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# Trends and Differentials in Adolescent and Young Adult Mortality in the United States, 1950 through 1993

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## ABSTRACT

Using data from the National Vital Statistics System and the National Longitudinal Mortality Study, this study examined mortality trends and differentials from 1950 through 1993 among US adolescents and young adults according to sex, race/ethnicity, education, family income, marital status, and cause of death. No appreciable reduction in youth mortality has occurred, especially among men. Declines in youth mortality from accidents have been nearly offset by increases in death rates from homicide, suicide, and firearm injuries. American Indians, Blacks, males, and those with least education and income were at increased risk of both overall and injury-specific youth mortality. (*Am J Public Health.* 1996; 86:560–564)

## Introduction

Adolescents and young adults aged 15 to 24 years[1] are a sizable demographic group and represent about 15% of the total US population.[2] Premature death among them, especially due to preventable causes such as homicide, suicide, motor vehicle crashes, and other injuries, results in an enormous toll each year on the years of potential life lost.[3]

Although mortality for the general population in the United States has declined consistently since 1950, no such decline in mortality has occurred for those aged 15 to 24.[4–6] In fact, mortality for the latter has changed very little since 1982.[4,5] Furthermore, the US youth mortality remains substantially higher than that of many industrialized countries, largely because of excess mortality from homicide, suicide, and unintentional injuries.[7–9]

Studies examining trends and differentials in US adolescent and young adulthood mortality by sex, race/ethnic-ity, socioeconomic status, and cause of death are either scarce or nonexistent.[4,9,10] To fill these gaps, this paper examines long-term mortality trends from 1950 through 1993 and estimates the effects of sociodemographic covariates on overall and injury-specific youth mortality.

## Materials and Methods

To analyze long-term mortality trends, sex-, race/ethnic-, and cause-of-

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TABLE 1—US Deaths and Death Rates per 100 000 Population for the 15- to 24-Year-Old Age Group, by Race/Ethnicity and Sex, 1979 through 1981 and 1989 through 1991

| Race/Ethnicity | 1979–1981 | | | | | | 1989–1991 | | | | | |
| | Total | | Male | | Female | | Total | | Male | | Female | |
| | No. | Rate | No. | Rate | No. | Rate | No. | Rate | No. | Rate | No. | Rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| White | 117 074 | 109.1 | 88 263 | 162.3 | 28 811 | 54.4 | 80 073 | 89.0 | 59 551 | 129.0 | 20 522 | 46.9 |
| Black | 22 744 | 132.0 | 16 697 | 198.3 | 6 047 | 68.6 | 26 046 | 161.7 | 20 398 | 254.7 | 5 648 | 69.7 |
| American Indian | 1 923 | 200.9 | 1 459 | 302.1 | 464 | 97.9 | 1 571 | 151.3 | 1 191 | 222.9 | 380 | 75.4 |
| Asian and Pacific Islander | 1 097 | 55.4 | 765 | 76.3 | 332 | 34.1 | 1 935 | 52.2 | 1 411 | 73.7 | 524 | 29.2 |
| Chinese | 167 | 38.1 | 119 | 53.4 | 48 | 22.3 | 250 | 32.1 | 170 | 42.1 | 80 | 21.3 |
| Japanese | 179 | 49.5 | 122 | 66.1 | 57 | 32.2 | 118 | 36.6 | 87 | 55.0 | 31 | 18.9 |
| Filipino | 155 | 41.7 | 113 | 61.9 | 42 | 22.2 | 307 | 43.4 | 220 | 62.0 | 87 | 24.6 |
| Other Asian[a] | 449 | 64.8 | 310 | 87.3 | 139 | 41.2 | 1 129 | 63.3 | 841 | 89.5 | 288 | 34.1 |
| Hawaiian | 147 | 130.6 | 101 | 177.5 | 46 | 82.6 | 131 | 114.0 | 93 | 156.8 | 38 | 68.4 |
| Hispanic[b] | 1 833 | 128.7 | 1 506 | 208.1 | 328 | 46.8 | 12 022 | 102.2 | 9 836 | 154.1 | 2 186 | 40.6 |
| Mexican | 1 250 | 139.4 | 1 048 | 225.7 | 202 | 46.7 | 8 549 | 103.4 | 7 136 | 157.2 | 1 413 | 37.9 |
| Puerto Rican | 326 | 123.8 | 260 | 201.8 | 66 | 49.1 | 741 | 86.6 | 561 | 128.7 | 180 | 42.9 |
| Cuban | 17 | 68.4 | 15 | 120.0 | 2 | ... | 200 | 56.7 | 151 | 82.4 | 49 | 28.8 |
| Other Hispanic[c] | 241 | 100.6 | 183 | 154.9 | 58 | 47.8 | 2 532 | 110.4 | 1 988 | 162.3 | 544 | 50.9 |

Source. National Center for Health Statistics, Mortality Detail Files, 1979 through 1981 and 1989 through 1991.
[a]This category includes Asian Indians, Koreans, Vietnamese, Cambodians, Laotians, Indonesians, and other Asian and Pacific Islanders.
[b]Data are based on reports from 45 states and the District of Columbia for 1989 through 1991; the 1979 through 1981 Hispanic data are based on reports from 15 states.
[c]This category includes Central and South American and other and unknown Hispanic groups.

death data from the National Vital Statistics System, 1950 through 1993, were used. To estimate socioeconomic differentials in mortality, the National Longitudinal Mortality Study, 1979 through 1985, was used. Detailed descriptions of the two national data sets are provided elsewhere.[4,11–16]

In the National Longitudinal Mortality Study, the dependent variables were risks of total-, external-cause, and firearm-mortality. Deaths from external causes (suicide, homicide, and unintentional injuries) included International Classification of Diseases, 9th Revision (ICD-9) E codes 800–999. Causes of death attributable to firearm mortality consisted of both firearm homicides and suicides and included ICD-9 E codes 922, 955.0–955.4, 965.0–965.4, 970, and 985.0–985.4.[4] The National Longitudinal Mortality Study sample comprised 114 706 individuals aged 15 to 24 years at the beginning of the study, of whom 492 (371 from external causes and 89 from firearm injuries) had died by the end of the 5-year follow-up. The risk of mortality was estimated as a function of sex, race/ethnicity, education, family income, marital status, nativity, and place of residence.[17,18]

Whenever appropriate, the pace of mortality decline or increase was approximated by annual arithmetic or exponential rates of change.[19,20] To estimate the effects of sociodemographic variables on the risk of youth mortality, the Cox proportional hazards model was applied to the National Longitudinal Mortality Study data.[16,21–23] The estimation of the Cox model was performed through the PHREG procedure of SAS.[24]

## Results

The overall trend in youth mortality during 1950 through 1993 is rather difficult to characterize, as the death rate showed a decreasing trend during the 1950s, a slightly increasing trend in the 1960s, and then again a decreasing trend until the mid-1970s. The youth mortality has changed very little in the past 15 years, showing yearly fluctuations.

### Trends in Sex Differentials

From 1950 through 1993, the death rate in the group aged 15 to 24 years had been two to three times higher for males than for females. The male/female mortality differential increased in the past four decades, because while young females experienced a substantial (45%) decline in their mortality, no appreciable mortality decline occurred for young males during the same period.
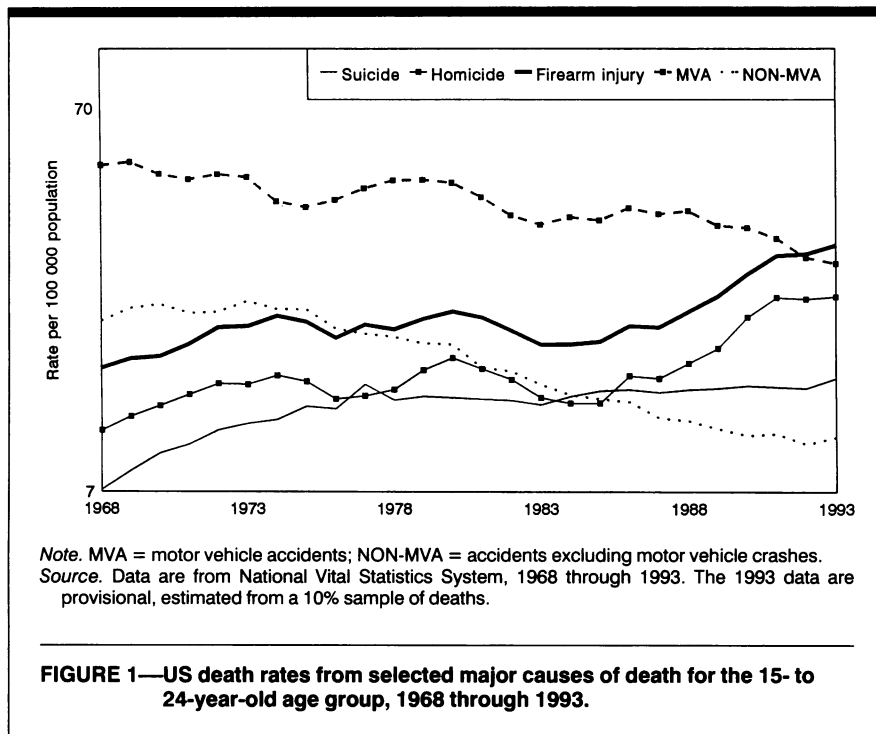
### Trends in Race Differentials by Sex

Examination of the yearly death rates from 1950 through 1993 showed that, in 1950, Black males aged 15 to 24 years had twice the death rate of White males. By 1984, the Black/White differential was considerably reduced among males; Black males had only a 20% higher death rate than White males. Since 1984, however, the Black/White gap has increased substantially, with the death rate in 1993 being 2.2 times greater for Black males than for White males in the group aged 15 to 24 years. This inequality is primarily because of a consistently upward increase in mortality among Black males aged 15 to 24 years: their mortality rose by 73% in just 9 years.

Compared with the 1950 situation when the ratio of Black to White mortality was 3, the racial gap among females aged 15 to 24 years had narrowed considerably to a ratio of 1.2 in 1985. Since 1985, the racial differential among females has once again increased somewhat, which was more a result of an increase in mortality among Black females than a result of a decline in mortality among White females.

### Trends in Racial/Ethnic Differentials by Sex

Table 1 provides detailed race/ethnic differentials in mortality among

Note. MVA = motor vehicle accidents; NON-MVA = accidents excluding motor vehicle crashes.
Source. Data are from National Vital Statistics System, 1968 through 1993. The 1993 data are provisional, estimated from a 10% sample of deaths.

**FIGURE 1—US death rates from selected major causes of death for the 15- to 24-year-old age group, 1968 through 1993.**

those aged 15 to 24 years in 1979 through 1981, and 1989 through 1991, respectively. Mortality data for ethnic minorities (excluding Blacks) should be interpreted with caution as the death rates reported by the National Center for Health Statistics may be underestimated by as much as 22% for American Indians, 8% to 12% for Asians, and 7% for Hispanics because of misidentification of ethnic identity on death certificates.[25,26]

Asians and Pacific Islanders, as a group, had the lowest youth mortality of all groups in both 1979 through 1981 and 1989 through 1991. In both time periods, compared with Whites, Chinese, Japanese, Filipinos, other Asians, and Cubans had significantly lower death rates, and Blacks, American Indians, Hawaiians, Mexicans, and other Hispanics had significantly higher death rates. Youth mortality decreased between 1979 through 1981 and 1989 through 1991 for most racial/ethnic and sex groups. However, Black males experienced a significant rise in mortality during the 10-year period.

*Leading Causes of Death*

Accidents (unintentional injuries), homicide, and suicide are the top three killers of American youth. Accidents accounted for 44% of all deaths in 1989 through 1991 and about 54% in 1979 through 1981. Motor vehicle accidents were responsible for over one third of all deaths in both time periods. From 1979 to

1991, the death rate due to homicide rose by more than 30%. Suicide was the third leading cause of death, accounting for about 13% of all youth deaths in 1989 through 1991. Suicide, too, has been claiming relatively more lives among the youth; the death rate from suicide rose by 6% from 1979 to 1991.

Cancer and heart disease were the fourth and fifth leading causes of death. The death rates for both causes decreased between 1979 through 1981 and 1989 through 1991. Human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) ranked as the sixth leading cause of death among youth, responsible for 1.6% of all deaths in 1989 through 1991. Between 1987 and 1993, the death rate from HIV/AIDS increased by 38%. Congenital anomalies, pneumonia and influenza, stroke, and chronic obstructive pulmonary diseases were the seventh, eighth, ninth, and tenth leading causes of death in 1989 through 1991, respectively.

*Racial and ethnic differentials.* Accidents, homicide, and suicide remain the top three leading causes of death in youth mortality for all major racial/ethnic groups, although the relative ranking of these causes differs by race/ethnicity. Homicide ranked as the leading cause of death for Black and Hispanic youth, whereas accidents were the leading cause of death for the other groups. The percentage of all youth deaths attributable to homicide

ranged from a low of 9% among Japanese to 37% among Hispanics and 51% among Blacks. Similarly, the proportionate share of accidents varied widely, with a low of 19% for Blacks to a high of 52% for American Indians. Suicide accounted for relatively more youth deaths among Filipinos (20%) and American Indians (19%) than for any other ethnic group.

*Yearly Trends in Major Causes of Death*

Trends in yearly death rates for five major causes of death: suicide, homicide, motor vehicle accidents, accidents excluding motor vehicle crashes, and firearm injuries are presented in Figure 1. Between 1968 and 1993, while youth mortality declined consistently for motor vehicle crashes and other injuries, it doubled for homicide, suicide, and firearm injuries. Vehicular-accident mortality decreased at a much faster pace (3.75% annually) than nonvehicular-accident mortality (1.88%) during 1968 through 1993. The average annual increase was 2.18% for homicide, 1.91% for firearm injuries, and 1.85% for suicide.

*Socioeconomic Differentials in Youth Mortality: Multivariate Hazards Analysis*

Table 2 presents the results of the Cox regression, showing crude and adjusted effects of each covariate on the risk (hazard) of all-cause and external-cause mortality. To avoid the truncation bias, the effects of marital status and education were estimated for those aged 20 to 24 years. Overall, male youth had 2.7 times the risk of their female counterparts. Compared with non-Hispanic Whites, the risk of total mortality was about 1.4 times higher for Blacks, 3.5 times higher for American Indians, and 77% lower for Asians. Family income and education were both inversely related to mortality. Specifically, those with annual family incomes less than $10 000 had 1.6 times the risk of those with family incomes of $25 000 or higher. Youth aged 20 to 24 years with 8 or fewer years of education had a 160% higher mortality risk than those with 13 or more years of education. Compared to married subjects, divorced, separated, or widowed subjects had a 2.2 times higher risk of mortality.

Although education, income, and marital status differentials were similar for mortality from both external causes and firearm injuries, sex and race differentials were more pronounced. Compared

TABLE 2—Bivariate and Multivariate Hazards Regression Estimates of the Effects of Sociodemographic Covariates on Total Mortality and Mortality from External Causes[a] for US Adolescents and Young Adults Aged 15 to 24 Years (n = 114 706), 1979 through 1985

| | Total Mortality | | | | External-Cause Mortality | | | |
| | Crude[b] | | Adjusted[c] | | Crude[b] | | Adjusted[c] | |
| Covariate | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI | Hazard Ratio | 95% CI |
|---|---|---|---|---|---|---|---|---|
| **Sex** | | | | | | | | |
| Female | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| Male | 2.65 | 2.18, 3.22 | 2.71 | 2.22, 3.30 | 3.85 | 3.01, 4.94 | 3.92 | 3.05, 5.02 |
| **Race/ethnicity** | | | | | | | | |
| Non-Hispanic White | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| Non-Hispanic Black | 1.53 | 1.20, 1.94 | 1.36 | 1.05, 1.76 | 1.47 | 1.11, 1.95 | 1.41 | 1.04, 1.91 |
| American Indian | 3.95 | 2.52, 6.20 | 3.51 | 2.22, 5.54 | 4.45 | 2.73, 7.27 | 3.96 | 2.41, 6.52 |
| Asian/Pacific Islander | 0.23 | 0.06, 0.94 | 0.23 | 0.06, 0.91 | 0.31 | 0.08, 1.24 | 0.40 | 0.10, 1.65 |
| Hispanic | 1.02 | 0.71, 1.46 | 1.03 | 0.70, 1.50 | 1.02 | 0.67, 1.54 | 1.14 | 0.74, 1.76 |
| **Place of residence** | | | | | | | | |
| Non-inner city | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| Inner city | 1.13 | 0.93, 1.37 | 1.09 | 0.89, 1.34 | 0.99 | 0.79, 1.25 | 0.97 | 0.76, 1.24 |
| **Family income, $** | | | | | | | | |
| ≥ 25 000 | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| < 10 000 | 1.67 | 1.30, 2.15 | 1.59 | 1.22, 2.07 | 1.56 | 1.17, 2.09 | 1.52 | 1.13, 2.06 |
| 10 000–14 999 | 1.52 | 1.15, 2.01 | 1.51 | 1.14, 2.00 | 1.30 | 0.93, 1.81 | 1.31 | 0.94, 1.83 |
| 15 000–19 999 | 1.19 | 0.86, 1.64 | 1.19 | 0.86, 1.64 | 1.24 | 0.87, 1.78 | 1.25 | 0.87, 1.79 |
| 20 000–24 999 | 1.14 | 0.82, 1.58 | 1.14 | 0.82, 1.59 | 1.17 | 0.81, 1.69 | 1.18 | 0.82, 1.71 |
| Income unknown | 1.78 | 1.22, 2.59 | 1.70 | 1.16, 2.47 | 1.98 | 1.31, 2.98 | 1.88 | 1.25, 2.84 |
| **Nativity status** | | | | | | | | |
| Foreign born | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| US born | 1.71 | 0.99, 2.97 | 1.59 | 0.89, 2.83 | 2.42 | 1.14, 5.11 | 2.34 | 1.07, 5.08 |
| **Marital status[d]** | | | | | | | | |
| Married | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| Single | 1.48 | 1.12, 1.95 | 1.43 | 1.06, 1.93 | 1.59 | 1.14, 2.21 | 1.46 | 1.02, 2.08 |
| Divorced/separated/widowed | 2.32 | 1.44, 3.74 | 2.23 | 1.37, 3.63 | 2.43 | 1.38, 4.26 | 2.37 | 1.33, 4.22 |
| **Education,[d] y** | | | | | | | | |
| ≥ 13 | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference | 1.00 | Reference |
| < 9 | 2.58 | 1.54, 4.31 | 2.60 | 1.52, 4.43 | 2.67 | 1.46, 4.90 | 2.72 | 1.45, 5.10 |
| 9–11 | 2.35 | 1.67, 3.31 | 2.16 | 1.51, 3.09 | 2.90 | 1.97, 4.27 | 2.66 | 1.77, 3.99 |
| 12 | 1.15 | 0.86, 1.55 | 1.15 | 0.85, 1.56 | 1.13 | 0.79, 1.61 | 1.12 | 0.78, 1.62 |
| Education unknown | 1.60 | 0.58, 4.36 | 1.51 | 0.53, 4.28 | 1.72 | 0.54, 5.50 | 1.50 | 0.45, 5.01 |

*Note.* CI = confidence interval.
*Source.* National Longitudinal Mortality Study, 1979 through 1985.
[a]External causes include suicide, homicide, and unintentional injuries (ICD-9 codes E800–E999).
[b]Hazard ratios are unadjusted for the effects of other covariates.
[c]Hazard ratios are adjusted for the effects of all other covariates in the model.
[d]Crude and adjusted effects of marital status and education pertain to those aged 20 to 24 years.

with women, young men had four and six times greater risks of dying from external causes and firearm injuries, respectively. Blacks and American Indians were 1.4 and 4 times more likely than Whites, respectively, to die from external causes. The relative hazards for firearm mortality were 2.1 for Blacks and 4.8 for American Indians. Compared with immigrants, US-born youth had over twice the risk of external-cause mortality. For natural causes (ICD-9 codes 001–799), the mortal-

ity effects of income and inner-city residence were greater than they were for external causes; however, the effects of sex, ethnicity, and education were either insignificant or substantially smaller.

To examine whether socioeconomic variables differentially affected mortality among young men and young women, separate models of total and external-cause mortality were estimated for men and women. The results (not reported here) indicate that although education

had a more powerful effect on male mortality, income was more strongly linked to female mortality.[14] Ceteris paribus, young men aged 20 to 24 years with 8 or fewer years of education had 3.3 times the mortality risk of those with 13 or more years of education. Young women in the lowest family income brackets experienced 2.2 times the mortality risk of their high-income counterparts. These sex differentials may be partly attributable to the stronger influence on social and occupa-

tional status (and hence exposures to work environment) of education for men and of family income for women. The National Longitudinal Mortality Study does indeed show that education is more highly correlated with occupational status, especially blue-collar occupation, among men than among women, whereas family income is more highly associated with occupational status and blue-collar employment among women.[13]

## Discussion

The overall mortality trend among American youth has been less than encouraging. No appreciable reduction in mortality has occurred in the past four decades, especially among males. In fact, youth mortality of Black males has risen at an annual rate of 7% in the past decade. Furthermore, the long-term trend has been characterized by two countervailing trends: a consistently downward trend in deaths due to unintentional injuries (especially motor vehicle crashes) and a consistently rising trend in mortality from violent causes such as homicide, suicide, and firearm injuries.

Substantial differentials in youth mortality were found across sex, racial/ethnic, and socioeconomic groups. The male/female differential was 3:1 for total mortality, 4:1 for external-cause mortality, and 6:1 for firearm mortality. As for the racial disparity, compared with Whites, the risk was generally two and four times higher for Blacks and American Indians, respectively. Blacks and particularly American Indians were at increased risks of external-cause and firearm mortality. Others at significantly increased risks were those in the lowest educational and income strata and those experiencing marital disruption.

The United States ranks poorly among industrialized nations in youth mortality, largely because of much higher mortality rates from violence among its youth. For example, compared with Japan and Sweden, the homicide rate for those aged 15 to 24 years in the United States is 20 to 90 times higher among men and 10

to 16 times higher among women. Similarly, youth mortality from suicide and unintentional injuries is almost twice as high in the United States as in Japan and Sweden.[4,7-9] Given the recent trend and magnitude of youth violence, it is unlikely that the United States will achieve the Year 2000 target of 85 deaths per 100 000 population for the group aged 15 to 24 years.[27] Clearly, the future course of youth mortality in the United States will depend greatly on the extent to which the nation is able to control deaths from unintentional injuries, violence (homicide, suicide, and firearm injuries), and HIV/AIDS infection among its youth. □

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