Access to firearms and the risk of suicide: a case control study

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Objective: This study examined the association between access to a firearm and risk of suicide in a consecutive sample of individuals who had made serious suicide attempts.

Method: The study used a case control design in which a sample of 197 individuals who died by suicide and 302 individuals who made medically serious suicide attempts was contrasted with 1028 randomly selected community control subjects.

Results: Suicide attempts by gunshot accounted for 1.3% of all serious suicide attempts (with non-fatal outcome) and 13.3% of suicides. However, among those making serious suicide attempts, gunshot had a high rate of fatality (83.3%). While access to a firearm was associated with increased risks that gunshot would be chosen as the method of suicide attempt (OR = 107.9; CI = 24.8–469.5), this access was not associated with significant increases in the risk of suicide (OR = 1.4; CI = 0.96–1.99).

Conclusions: For this sample, access to a firearm was not associated with a significant increase in the risk of suicide, although such access was associated with an increased probability that gunshot would be chosen as the method of suicide attempt.

A number of recent studies have reported increased rates of suicide among young males aged 15–24 years and suggested that a significant proportion of these deaths might be attributable to increased availability of firearms [1–5]. These conclusions have been supported by the literature [1,2,5–9], predominantly from the United States, which has suggested that access to firearms is a significant risk factor for youth and older suicide in the United States. For example, Brent et al. [1] examined the relationship between access to firearms and rates of suicide in a sample of adolescents who died by suicide and in non-suicidal psychiatric control subjects. Even when due allowance was made for confounding factors, adolescents who had access to firearms had odds of suicide which were twice the odds of those without such access.

The trends emerging from the United States literature on firearm access and youth suicide have recently been applied to the analysis of firearm deaths by suicide in New Zealand. In a review of firearm deaths in New Zealand for the 10-year period from 1978 to 1987, Norton and Langley [10] concluded that limiting access to firearms in New Zealand could, on the basis of United States data, potentially prevent up to 18 suicides per year among those aged 15–24 years.

There are, however, a number of factors which

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suggest that generalisations of United States studies to a New Zealand context should be made cautiously. Specifically, United States estimates suggest a far higher rate of gun ownership in the United States [1,6,9] than in New Zealand, and far more frequent use of firearms as a means of suicide [1,6,9,11]. Information from the Centers for Disease Control [12] suggests that approximately 60% of United States suicide deaths are by gunshot. In contrast, firearms accounted for 18.3% of suicide deaths in New Zealand in 1992 [13]. In addition, there are marked differences in the type of firearms owned in the United States and in New Zealand, with the majority of United States firearms being handguns while the majority of New Zealand guns (in excess of 97%) are long-barrelled rifles [Coote J: personal communication]. Access to handguns is also severely restricted in New Zealand by legislation [Arms Act, 1983; Arms Amendment Act, 1992; Arms Regulations, 1992]. For these reasons, estimates of the impact of restrictions on firearm ownership and access (based on United States data) on suicide reduction in New Zealand may provide a fallible guide.

To address this issue, this paper reports analyses of the relationship between access to firearms and risks of suicide using data collected during a large case control study of suicidal behaviour. There were three specific aims of these analyses: (i) to examine the extent to which suicide attempts involving firearms were fatal; (ii) to examine the extent to which access to firearms influenced the choice of method used for serious suicide attempts; and (iii) to examine the extent to which access to firearms was associated with increased risk of suicide.

Method

Selection of cases and control subjects

The Canterbury Suicide Project was a case control study of suicidal behaviour in which the following three groups were compared:

Suicides

The group of suicides comprised a consecutive series of 197 individuals who died during the period from 1 July 1991 to 31 May 1995 in the Canterbury region, for whom there had been coroners' verdicts

of suicide. Christchurch (population 315 000) is the central city of the Canterbury region which is a mixed urban/rural area with a regional population (including Christchurch city) of 430 000.

A total of 210 individuals died by suicide during the study period and the families of 197 of these agreed to participate in the study, giving a response rate of 93.8%.

Medically serious suicide attempts

This series included 302 individuals who made suicide attempts during the period from 1 September 1991 to 31 May 1994 in the Canterbury region. Medically serious suicide attempts were defined as those which required hospital admission for longer than 24 hours and which met one of the following treatment criteria:

(1) Treatment in specialised units, including the Intensive Care Unit (for drug overdose suicide attempts), the Hyperbaric Unit (for carbon monoxide poisoning attempts) or the Burns Unit.

(2) Surgery under general anaesthesia, for example, for tendon repair or stabbing injuries. (Superficial cuts which did not require surgical repair were excluded.)

(3) Medical treatment beyond gastric lavage, activated charcoal or routine neurological observations. More specifically, patients were included in the study if they required treatments such as antidotes for drug overdoses, telemetry or repeated tests or investigations.

In addition, individuals who made suicide attempts with a high risk of fatality, such as hanging or gunshot, and who were admitted for more than 24 hours but did not meet the above treatment criteria, were also included in the sample of serious suicide attempts.

In Canterbury there is a sole entry point for emergency hospital treatment via the Emergency Department at Christchurch Hospital. Cases were identified by daily calls to the Emergency Department, the Psychiatric Emergency Service and relevant admitting wards. Independent checks with all three locations provided a daily triple check to ensure identification of eligible cases. Individuals who met criteria for inclusion in the study were interviewed in hospital when medical and psychiatric staff considered it appropriate for them to be seen, usually immediately prior to discharge.

Case identification sought individuals who made serious suicide attempts rather than incidents of serious suicide attempt. Therefore, individuals who, during the study period, made more than one suicide attempt which met criteria for inclusion in the study were interviewed for the initial attempt only.

In total, of the 317 individuals who made serious suicide attempts during the study period 302 participated in the study, giving a response rate of 95.3%. Thirteen people (4.1%) refused involvement and two (0.6%) were not interviewed because of language difficulties.

Control subjects

Control subjects were selected from electoral rolls for the Canterbury region. An age and gender stratified sample was obtained in which the sample was sorted by gender into six age strata (18–24 years; 25–29 years; 30–39 years; 40–49 years; 50–59 years; and 60 years and older) with the number of subjects in each age by gender stratum being selected at a rate proportional to the known age by gender distribution of the population aged 18 years and over. In total, 1200 subjects were sel? ᵗᵒᵈ for the control sample and 1028 of these participated in the study. Ninety-three (7.8%) refused involvement, 57 (4.8%) could not be traced and 22 (1.8%) were unable to adequately complete the interview because of intellectual limitations, illness or language problems. The estimated response rate for control subjects was, therefore, 85.7%.

Official estimates from the national Electoral Roll Office suggested 95.5% of the eligible population were enrolled on Canterbury electoral rolls during the data collection period of the study.

Subjects selected from electoral rolls were mailed a letter of introduction explaining the study. The study interviewer then called at their homes, discussed the study and arranged to return to each subject's home to conduct an interview at a convenient time.

The study was approved by the Ethics Committees of the Canterbury Area Health Board and the Southern Regional Health Authority. Written informed consent was obtained from all study participants after the aims and procedures of the study had been fully explained. For children aged under 16 years, both the assent of the child and written informed consent of a parent or guardian was obtained.

Sample size

Sample sizes were determined by two considerations: (i) the availability of cases and controls; and (ii) power calculations. Power calculations showed that for comparisons between 500 cases and 1000 control subjects, the study had 80% power (with $\alpha = 0.05$) to detect an odds ratio (OR) of 1.8 for risk factors with a 5% base rate of exposure in the population, and of 1.36 for risk factors with a 50% base rate of exposure.

Data analysis and statistical procedures

The bivariate associations between risk factors and odds of suicide attempt are described by odds ratios, 95% confidence intervals and corresponding tests of significance. These methods are extended to the multivariate case by fitting multiple logistic regression models to secure estimates of adjusted odds ratios and to conduct appropriate tests of significance.

Data collection and analysis

A semi-structured interview was conducted personally, with each control subject and with each individual who made a serious suicide attempt, by trained, experienced interviewers to retrospectively construct a life history and to obtain information about potential risk factors for suicide attempts. Fieldwork was closely monitored, with each interviewer meeting weekly with the supervisor for debriefing, checking and editing of each interview. For each person in the study (suicides, serious suicide attempts and control subjects), a parallel interview was conducted with a 'significant other', usually a family member or someone who knew the subject well.

From the data base of the study, the following measures were derived for each sample group:

Access to firearms

For both cases and control subjects, information on access to firearms was obtained from the interview conducted with the significant other. Each informant was asked whether the subject had access to a firearm in the household or home environment in which they lived. As self-report data were not available for the suicide group, significant other data were used for this analysis to ensure uniformity of assessment across all three subject groups.

Method of suicide

Using coroners' reports, the principal method of suicide for those who died by suicide was defined as the method which made the major contribution to fatality. For those who made serious suicide attempts, the principal method of suicide attempt was identified, on the basis of self-report, significant-other report and medical record data, as the method which resulted in illness or injury for which hospital admission and treatment was necessary.

Demographic variables

Demographic data (age, gender and ethnicity) were ascertained by self-report for those who made serious suicide attempts and control subjects, and from coroners' records and significant-other data, for the series of suicides. Of those 499 individuals who made suicide attempts (including 302 who made non-fatal suicide attempts and 197 who died), 88.4% were European (Pakeha), 3.6% were Maori, 5.6% were part Maori/part European, 0.6% were Pacific Islanders and 1.8% were of other cultural identifications. Of the control subjects, 91.3% were European, 2.9% were Maori, 3.6% were part Maori/part European, 0.2% were Pacific Islanders and 2.0% were of other cultural identifications. There were no significant differences between ethnicity and suicide attempt rate (χ^2=6.5; df=7; p>0.40).

Psychiatric morbidity

The interview conducted with subjects and significant other informants included a diagnostic section modified from the SCID interview schedule [14] to generate DSM-III-R diagnoses [15] of selected mental disorders. Information gathered from both subject and significant other interviews was integrated in a diagnostic conference, which always included the principal investigator (AB) and at least one psychiatrist (PJ or RM), to produce, for each subject, best estimate diagnoses of mental disorders (according to DSM-III-R criteria) for the month prior to the subject having made a serious suicide attempt. For conduct disorder and antisocial personality disorder, a lifetime history was obtained. The test–retest reliability of the best estimate diagnostic procedure was ascertained by re-evaluation of a random sample of 20% of all subjects (cases and controls). The

test–retest agreement was high, with Kappa coefficients [16] for the principal diagnostic categories (affective disorders, substance use disorders, anxiety disorders, eating disorders, non-affective psychosis, antisocial disorders) ranging from 0.95 to 0.99.

A subject was classified as having a mental disorder in the month prior to the suicide attempt if he/she met criteria for at least one of the six diagnostic categories (any affective disorder, any substance use disorder, any anxiety disorder, any eating disorder, any non-affective psychosis, any antisocial disorder).

To estimate the prevalence and lethality of various methods of suicide, analysis was restricted to the 150 cases of completed suicide and the 302 cases of medically serious suicide attempts which occurred during the same time period (1 September 1991 to 31 May 1994). For all other case control analyses, all subjects (302 serious suicide attempts, 197 completed suicides) were included.

Results

The prevalence and lethality of different methods of suicide

Table 1 categorises the group of 302 individuals who made medically serious but nonfatal suicide attempts and 150 individuals who made fatal suicide attempts during the same time period, classified by the principal method used for the suicide attempt. The table indicates the following:

(1) Among those making serious suicide attempts, the rate of fatality varied with the method used. Gunshot and hanging were the most lethal methods, with rates of fatality of 83.3% and 82.4%, respectively. Two-thirds (66.7%) of serious attempts by carbon monoxide poisoning resulted in fatality. In contrast, attempts by overdose or poisoning had a low risk of death, with rates of fatality of 7.9%. The miscellaneous group of methods, including cutting or stabbing, electrocution, drowning, jumping from a height and other uncommon methods, had an overall rate of fatality of 29.3%.

(2) Of the 452 individuals who made either fatal or non-fatal serious suicide attempts, 24 used gunshot and of these attempts 83.3% (20/24) were fatal. Two-thirds (66.7%) of subjects who made serious suicide attempts by gunshot were aged 25 years or older and a clear majority, 91.7% (22/24), were male.

Table 1. Fatality rate by method for individuals who made serious suicide attempts (including fatal and nonfatal outcomes)

Method	Suicide		Serious suicide attempts		Total % fatal
	n	%	n	%	%
Gunshot	20	13.3	4	1.3	83.3
Hanging	42	28.0	9	3.0	82.4
Carbon monoxide poisoning	56	37.3	28	9.3	66.7
Overdose/poisoning	20	13.3	232	76.8	7.9
Other methods	12	8.0	29	9.6	29.3
Total	150	100	302	100	42.6

Table 2. Access to firearms and choice of method for individuals who made serious suicide attempts (including fatal and nonfatal outcomes; n)

		Method		
		Gun-shot	Not gun-shot	Total
Access to firearm	Yes	22	43	65
	No	2	385	387
		24	428	452

OR = 107.9; CI = 24.8–469.5; χ^2 = 136.7; df = 1; p < 0.0001

(3) Overall, attempts by gunshot accounted for 1.3% of all serious suicide attempts with a non-fatal outcome and for 13.3% of suicide deaths. These results suggest that, while gunshot was a highly lethal method of suicide attempt, it was chosen relatively infrequently.

The relationship between access to firearms and choice of method of suicide

For the sample of 197 individuals who died by suicide and the 302 individuals who made serious suicide attempts, Table 2 shows the relationship between having access to a firearm and the choice of method of suicide attempt, classified as gunshot/not gunshot. Of those having access to a firearm, one-third (22/65) chose gunshot as the method of suicide attempt. In contrast, only two of the 387 individuals who did not have access to a firearm in the home chose gunshot as the method of suicide attempt. Clearly, there was a highly significant relationship between access to a firearm and choice of gunshot as the method of suicide attempt (OR=107.9; CI = 24.8–469.5; χ^2=136.7; df=1; p<0.0001).

The relationship between access to firearms and risk of suicide

The results in Table 2 indicate that, among those who made serious suicide attempts, access to a firearm increased the risk that gunshot would be chosen as the method of suicide attempt. This result, however, does not imply that access to a firearm

increases risks of suicide since those who do not have access to a firearm may substitute other perhaps equally lethal methods, such as hanging. The extent to which access to a firearm was associated with increased risk of suicide is examined in Table 3, which compares the proportion of the series of 1028 control subjects who reported having access to a firearm with the number of suicide victims who were reported to have lived in an environment with access to firearms. The table shows that the level of access to firearms by those who died by suicide and by the control sample was, in fact, quite similar: 23.9% (47/197) of those who died by suicide had access to firearms compared with 18.5% (190/1028) of control subjects who lived in households with such access. The odds ratio relating access to a firearm and risk of suicide was 1.4 (CI = 0.96–1.99) and was statistical-

Table 3. Access to firearms and risk of suicide for individuals who died by suicide and for control subjects (n)

		Suicide	Control subjects
Access to firearm	Yes	47	190
	No	150	838
		197	1028

OR = 1.4; CI = 0.96–1.99; χ^2 = 3.1; p >0.05

ly non-significant (χ^2=3.1; df=1; p>0.05). These results suggest that while access to a firearm was associated with an increased risk that gunshot would be chosen as the method of suicide (Table 2), this access was not associated with significant increases in the risk of suicide (Table 3).

While the results in Table 3 show that, for the total population (males and females) access to a firearm was not related to increased risk of suicide, this analysis could have been misleading for two reasons:

(1) With two exceptions, suicide attempts involving gunshot were confined to males, and males were over-represented among suicides (81.3%).

(2) It could be suggested that access to firearms could be related to psychiatric morbidity, with those with psychiatric disorders more likely to have access to firearms.

To address these issues, the analysis in Table 3 was extended to examine the relationship between access to a firearm and risk of suicide, for the sample of males only, and taking account of psychiatric morbidity in the month prior to the suicide attempt. Access to a firearm was entered into a logistic regression analysis with age and with current psychiatric disorder factors (any affective disorder, any substance use disorder, any anxiety disorder, any antisocial disorder, non-affective psychosis).

The results of this analysis are shown in Table 4 and suggest that, for the sample of males only, access to a firearm reduced the odds of suicide to 0.93 (CI = 0.6–1.44; χ^2=0.1; df=1; p>0.50) before adjustment for age. After adjustment for age and for the presence of psychiatric disorder, the odds of suicide were 1.00 (CI = 0.74–1.34; χ^2=0.0; df=1; p>0.90).

Table 4. Unadjusted and age adjusted odds ratios between risk of suicide and access to firearms for male individuals who died by suicide and for male control subjects

	Odds ratios	95% CI	χ^2	p
Unadjusted	0.93	0.60–1.44	0.10	>0.50
Adjusted*	1.00	0.74–1.34	0.00	>0.90

*Adjusted for age, psychiatric disorder within the month prior to the suicide attempt including any affective disorder, any substance use disorder, any anxiety disorder, any antisocial disorder, non-affective psychosis.

These results suggest that access to firearms was not associated with a detectable increase in the risk of suicide for the sample of males only when the odds ratio was adjusted for the effects of age and the presence of psychiatric disorder.

Discussion

Prevalence and lethality of suicide attempts by gunshot

This paper has examined the results of a case control study of access to firearms and risk of suicide. The results of the study suggest, first, that gunshot was a method of suicide attempt which was used relatively infrequently by individuals who made serious suicide attempts. Of the total of 452 serious suicide attempts (including 150 suicides) only 24 (5.3%) involved gunshot. It should be noted that this figure is likely to overestimate the true rate with which firearms are used in suicide attempts since this study was confined to serious suicide attempts which resulted in hospital admission and/or death. Despite the fact that gunshot was used infrequently, this method had a high rate of fatality. Among those making serious suicide attempts, 83.3% of attempts involving gunshot were fatal. This fatality rate was equalled only by attempts involving hanging.

Access to firearms and choice of method of suicide attempt

Second, the results indicate that having access to a firearm acted as a relatively strong determinant of the method chosen for serious suicide attempt. Of those having access to a firearm, one-third made serious suicide attempts using gunshot, whereas of those not having access to a firearm in the home environment, only two chose this method. These results are generally consistent with findings from studies in the United States, Canada and Australia which have suggested that choice of gunshot as the method of suicide attempt varies with the availability of firearms [1–7].

Access to firearms and risk of suicide

The results show, however, that access to a firearm was not a significant risk factor for suicide. The odds ratio between access to firearms and suicide risk was 1.4 for the total sample (males and females) and for

the sample of males only the odds ratio reduced to 1.00 after adjustment for age and the presence of psychiatric morbidity. In neither case were these odds ratios significantly different from 1. These results are not consistent with the findings from North American studies which have identified access to firearms as a significant risk factor for suicide [1,2,6]. Kellerman et al. [6], for example, using a case control design involving 360 matched pairs, suggested that access to a firearm was associated with a 4.8-fold increase in the odds of suicide, and Brent et al. [1], in a case control study of 47 adolescent suicides, found a somewhat lower odds ratio of 2.1 between access to a firearm and suicide. The discrepancy in the role of firearms as a risk factor for suicide between the present study and United States studies is probably explained by the following:

(1) Access to firearms is much more readily available in the United States than in New Zealand. The reports of Kellerman et al. [6] and Brent et al. [1] suggest that 37% to 41% of control subjects had access to a firearm in the home, and national estimates of United States household gun ownership suggest that 48.0% have guns [8]. In New Zealand, less than half this number (18.5%) of control subjects in our study had such access.

(2) Suicide attempts by gunshot are far more common in the United States than in New Zealand or Australia. While the studies of Brent et al. [1] and Kellerman et al. [6] suggest that between 47% and 72% of suicides in their studies were by gunshot, only 13.3% of suicides in our study were by gunshot, and in Australia in 1989, 25% of male suicides and 7% of female suicides were by gunshot [17].

The net effect of both the lower rate of access to firearms in New Zealand and the lower frequency with which gunshot was used as the method of suicide attempt, is to reduce the odds ratio between access to firearms and risk of suicide for the present sample compared with the United States samples.

Access, lethality and suicide risk

At first sight, the finding that exposure to firearms was not associated with a detectable increase in suicide risk would appear to be inconsistent with the following observations: (i) access to firearms was associated with an increased risk that gunshot would be chosen as the method of suicide attempt; and (ii) serious suicide attempts by gunshot have high mortality.

From (i) and (ii) above, it would be expected that access to firearms would be associated with a detectable increase in the risk of suicide. The results of this study do not support such an association, and the apparently paradoxical nature of this finding may be explained as follows. Access to firearms, suicide attempt by gunshot, and death are linked by a causal chain model in which access to firearms increases the risk that suicide attempts will be made by gunshot, and gunshot attempts are associated with an increased risk of mortality.

A feature of such causal chain models is that even when there are strong linkages between adjacent parts of the chain, the linkage between the start of the chain (access to firearms) and the endpoint (death by suicide) may be relatively weak. In the present study, the relatively strong relationship between access to firearms and choice of gunshot, and the relatively strong association between gunshot and mortality, produce a situation in which the net effects of these two associations lead to a relatively weak linkage between access to firearms and suicide risk.

Firearm restrictions and reductions in suicide deaths

Collectively, these findings provide only limited and qualified support for suggestions that more restrictive firearm controls might lead to a reduction in suicide deaths in New Zealand. In support of such claims, our findings do suggest that access to firearms is associated with an increased risk that gunshot will be chosen as the method of suicide, and gunshot is a method of suicide attempt which has high mortality.

However, the impact of these associations on the prevention of suicide, at least in New Zealand, may be minor. The use of United States data to derive estimates of the potential reduction in suicides in New Zealand if firearm restrictions were to be instituted appears to lead to overestimations of the impact of restricting firearm access on New Zealand suicide rates, since estimates of the relationship between access to firearms and risk of suicide are considerably higher for United States studies than for local data.

Further, while limiting access to firearms may reduce the frequency with which gunshot is chosen as the method of suicide, the impact of such measures on the suicide rate may be minimal. It is our impression that in cases where individuals are deter-

mined to die, restricting access to firearms will not necessarily deter them, since they may substitute other (potentially equally lethal) methods such as hanging, for example, to which access could not reasonably be restricted. The extent to which limiting access to a particular method of suicide achieves a significant and permanent reduction in the rate of suicide has been examined in a number of studies [5,7,17–22] and appears equivocal. Such studies suggest that only very modest reductions in the overall rate of suicide may be achieved by restricting access to one particular method of suicide, since those who attempt suicide may substitute other methods. An illustration of this is provided by Burvill [18], for example, who suggested that the detoxification of domestic gas in Australia resulted in a reduction in the number of suicides by domestic gas. However, this reduction was offset by increased use of carbon monoxide poisoning using motor vehicle exhaust.

Nonetheless, we are generally supportive of proposals to restrict access to firearms or, at least, to maintain access to the present comparatively low level which exists in New Zealand. While it is open to debate whether further regulation and control of firearm access would lead to a reduction in the number of suicides by gunshot, it is our belief that such limitations may prevent a small number of impulsive suicide attempts made in situations of extreme anger or distress. In such situations, limiting ready access to firearms in the home may prevent impulsive acts for which, in comparison with premeditated suicides, the substitution of another method may not necessarily occur.

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