The Association between the Purchase of a Handgun and Homicide or Suicide

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ABSTRACT

Objectives. The purpose of this study was to determine whether purchase of a handgun from a licensed dealer is associated with the risk of homicide or suicide and whether any association varies in relation to time since purchase.

Methods. A case–control study was done among the members of a large health maintenance organization. Case subjects were the 353 suicide victims and 117 homicide victims among the members from 1980 through 1992. Five control subjects were matched to each case subject on age, sex, and zip code of residence. Handgun purchase information was obtained from the Department of Licensing.

Results. The adjusted relative risk for suicide was 1.9 (95% confidence interval [CI] = 1.4, 2.5) for persons with a history of family handgun purchase from a registered dealer. The adjusted relative risk for homicide, given a history of family handgun purchase, was 2.2 (95% CI = 1.3, 3.7). For both suicide and homicide, the elevated relative risks persisted for more than 5 years after the purchase.

Conclusions. Legal purchase of a handgun appears to be associated with a long-lasting increased risk of violent death. (*Am J Public Health.* 1997;87:974–978)

Introduction

In the United States in 1994 there were 31 142 suicides and 24 926 homicides with respective age-adjusted mortality rates of 12.0 and 9.6 per 100 000; firearms were used in 60% of suicides and 72% of homicides.[1] Guns are thought to be present in 49% of US households,[2] and 33% of gun owners report that protection is the primary reason for ownership.[3] Firearms can sometimes provide safety benefits to their owners.[4,5] Whether the benefits of firearm ownership outweigh the risks is debated.[6–9]

Evidence that access to firearms may increase the risk of suicide and homicide comes from five case–control studies.[10–14] These studies have several limitations. First, they used information from proxy respondents for case subjects, but often interviewed control subjects directly; this difference might have biased the results.[15] Second, interviews were used to ascertain gun ownership; bias could have resulted if there was deception by some respondents and the degree of deception differed between the case and control subjects. Third, two of the studies were confined to events in homes.[12,14] Persons without guns might choose a suicide method that necessitated leaving the home and there might be no association between gun ownership and all suicides.[16] Only 24% of murders in the study area occurred in the home,[14] so the association between gun ownership and most homicides is unknown.[17] Fourth, three of the studies were confined to adolescents.[10,11,13] Finally, the study of homicides[14] was criticized[17] because the socioeconomic status of many victims was low. It is conceivable that firearms might be a risk factor for homicide among the poor but not among others.

To address these issues, we studied the predominantly middle-class members of a health maintenance organization. Our main question was whether purchase of a handgun from a licensed dealer was associated with an increased or decreased risk of suicide or homicide. In addition, we asked whether risk or benefit varied in relation to the time since purchase, number of handguns purchased, or caliber of weapon purchased.

Methods

Group Health Cooperative of Puget Sound, a health maintenance organization in Washington State, grew from 320 000 members in 1980 to 450 000 members in 1992. Compared with the 1984 adult population of the United States, a random sample of 1133 adult Group Health members in 1984 were more often female (55% vs 52%), more likely to have completed high school (91% vs 70%),

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less often African American (3% vs 11%), and less likely to have a family income below $15 000 (20% vs 33%).[18–21]

A case subject was a Group Health member who died of suicide or homicide during the period January 1, 1980, through December 31, 1992. Computerized Washington State death certificates were compared with computerized Group Health membership records to identify case subjects. For each case subject, five control subjects were sought from the membership file. Control subjects were randomly selected from among persons who were Group Health members on the day the case subject died and who matched that person on sex, age (within 6 years), and zip code of residence. If five control subjects could not be found within the case subject's zip code, we selected additional control subjects from adjoining zip codes. The case subject's date of death became the reference date for his or her matched control subjects. For each case and control subject, we identified family members (spouse or children) who were enrolled under the same Group Health policy.

When a handgun (but not a long gun) is purchased from a licensed dealer in Washington State, information about the sale must be reported to the Department of Licensing. This information was computerized for purchases from 1940 through June 1993. This file was linked to the subjects and family members to identify the handgun purchase history of each study subject and his or her family prior to death or reference date. We defined three categories of handgun purchase: (1) family purchase (purchase by the subject or any family member), (2) personal purchase (purchase by the study subject), and (3) family member purchase (purchase by any family member, but not the study subject).

The most recent address prior to death or reference date for each subject was obtained from Group Health files. Computerized geocoding methods (Harte-Hanks Data Technologies, Billerica, Mass) were used to map this address to a census block group. The socioeconomic status of persons in each census block group was measured by means of 1990 census variables: median family income in 1989, median value of owner-occupied homes, and average years of education for persons over 24 years of age.[22]

Person-years of Group Health membership were calculated by age and sex. Age-adjusted rates were directly standardized to the 1940 United States population.[23] Odds ratios from conditional logistic regression, which accounted for the matched design, were used to approximate relative risks.[24] Potential confounding variables examined were the number of family members and the measures of census block group affluence and education. The chi-square approximation of the likelihood ratio statistic was used for tests of heterogeneity, trend, and interaction.

TABLE 1—Incidence of Suicide and Homicide among Members of Group Health Cooperative, Washington State, 1980 through 1992

	Suicides/100 000 Member-Years (95% CI)	Homicides/100 000 Member-Years (95% CI)
All members	8.3 (7.5, 9.2)	2.7 (2.2, 3.2)
Age, y		
0–12	0.1 (0.0, 0.7)	1.2 (0.6, 2.3)
13–19	8.8 (6.3, 11.2)	3.9 (2.3, 6.1)
20–49	9.3 (8.0, 10.7)	2.8 (2.1, 3.6)
50+	12.4 (10.4, 14.7)	2.9 (2.0, 4.1)
Sex		
Men	13.4 (11.9, 15.1)	2.9 (2.2, 3.7)
Women	3.8 (3.0, 4.6)	2.4 (1.9, 3.2)
Deaths involving firearms		
Men	8.6 (7.4, 9.9)	1.6 (1.2, 2.3)
Women	1.2 (0.9, 1.8)	1.4 (1.0, 2.0)
All	4.7 (4.1, 5.4)	1.5 (1.2, 1.9)

Note. CI = confidence interval.

Results

Incidence Rates

From 1980 through 1992, there were 4 407 197 person-years of Group Health membership, with 366 suicides and 117 deaths by homicide (Table 1). Age-adjusted Group Health mortality per 100 000 persons per year was 7.8 for suicide and 2.7 for homicide. The incidence of suicide was 3.6 times higher for males, while homicide rates showed little difference by gender. Among suicides, 52.7% used a gun, and 56.4% of homicides involved a firearm.

Comparison of Case and Control Subjects

Five matched control subjects were identified for 96.3% of all case subjects. No control subjects were found for 13 suicides, but at least one was found for each homicide victim. Among control subjects, 97.8% had an age at reference date that differed from their respective case subject's age at death by less than 2 years, and 99.1% resided in the same zip code as their matching case subject. Case subjects were more likely than control subjects to have no family members (33.7% vs 25.4% for suicides and 31.9% vs 26.1% for homicide victims).

Not all addresses could be geocoded; census block group data could be linked to 83.4% of all matched case subjects and 83.4% of all control subjects. Suicides showed little difference from control subjects for the census variables; P values for trend tests were all greater than .8. Homicide victims were more likely than control subjects in the same zip code area to reside in poor neighborhoods, as judged by median family income (test for trend, $P = .01$), but showed little difference from control subjects in median value of neighborhood homes (test for trend, $P = .8$) or in the educational attainment of neighborhood adults (test for trend, $P = .6$).

Suicide and Handgun Purchase

Persons who committed suicide were more likely than control subjects to have a history of family handgun purchase (24.6% vs 15.1%). The relative risk for suicide, given a family handgun purchase, was 1.9 (95% confidence interval [CI] = 1.4, 2.5) (Table 2). The relative risks for suicide given a personal or family member handgun purchase were also elevated, although the elevated risk for family member purchase was not statistically significant. These estimates are adjusted for the matching variables; further adjustment for family size or the socioeconomic status variables resulted in no important change. The relative risk for suicide involving a gun was 3.1 (95% CI = 2.2, 4.4) for persons with a family handgun

TABLE 2—Handgun Purchase History and Relative Risk Estimates for Matched Suicides and Control Subjects

Handgun Purchase History	Suicides (n = 353) No.	(%)	Control Subjects (n = 1756) No.	(%)	Adjusted Relative Risk[a]	95% Confidence Interval	P[b]
Category of purchase							. . .
Family	87	(24.6)	265	(15.1)	1.9	1.4, 2.5	
Personal	62	(17.6)	177	(10.1)	2.0	1.4, 2.8	
Family member	25	(7.1)	88	(5.0)	1.5	0.9, 2.5	
Time since family purchase, y							.03[c]
<1	11	(3.1)	12	(0.7)	5.7	2.4, 13.5	
1–4	11	(3.1)	37	(2.1)	1.7	0.8, 3.4	
≥5	65	(18.4)	216	(12.3)	1.7	1.3, 2.3	
No. family purchases							.06
1	45	(12.7)	162	(9.2)	1.6	1.1, 2.2	
2	14	(4.0)	44	(2.5)	1.8	1.0, 3.4	
≥3	28	(7.9)	59	(3.4)	2.7	1.7, 4.4	
Maximum caliber of family purchase[d]							.3
.22–.30	30	(8.5)	107	(6.1)	1.6	1.0, 2.4	
.32–.45	56	(15.9)	153	(8.7)	2.1	1.5, 2.9	

[a]Adjusted for age, sex, zip code area, and reference date.
[b]Statistical significance of any trend across the presented categories.
[c]Test for heterogeneity of exposure categories.
[d]Data missing for 1 case and 5 control subjects.

TABLE 3—Handgun Purchase History and Relative Risk Estimates for Matched Homicide Victims and Control Subjects

Handgun Purchase History	Homicide Victims (n = 117) No.	(%)	Control Subjects (n = 582) No.	(%)	Adjusted Relative Risk[a]	95% Confidence Interval	P[b]
Category of purchase							. . .
Family	25	(21.4)	69	(11.9)	2.2	1.3, 3.7	
Personal	11	(9.4)	29	(5.0)	2.2	1.0, 4.7	
Family member	14	(12.0)	40	(6.9)	2.1	1.0, 4.2	
Time since family purchase, y							.3
<5	3	(2.6)	17	(2.9)	1.0	0.3, 3.6	
5–9	5	(4.3)	11	(1.9)	2.9	0.9, 8.9	
≥10	17	(14.5)	41	(7.0)	2.5	1.3, 4.7	
No. family purchases							.004
1	7	(6.0)	37	(6.4)	1.1	0.5, 2.5	
2	7	(6.0)	20	(3.4)	2.1	0.8, 5.2	
≥3	11	(9.4)	12	(2.1)	6.2	2.4, 15.6	
Maximum caliber of family purchase[c]							.2
.22–.30	5	(4.3)	23	(4.0)	1.3	0.5, 3.4	
.32–.45	20	(17.1)	44	(7.6)	2.7	1.5, 5.0	

[a]Adjusted for age, sex, zip code area, and reference date.
[b]Statistical significance of any trend across the presented categories.
[c]Data missing for 2 control subjects.

purchase compared with others, while the relative risk for suicide not involving a gun was 0.8 (95% CI = 0.4, 1.3).

The median interval between the first handgun purchase by the victim or any family member and any suicide with a gun was 10.7 years (range, 11 days to 52.5 years). The relative risk for suicide given a family handgun purchase was greatest within the first year after purchase but remained elevated even after 5 years (Table 2).

The association between handgun purchase and suicide tended to become stronger as the number of handguns purchased increased (test for trend across categories, $P = .06$) (Table 2). When persons were classified by the largest caliber of any family handgun purchase, the relative risk of suicide showed little variation by caliber.

The association between family handgun purchase and suicide was estimated in several subgroups. No statistically significant differences in the relative risk estimates were found for categories of sex, age, or neighborhood median family income (data not shown).

Homicide and Handgun Purchase

Homicide victims were more likely than control subjects to have a history of family handgun purchase (21.4% vs 11.9%). The relative risk of death by homicide for those with a family handgun purchase was 2.2 (95% CI = 1.3, to 3.7) (Table 3). The relative risks for death by homicide given a personal or family member purchase were also elevated, although these estimates were of borderline statistical significance. These estimates are adjusted for the matching variables; further adjustment for family size or the census variables resulted in no important change. The relative risk for death by homicide involving a gun was 2.2 (95% CI = 1.1, 4.4) for persons with a family handgun purchase compared with others, while the corresponding relative risk for homicide not involving a gun was 2.0 (95% CI = 0.9, 4.7).

The median interval between first family handgun purchase and any homicide death with a gun was 11.3 years (range, 5.1 to 21.9 years). The relative risk of death by homicide associated with family handgun purchase bore no statistically significant relationship to time since purchase (Table 3).

There was a stronger association between handgun purchase and death by homicide as the number of handguns purchased increased (test for trend across categories, $P = .004$) (Table 3). When persons were classified by the largest caliber of any family handgun purchase, the relative risk of homicide did not show a statistically significant variation by caliber.

When subgroups were analyzed, the association between family handgun purchase and death by homicide was not statistically different by categories of sex, age, or neighborhood median family income (data not shown).

Discussion

Members of a health maintenance organization whose families had a history of registered handgun purchase had risks of death by suicide and homicide that were twice as high as the risks of members of the same age, sex, and neighborhood who had no history of handgun purchase. The increased relative risks persisted for more than 5 years after the purchase.

From 1980 through 1992, the age-adjusted suicide rate in the Group Health population was 7.8 per 100 000 persons per year; the corresponding rate was 13.2 in Washington State and 11.5 in the United States (mortality and population data from the National Center for Health Statistics). The middle-class nature of the study population is reflected in the low age-adjusted homicide rate: 2.7 per 100 000 persons per year for Group Health members during the study period, compared with 5.3 for all of Washington and 9.5 for the United States.

Inability to measure and control for other differences between case and control subjects could have biased our relative risk estimates. Three previous studies of the association between gun ownership and suicide[11–13] and the only previous study regarding death by homicide[14] adjusted their relative risk estimates for variables that we did not measure, including psychiatric history, substance abuse, criminal history, and previous household violence. In three of these studies[12–14] these adjustments increased the relative risk estimates.

Residual confounding in our study can be assessed indirectly by examining the relative risk estimates for suicide and homicide deaths without a gun; we would expect handgun purchase to have little positive association with deaths that do not involve a gun. For suicide by means other than a firearm, the relative risk was 0.8 (95% CI = 0.4, 1.3) among those with a history of handgun purchase. The finding that this estimate is close to 1.0 suggests that the underlying risk of suicide was similar between handgun purchasers and nonpurchasers apart from purchase history.

For death by homicide by means other than a gun, the relative risk was 2.0 (95% CI = 0.9, 4.7) among those with a history of family handgun purchase. Although chance could explain this finding, another explanation may be that handgun purchasers were more inclined toward violence or lived in more dangerous surroundings and these factors induced them to purchase handguns. This violent personality or environment may have increased the risk for both gun-related and other homicide death, regardless of exposure to handgun purchase. If this theory is true, then the apparent association between handgun purchase and all homicide deaths may be due to uncontrolled confounding. Another explanation might be that some handgun purchasers were encouraged by their ownership of a gun to engage in activities that increased their risk for homicide by any means.

Handgun purchase from a licensed dealer can be considered a proxy measure for handgun ownership. Some study subjects classified as exposed to handguns may have disposed of their handguns; others classified as not exposed may have possessed handguns that they purchased legally from sources other than a registered dealer, purchased out of state, or obtained illegally. If such errors in classification occurred with similar frequency among case and control subjects, the relationship between handgun ownership and risk could have been underestimated in our study.[25] It is also possible that persons inclined to commit homicide may have been more likely to procure handguns exclusively by private or illegal means; these transactions are not reported to the state. If this pattern is present, it would tend to bias our relative risk estimates for homicide toward zero.

There is evidence that handgun purchase records did not grossly underestimate exposure to handguns in our study. In 1992, of 1000 Seattle adults interviewed, 14.2% reported household ownership of a handgun.[26] This figure is similar to the prevalence of family handgun purchase history among our control subjects matched to suicide and homicide victims (15.1% and 11.9%, respectively).

Defining exposure as purchase of a handgun from a dealer offered some advantages. Because exposure was recorded before the outcome, recall bias was eliminated. We did not have to rely on proxy respondents for exposure information regarding the case subjects, and deception regarding exposure was eliminated. Those who recommend purchase of a handgun for protection are referring to legal purchase, and many of these purchases would be from dealers. If this exposure is associated with an increased risk of death, the overall risk of legal handgun purchase may outweigh any protective benefit.

Our finding of an increased relative risk for suicide among persons in families that purchased handguns agrees in general with the findings of previous case–control studies of suicide and gun ownership. Three studies were conducted among adolescents in western Pennsylvania.[10,11,13] Using inpatients as control subjects, the first study reported that the relative risk for suicide among those with firearms in the home was 2.7,[10] and the second study gave an estimate of 2.1.[11] The third study used population-based control subjects and reported an adjusted relative risk for suicide, given a handgun in the home, of 9.5 (95% CI = 1.7, 53.9).[13] A study conducted in Tennessee and Washington estimated that the relative risk for suicide in the home among handgun owners was 5.8.[12]

Our finding regarding death by homicide and purchase of a handgun was similar to that of the only previous case–control study of this association. In Tennessee, Washington, and Ohio, victims of homicide in the home were compared with population-based control subjects; the relative risk for homicide, adjusted for matching variables, was 1.9 (95% CI = 1.4, 2.7) among handgun owners.[14] The authors reported a relative risk of 2.7 among owners of any firearm compared with nonowners, after further adjustment for other variables, but a fully adjusted relative risk estimate for handguns was not given.

Some persons may purposely buy a handgun to commit suicide or homicide. There was evidence in our data that this was true for suicide; within the first year after purchase, the relative risk of suicide was more than fivefold higher among those with a family history of handgun purchase. After the first year the increased relative risk of suicide persisted at a lower level, consistent with the theory that the presence of a handgun in the home may facilitate suicide during a period of despondency. For homicide the results were different; no Group Health member was murdered with a gun within 5 years of any first handgun purchase, and the elevated risks for death by homicide associated with handgun purchase did not show any statistically significant variation by time since purchase. This suggests that in the Group Health population, deliberate

legal purchase of a handgun to commit murder within a family is a rare event.

Our findings should be of interest to persons who own a handgun or are considering the purchase of a handgun. While there are occasional situations in which handguns offer protection against violent death, our study and previous studies agree that on average, the acquisition of a handgun appears to be associated with an increased risk of violent death. □

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