EXPOSURE TO TELEVISION AS A RISK FACTOR FOR VIOLENCE

BRANDON S. CENTERWALL

It has long been hypothesized that exposure to television is a risk factor for aggression and violence; the earliest public hearings on the question took place in 1952, when fewer than one quarter of US households possessed television sets (1). Over the years, there have been scores of research reports on the issue (2-4), as well as several major governmental investigations (5-7). Throughout the controversy, however, there has been minimal input from epidemiologists.

The relative absence of epidemiology from the discussion is attributable to a problem confronting any epidemiologist investigating exposure to television as a risk factor for violence: Virtually 100 per cent of the general population is exposed. No valid case-control groupings can be made in the United States comparing populations exposed to television with equivalent populations not exposed to television. Those rare individuals or enclaves who are truly unexposed to television—for example, the Amish—are manifestly atypical and so contaminated with self-selection bias as to preclude meaningful comparisons. It is safe to say that if valid exposed versus unexposed groupings were possible in the United States, epidemiologists would have brought their skills to bear on the issue years ago.

I have recently prepared a monograph on television and violence, in which I bring the tools of epidemiology to bear on the problem (8). As the monograph is intended for a wide audience, few of whom are skilled in epidemiologic methods, it deliberately avoids in-depth discussion of several methodological issues of importance to epidemiologists but likely to be obscure to nonspecialists. For example, there is little elaboration on the thorny problems of avoiding the ecological fallacy and minimizing specification bias. I address these issues and others in the present paper, beginning first with a summary of the background, methodology, and results of the study. For details not presented here, I refer the reader to the more completely presented analysis (8).

BACKGROUND

As is reflected in the conclusions of three government investigations (5-7) and a Rand Corporation report (3), there is a broad consensus in the scientific literature that exposure to television violence increases children's physical aggressiveness, but the question of whether this further leads to increased rates of violence has generally been left open. To address that question, researchers have taken the study
of television out of the laboratory and into natural settings.

Joy et al. (9) have investigated the effect of the introduction of television into a previously unexposed Canadian community ("Notel"), using as control groups two similar communities that already had television. Notel acquired television at a late date (1973) because of technical difficulties with signal reception rather than because of any hostility toward television. In a double-blind research design, a cohort of 45 first- and second-grade children were observed prospectively over a period of two years for rates of objectively measured noxious physical aggression (e.g., hitting, shoving, and biting). Rates of physical aggression did not change significantly among children in the two control communities. Two years after the introduction of television, rates of physical aggression among children in Notel had increased by 160 per cent (p < 0.001).

In a stratified case-control study of adolescent boys (n = 1,565), Belson (10) examined the association between rates of serious violent behavior (i.e., assault, rape, major vandalism, and abuse of animals) and prior lifetime exposure to television violence. Adolescent males who reported having watched above-average quantities of television violence reported rates of serious violence 49 per cent higher than those of matched adolescent males who reported having watched below-average quantities of television violence (p = 0.02).

In a 22-year prospective study of an age cohort in a rural US county (n = 875), Eron and Huesmann (11) observed that the frequency of television viewing at age eight years predicted the seriousness of criminal acts committed by age 30. This held true for both men (p < 0.001) and women (p < 0.05). After controlling for the boys' baseline aggressiveness, intelligence, and socioeconomic status at age eight, Huesmann found that the boys' television violence viewing at age eight still significantly predicted the seriousness of the crimes for which they were convicted by age 30 (p < 0.05) (12).

In a retrospective case-control study, Kruttschnitt et al. (13) compared 100 male felons imprisoned for violent crimes (e.g., murder, rape, and assault) with 65 men without a history of violent offenses, matching for age, race, and census tract of residence at ages 10–14 years. Through the use of quantitative measures of television viewing, violent offenders reported watching 15 per cent more violent television programs per week as children than did the matched controls. After controlling for school performance, exposure to parental violence, and baseline level of criminality, Kruttschnitt et al. found that the associations between adult criminal violence and childhood exposure to television violence approached statistical significance (p < 0.10).

All Canadian and US studies of the effect of prolonged childhood exposure to television (two years or more) demonstrate a positive relation between earlier exposure to television and later physical aggressiveness, although not all studies reach statistical significance. (For a further review of the literature, see Centerwall (8)). These studies establish the link between exposure to television and subsequent increases in physical aggressiveness at the level of the individual, thereby providing the conceptual basis for examining the effect of exposure to television upon entire populations. They underscore the need to determine whether exposure to television is a risk factor for increased rates of violence in adult life. To address this issue, I took advantage of a historical experiment—the absence of television in South Africa prior to 1975.

**TELEVISION AND HOMICIDE IN SOUTH AFRICA, CANADA, AND THE UNITED STATES**

The South African government did not permit television broadcasting prior to 1975, even though South African whites were a prosperous, industrialized Western society (14). Amidst the hostile tensions between the Afrikaner and English white
communities, it was generally conceded that any South African television broadcasting industry would have to rely on British and American imports to fill out its programming schedule. Afrikaner leaders felt this would provide an unacceptable cultural advantage to the English-speaking South Africans. Rather than negotiate a complicated compromise, the Afrikaner-controlled government chose to finesse the issue by forbidding television broadcasting entirely. Thus, an entire population of two million whites—rich and poor, urban and rural, educated and uneducated—was non-selectively and absolutely excluded from exposure to television for a quarter-century after the medium was introduced into the United States. Since the ban on television was not based upon any concerns regarding television and violence, there was no self-selection bias with respect to the hypothesis being tested.

To evaluate television as a risk factor for violence, I examined homicide rates in South Africa, Canada, and the United States. Given that blacks in South Africa live under quite different conditions than blacks in the United States, I limited the comparison to white homicide rates in South Africa and the United States and the total homicide rate in Canada (which was 97 per cent white in 1951 (15)). Data analyzed were from the respective government vital statistics registries (8). The reliability of the homicide data is discussed elsewhere (8).

Following the introduction of television into the United States, the annual incidence of white homicide deaths increased by 93 per cent, from 3.0 homicides per 100,000 white population in 1945 to 5.8 homicides per 100,000 in 1974; in South Africa, where television was banned, the incidence of white homicide deaths decreased by 7 per cent, from 2.7 homicides per 100,000 white population in 1943–1948 to 2.5 homicides per 100,000 in 1974 (figure 1). As with US whites, following the introduction of television the incidence of Canadian homicides increased by 92 per cent, from 1.3 homicides per 100,000 population in 1945 to 2.5 homicides per 100,000 in 1974 (figure 2).

Violence is a multifactor phenomenon, involving such established risk factors as age, sex, socioeconomic status, and preexisting culture. Therefore, it is anticipated that baseline rates of violence will vary across countries (compare Canada and South Africa). For the same reason, exposure to television is not expected to determine the absolute rate of violence; rather, the attained rate of violence will reflect both exposure to television and the baseline rate of violence (compare Canada and the United States), as well as the effect of changes in other risk factors—for example, socioeconomic conditions.

Following the introduction of television, homicide rates doubled in Canada and the United States, whereas in South Africa, where television did not exist, white homicide rates remained the same over time. For both Canada and the United States, there was a lag of 10–15 years between the introduction of television and the subsequent doubling of the homicide rate (figures 1 and 2). Given that homicide is an adult activity, if television exerts its behavior-modifying effects primarily upon children, the initial “television generation” would have had to age 10–15 years before they would have been old enough to affect the homicide rate. Evidence for a “television cohort” effect is presented elsewhere (8).

IS THERE AN ECOLOGICAL FALLACY?

The investigative design is that of a population intervention study, wherein a cohort undergoing an intervention is observed prospectively to determine what effect (if any) the intervention had, using as a control group a cohort not subjected to the intervention (16). An example would be a study to determine whether helmet use laws decrease motorcyclist fatality rates in states that pass such laws as compared with states that do not. Another example would be a study to determine whether water supply fluoridation decreases the incidence of
dental caries in a town that begins fluoridation as compared with a town that does not. In the present instance, the intervention was the South African government's decision to block the dissemination of television technology within South Africa. (Strictly speaking, the present study follows a "historical prospective" design, since the data on homicides were retrieved retrospectively from archives in which they had been stored prospectively.)

As has been noted by Morgenstern (16), issues of aggregation bias and the ecological fallacy are rendered moot in population intervention studies, provided that the link between risk factor and outcome variable has already been established at the level of the individual. I will demonstrate more formally why population intervention studies are free of the ecological fallacy.

To review the basics: Epidemiology normally seeks to determine the association between exposure variables ($x$) and disease outcomes ($y$) at the level of the individual ($i$). In ecologic analysis, individuals are aggregated into groups wherein the associa-
* The 1945 homicide rate for South African whites is a six-year average (1943–1948). Television broadcasting was not permitted in South Africa prior to 1975. Sources: television data, Dominion Bureau of Statistics and Statistics Canada, Ottawa, Ontario, Canada; homicide data, vital statistics bureaus of the governments of Canada and South Africa (8). Reprinted with permission (8).

As is further demonstrated by Firebaugh (18), aggregated data analysis avoids the ecological fallacy if, and only if, the group exposure \( X_j \) has no effect on disease risk \( y_{ij} \) at the individual level, controlling for the individual's exposure value \( x_{ij} \), where

\[
y_{ij} = a + \beta_1 x_{ij} + \beta_2 X_j + \epsilon
\]

\((i = 1, 2 \ldots n; j = 1, 2 \ldots m)\)

However, ascertainment of such a condition requires knowledge of \( x_{ij} \) and \( y_{ij} \), which (if known) would eliminate the perceived need to work with aggregated data in the
first place. If, however, the group exposure \((X_j)\) is the same as each individual exposure \((x_{ij})\), that is, \(x_{ij} = X_j\), then \(X_j\) will have no independent effect upon \(y_{ij}\), controlling for \(x_{ij}\). In other words, the analysis of grouped data avoids the ecological fallacy provided that individuals are aggregated into homogeneous groups wherein each individual has the same exposure to the risk factor as does the group as a whole (see also Greenland and Morgenstern (19)).

Population intervention studies meet these criteria, for which reason they can be analyzed without danger of the ecological fallacy. For example, one can compare the incidence of dental caries in towns with different levels of water fluoridation without incurring the ecological fallacy because the exposure of each individual in the town is the same as that of the town as a whole. Similarly, a state's helmet-use law can be studied using ecologic data because the law not only applies to the state but equally to each individual within the state; it is not necessary to conduct household surveys to determine who is exposed to the law, since we know that the law applies to everyone. Since television did not exist in South Africa prior to 1975, we know that each individual in South Africa was equally without television. By the 1960s, essentially all Canadians and Americans had been exposed to television (figures 1 and 2), such that if exposure is measured as a dichotomous variable (i.e., exposed versus not exposed) the exposure of each individual is the same as the exposure of the country as a whole.

Comparisons between South Africa, Canada, and the United States do not result in an ecological fallacy because each individual exposure is known implicitly from what is known about each country as a whole. Since the unit of analysis is ultimately the individual, the present study compares (in 1945, the baseline year) 2,342,000 white South Africans with 125,266,000 white Americans and 12,072,000 Canadians, for a total \((n)\) of 139,680,000.

As is frequently the case in epidemiology, there are rough edges. In the town with fluoridation some persons will be drinking bottled water, whereas in the town without fluoridation some parents will be giving their children fluoride preparations. In a state with a motorcycle helmet-use law, there will be persons immune to the law, whereas in a state without such a law there may be local ordinances requiring helmets (although this is unlikely). Prior to 1975, there were South African whites who had spent their formative years living in countries with television before coming to South Africa; there were US whites and Canadians who had spent their formative years living in countries without television. Such exceptions are inevitable; they do not invalidate the analysis provided that they are infrequent and \(n\) is large.

**Minimizing specification bias**

To minimize specification bias, the countries chosen as controls had to match South Africa on pertinent social and historical factors. South Africa, Canada, and the United States all began as frontier colonies initially settled by whites from Western Europe. All three countries developed lasting schisms between two competing white ethnic groups of distinguishable language and culture. In the period immediately preceding the introduction of television into Canada and the United States, all three were multiparty, representative, federal democracies with strong Christian religious influences, where people of nonwhite races were generally excluded from political power. Thus, no other countries provided as good a match with South Africa as did Canada and the United States. Although television broadcasting was prohibited prior to 1975, white South Africa had well developed book, newspaper, radio, and cinema industries. Therefore, the effect of television could be isolated from that of other media.

It was necessary to further take into account possible confounding third variables, both accessible (i.e., known and measurable) and inaccessible (i.e., unknown or un-
measurable) (20). I have examined an array of possible confounders—changes in age distribution, urbanization, economic conditions, alcohol consumption, capital punishment, civil unrest, and the availability of firearms. None provided a viable alternative explanation for the observed homicide trends (8).

As is discussed by Catalano and Serxner (20), inaccessible third variables can be controlled through the use of multiple control groups. For example, a comparison of South Africa with only the United States (figure 1) could easily lead to the hypothesis that US involvement in the Vietnam War, or the turbulence of the civil rights movement, was responsible for the doubling of homicide rates in the United States. The inclusion of Canada as a control group precluded these hypotheses, since Canadians likewise experienced a doubling of homicide rates (figure 2) without involvement in the Vietnam War and without the turbulence of the US civil rights movement. The possibility of local, inaccessible confounders in either the United States or Canada was largely eliminated, since each country served as a control for the other.

A similar cross-control for local inaccessible confounders was not possible for South Africa, since there were no other television-free countries similar to South Africa. Thus, there remains a residual concern that, despite extensive control for specification bias, there may yet have been an unidentified confounding variable within South Africa itself that could account for the findings. It is not scientifically possible to prove a negative (i.e., I cannot prove that such a variable does not exist). Therefore, we must subject the etiologic hypothesis to further testing. Falsifiable hypotheses must be tested to determine whether the results substantiate or contradict the etiologic theory that exposure to television is a risk factor for violence.

TESTING THE ETIOLOGIC HYPOTHESIS

Two major hypotheses are that 1) exposure of susceptible populations to television is followed by a major increase in rates of violence, and 2) the timing of the introduction of television into the population predicts the timing of the subsequent increase in rates of violence. These hypotheses can be tested across various populations (8).

For example, following the introduction of television into the United States, annual homicide rates increased for both whites and minorities, increasing by 157 per cent for whites and 63 per cent for minorities between 1955 and 1975. As might be expected for what was then an expensive luxury commodity, minority households acquired their first television sets approximately five years later than white households. White homicide rates began to increase in 1958; as predicted by the hypothesis, minority homicide rates did not begin to increase until four years later.

Similarly, following the introduction of television, homicide rates increased in all nine US census regions. The different census regions did not acquire television at the same time; neither did their homicide rates begin to increase at the same time (Middle Atlantic homicide rates began to increase in 1958, whereas West South Central homicide rates did not begin to increase until 1964). The correlation between the timing of the acquisition of television, by region, and the timing of the region’s subsequent increase in the homicide rate is 0.82 (p = 0.003).

Likewise, following the introduction of television, homicide rates increased in both urban and rural populations, but not at the same time. As would be expected, metropolitan centers acquired television first, then progressively smaller cities and towns. As predicted by the hypothesis, there was a parallel sequence in the increase in homicide rates, homicide rates first increasing in metropolitan centers, then in progressively smaller cities and towns.

Altogether, the etiologic hypothesis was tested against 11 falsifiable hypotheses (table 1). All 11 tests substantiated the etiologic hypothesis. Note that the data used to test the etiologic hypothesis are ecologic, aggregated data. Using ecologic
Falsifiable hypotheses tested to evaluate the etiologic hypothesis that exposure to television is a risk factor for violence

1. For the United States, the introduction of television was followed by major percentage increases in homicide rates among both whites and minority groups.

2. Since US whites acquired television sets sooner (on the average) than minority group members, the homicide rate began to increase among whites sooner than it did among minority group members.

3. For each of the nine census regions of the United States, the introduction of television was followed by a major percentage increase in the homicide rate.

4. Across the nine census regions, the timing of a region's acquisition of television predicted the timing of the subsequent increase in the homicide rate.

5. The introduction of television into the United States was followed by major percentage increases in homicide rates of criminal homicide in cities and towns of all population sizes.

6. Across US cities and towns of different population sizes, the timing of the population's acquisition of television predicted the timing of the subsequent increase in the average rate of criminal homicide.

7. The introduction of television into the United States was followed by major percentage increases in rates of violence committed by both men and women.

8. Since US boys and girls had an equal onset of exposure to television, subsequent increases in rates of violence occurred at the same time for men and women.

9. Following the introduction of television into the United States, increases in the rate of violence occurred first in the youngest age group, then later in successively older age groups.

10. In countries in which exposure to television can be inferred to increase levels of aggression in individuals, the introduction of television was followed by major percentage increases in homicide rates.

11. Across such countries, the timing of the population's acquisition of television predicted the timing of subsequent increases in the homicide rate.

As of 1983, the most recent year for which data are available (21), the white South African homicide rate had reached 3.9 homicide deaths per 100,000 white population—an annual rate greater than any observed in the pretelevision years, 1945-1974, and 56 per cent greater than the rate in 1974, the last year before television was introduced. In contrast, Canadian and white American homicide rates have not increased since 1974. As of 1983, the Canadian homicide rate was 2.4 per 100,000 population, as compared with 2.5 per 100,000 in 1974. In 1983, the US white homicide rate was 5.6 per 100,000 white population, as compared with 5.8 per 100,000 in 1974.

As with other studies that use external control groups, it is important that the data testing a falsifiable hypothesis be examined after the hypothesis has been formulated (22). It was not possible to meet this criterion in all respects in the present study. I already knew from prior research that there had been major increases in homicide rates.
among both whites and minority groups in the United States, and that homicide rates had increased in all census regions of the United States. Therefore, data necessary for testing two of the 11 hypotheses were known prior to analysis. The remainder of the data were examined and analyzed after the hypotheses were formulated.

EXPOSURE TO TELEVISION AS A RISK FACTOR FOR VIOLENCE

The exposure variable chosen for study in the present analysis is exposure to television in general rather than exposure to television violence in particular, even though most (but not all) studies at the individual level have focused upon television violence as the key risk factor. Just as cigarette smoke is a mixture of many substances, so likewise exposure to the television medium and its multifarious contents is an exceedingly complex experience. It was a sufficient accomplishment for epidemiology to initially establish that cigarette smoking is a risk factor for lung cancer without attempting to parcel out the relative importance of the various compounds in cigarette smoke; that could come later. Similarly, while exposure to television violence may well be the most important component leading to violent behavior, I do not wish to prematurely shut out the possibility that other aspects of television viewing also contribute. It is best to keep an open mind on the matter, and that is best achieved by not predicating the analysis upon a particular mechanism.

The etiologic hypothesis of exposure to television as a risk factor for violence has been tested successfully against falsifiable hypotheses. The available information meets the epidemiologic criteria for causality (23): The observed relation is consistent across diverse populations. The timing of the acquisition of television predicts the timing of the subsequent increase in rates of violence. The observed relation is consistent with the results of numerous controlled experiments and observational studies (2–13). There is a biologically plausible explanation for how exposure to television can cause increases in levels of aggressiveness (3, 7, 12).

What is the relative risk for homicide, given exposure to television? Following the introduction of television in the 1950s, US homicide rates doubled. A doubling of the homicide rate after everyone is exposed to television implies that the relative risk of homicide after (prolonged) exposure to television, compared with no exposure, is approximately 2:1. A 2:1 relative risk indicates that exposure to television is not a strong risk factor for homicide. It is only by virtue of being ubiquitous that it exerts an effect upon general rates of violence.

The population attributable risk (PAR) is the proportion of incident cases in the population attributable to the presence of a risk factor. For a risk factor with estimated relative risk RR, population attributable risk can be estimated by

\[
\text{PAR} = \frac{\hat{p}(\text{RR} - 1)}{[\hat{p}(\text{RR} - 1) + 1]}
\]

where \(\hat{p}\) is the estimated proportion of the population exposed to the risk factor. For the United States, the proportion exposed to television is approximately 1.0 and the relative risk of homicide is estimated to be 2.0. Therefore, \(\text{PAR} = 1.0(2.0 - 1.0)/[(1.0(2.0 - 1.0) + 1.0) = 0.5\). In other words, it is estimated that exposure to television is etiologically related to approximately one half of the homicides committed in the United States, or approximately 10,000 homicides annually. Although the data are not as well developed for other forms of violence, they indicate that exposure to television is also etiologically related to a major proportion—perhaps one half—of rapes, assaults, and other forms of interpersonal violence in the United States (8).

REFERENCES

1. United States Congress, House Committee on Interstate and Foreign Commerce. Hearings and


