown in this study. It is not clear whether writing on skin rather than in more conventional material suggests that the suicide may not have been planned, or instead that the decedent wanted to ensure that a message was found. Notes on skin may be slightly different to messages written on other surfaces, as space is limited and pens and markers may not write as effectively. An additional problem with skin

messages is their vulnerability to erasure, making clear documentation of these findings at the scene, important.

## **FUTURE DIRECTIONS**

- Further analysis of the reasons for disparities between local and national datasets is required. This should focus on developing methods for capturing and verifying local data, so that information can be entered into larger databases in a more uniform and reliable manner.
- Individual studies reported above, should be compared with data from other forensic centres so that the reasons for the identified features and trends can be further explored.
- Suicide prevention campaigns should be provided with local data to enable more specific regional as well as cultural initiatives, to be developed.

## APPENDIX

TABLE 1—*Case details of prisoner deaths in SA over a 15-year period (January 1996–December 2010).*

<b>Manner of death</b>	<b><i>n</i>, %</b>
<b>Unnatural</b>	<b>31, 64.6</b>
Suicide	25, 100.0
Hanging	23, 92.0
Jumping from a height	2, 8.0
Non-suicide	23, 100.0
‘Accident’	6, 26.1
<b>Natural</b>	<b>17, 35.4</b>
Cardiovascular disease	8, 34.8
Malignant neoplasm	4, 17.4
Miscellaneous	5, 21.7
<b>Total</b>	<b>48, 100.0</b>