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This study examined years of potential life lost (YPLL) before age 65 years to assess the relative impact of human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) versus other leading causes of death on premature mortality in New York City, New York, between 1983 and 1994. Most causes of death showed substantial year-to-year variation in YPLL, with the exception of HIV/AIDS. The YPLL attributed to HIV/AIDS increased monotonically from 11,866 in 1983 to 167,317 in 1994, a nearly 15-fold increase. The rank order of the relative contribution of HIV/AIDS to total YPLL changed from the eighth leading cause of death to the leading cause. YPLL from heart disease, which ranked second in 1983, declined to fourth in 1994, homicide was unchanged, and chronic liver disease declined from fifth to ninth rank. The annual YPLL attributed to malignant neoplasms was similar to that for heart disease, but peaked in 1984, and the reduction over the subsequent decade was about 13%. Total YPLL was 78% greater among males than among females in 1983 and was nearly twice as high in 1994. Premature mortality decreased steadily for non-Hispanic whites, from 150,967 to 135,027 years for the years 1983–1994, while increasing 20% among blacks (from 179,176 to 215,826 years) and 48% among Hispanics (from 89,869 to 132,869 years). Among blacks and Hispanics, homicide contributed more years of YPLL than did either heart disease or malignant neoplasms in every year of observation. The HIV/AIDS epidemic and mortality associated with violence have become important public health challenges to the health and well-being of New Yorkers.


Mortality statistics are often used as a measure of the socioeconomic well-being of communities (1) and as a means of quantifying the relative importance of various causes of death (2). As such, they are useful for the identification of priorities for public health efforts in disease prevention and mortality reduction (3). Although a number of different mortality indices can be constructed, such as crude death rates, age-adjusted death rates, or age-specific death rates, measures of premature mortality have been found to be useful because they provide a summary measure of deaths by cause among younger persons (4) and correlate well with other health status indicators (5). In this analysis, we use the number of years of potential life lost (YPLL) before age 65 years as a measure of premature mortality to assess the relative impact of acquired immunodeficiency syndrome (AIDS)-related mortality versus other leading causes of death in New York City, New York, during the period 1983 through 1994.

Analysis of mortality in New York City is informative for several reasons. First, New York City has a large and heterogeneous population. According to the 1990 census, the 7.3 million residents were 43 percent non-Hispanic white, 25 percent black, 24 percent Hispanic, and 7 percent Asian or other races (6). Second, the overall age-adjusted death rate in New York City in 1994 was 24 percent greater than the national average and was 70 percent greater among black than among white New Yorkers (7). Third, New York City is a major urban epicenter of the AIDS epidemic in the United States and has reported nearly 16 percent of all AIDS cases in the nation (8). Fourth, New York City is unique because it is the only city in the nation that maintains an independent vital registration system, and computer access to death certificates is available within a week of filing, minimizing problems with delays in reporting.
MATERIALS AND METHODS

Mortality data from the New York City Department of Health Office of Vital Statistics death tapes for death years 1983 through 1994 were used to calculate premature mortality for deaths of persons aged 0–65 years. Causes of death were stratified by the underlying cause of death as coded by nosologists in accordance with the International Classification of Diseases, Ninth Revision (ICD-9) (9). Human immunodeficiency virus (HIV)/AIDS deaths were estimated using codes for deficiency of cell-mediated immunity (ICD-9 code 279.1), Pneumocystis carinii pneumonia (ICD-9 code 136.3), and Kaposi's sarcoma (ICD-9 code 173.9) for 1983 through 1986, and codes 042–044 for 1987 through 1994 (9, 10). Analysis was restricted to the 15 leading causes of death in 1993 for New York City residents only. The nominal classification of causes of death and their associated ICD-9 codes are shown in Appendix table 1. Separate analyses were conducted by race/ethnicity, gender, and calendar year of death. For this analysis, premature mortality was defined as the YPLL before age 65 years. For an individual, YPLL is calculated as the difference between age at death and age 65 years, and a value of zero is assigned if the age at death was equal to or greater than 65.

RESULTS

Total premature mortality

Total premature mortality in New York City increased from 441,749 years to 571,107 years between 1983 and 1989 (table 1) at an average annual rate of 4.4 percent. After 1989, a general decline was observed, and by 1994, total premature mortality had fallen to 516,597 years. The fifteen leading causes of death shown in table 1 accounted for 78–87 percent of total YPLL during the 12 years of observation.

As shown in figure 1, causes of death such as heart disease and malignant neoplasms contribute proportionately less to YPLL than to total mortality. However, deaths due to HIV/AIDS and homicide contribute more to premature mortality than to total deaths.

Premature mortality attributed to most causes of death showed substantial year-to-year variation, with the one important exception of HIV/AIDS. The YPLL attributed to HIV/AIDS as shown in table 1 increased monotonically from 11,866 years in 1983 to 167,317 years in 1994, a nearly 15-fold increase. Since 1986, HIV/AIDS has been the most important cause of premature mortality among New Yorkers, and the gap between HIV/AIDS and other causes of death has widened in each subsequent year (figure 2). The rank order of the relative contribution of HIV/AIDS to total YPLL shown in table 1 reflects this increase, ascending from eighth to first between 1983 and 1994. In contrast, table 1 shows that YPLL from heart disease, which was second in 1983, declined to fourth in 1994, homicide was unchanged, and chronic liver disease declined from fifth to ninth rank.

A summary of the relative contribution of HIV/AIDS to total premature mortality over time, by gender and race/ethnicity, is presented in table 2. Overall, the contribution of HIV/AIDS to total YPLL increased from less than 3 percent in 1983 to 32.4 percent in 1994.

YPLL due to heart disease reached a maximum of 57,070 in 1985 and, by 1994, had declined by 26 percent to 42,261. The pattern of secular change in YPLL observed among deaths attributed to malignant neoplasms closely resembled those of heart disease, but peaked 1 year earlier, in 1984, and the reduction over the subsequent decade was more than 11 percent.

Homicide was the third highest contributor to YPLL in 1983 and increased from 53,640 to 71,728 years between 1983 and 1990. Between 1990 and 1994, there was a 30 percent decline in premature mortality attributed to homicide, although the YPLL due to homicide as shown in table 1 held the same contribution rank in 1983 as in 1994.

The category “conditions originating in the perinatal period” was the fourth highest contributor to total YPLL in 1983 (table 1) and fifth in 1994. However, the magnitude of YPLL attributed to perinatal conditions should be interpreted with caution. Although the absolute number of perinatal deaths is small relative to other causes with lower YPLL, since these deaths occur near birth, the individual contribution of each death is equal to or near the maximum of 65 years.

Gender differences in premature mortality

As with other measures of mortality, YPLL are characterized by substantial differences between men and women. For example, total YPLL was 78 percent greater among males than among females in 1983 and was nearly twice as high in 1994. Most of the gender differences in premature mortality are explained by the effects of different causes of death. For example, homicide was the leading cause of premature mortality among males in 1983 and occupied this rank until 1985, when HIV/AIDS became the leading cause of YPLL. By contrast, malignant neoplasms were the leading contributors to YPLL among women from 1983 through 1990. After 1990, HIV/AIDS became the leading cause of YPLL among women, followed by malignant neoplasms, perinatal conditions, heart disease, and homicide.

Premature mortality due to heart disease declined among both men and women between 1983 and 1994: from 36,771 to 27,441 years among men and from
TABLE 1. YPLL* before age 65 years, New York City, New York, 1983–1994

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>All causes (total)</td>
<td>441,749</td>
<td>451,363</td>
<td>478,923</td>
<td>509,142</td>
<td>543,206</td>
<td>567,840</td>
<td>571,107</td>
<td>551,433</td>
<td>551,662</td>
<td>531,151</td>
<td>522,640</td>
<td>516,597</td>
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<td>Heart disease</td>
<td>55,201</td>
<td>56,903</td>
<td>57,070</td>
<td>51,808</td>
<td>53,049</td>
<td>49,316</td>
<td>53,678</td>
<td>48,894</td>
<td>47,084</td>
<td>46,187</td>
<td>45,251</td>
<td>42,261</td>
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<td>Malignant neoplasms</td>
<td>59,462</td>
<td>60,797</td>
<td>59,605</td>
<td>56,944</td>
<td>58,391</td>
<td>55,776</td>
<td>56,046</td>
<td>58,644</td>
<td>56,141</td>
<td>53,603</td>
<td>52,080</td>
<td>53,946</td>
</tr>
<tr>
<td>HIV/AIDS*</td>
<td>11,866</td>
<td>25,074</td>
<td>44,731</td>
<td>70,573</td>
<td>84,456</td>
<td>100,196</td>
<td>110,512</td>
<td>117,571</td>
<td>129,940</td>
<td>127,707</td>
<td>144,744</td>
<td>167,317</td>
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<td>Pneumonia and influenza</td>
<td>11,360</td>
<td>15,723</td>
<td>15,847</td>
<td>16,741</td>
<td>15,500</td>
<td>12,438</td>
<td>14,248</td>
<td>15,984</td>
<td>12,270</td>
<td>10,000</td>
<td>11,018</td>
<td>7,176</td>
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<td>Cerebrovascular disease</td>
<td>9,325</td>
<td>9,787</td>
<td>10,406</td>
<td>10,893</td>
<td>10,677</td>
<td>9,851</td>
<td>9,643</td>
<td>9,818</td>
<td>9,038</td>
<td>7,776</td>
<td>7,282</td>
<td>6,658</td>
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<td>Hypertension with or without renal disease</td>
<td>785</td>
<td>865</td>
<td>1,017</td>
<td>545</td>
<td>636</td>
<td>842</td>
<td>980</td>
<td>1,120</td>
<td>1,430</td>
<td>1,890</td>
<td>1,911</td>
<td>1,751</td>
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<tr>
<td>Homicide</td>
<td>53,640</td>
<td>47,926</td>
<td>44,256</td>
<td>49,090</td>
<td>52,454</td>
<td>61,433</td>
<td>60,129</td>
<td>71,728</td>
<td>68,600</td>
<td>64,244</td>
<td>63,256</td>
<td>49,966</td>
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<td>Chronic obstructive pulmonary disease</td>
<td>5,104</td>
<td>5,918</td>
<td>6,425</td>
<td>7,111</td>
<td>6,089</td>
<td>5,684</td>
<td>5,971</td>
<td>5,972</td>
<td>5,336</td>
<td>5,406</td>
<td>5,413</td>
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<td>Accidents</td>
<td>21,108</td>
<td>20,445</td>
<td>19,593</td>
<td>23,044</td>
<td>22,312</td>
<td>24,006</td>
<td>27,492</td>
<td>26,444</td>
<td>26,663</td>
<td>22,533</td>
<td>21,198</td>
<td>19,518</td>
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<tr>
<td>Diabetes mellitus</td>
<td>5,792</td>
<td>5,352</td>
<td>5,256</td>
<td>5,169</td>
<td>5,085</td>
<td>4,472</td>
<td>4,256</td>
<td>4,151</td>
<td>4,106</td>
<td>4,523</td>
<td>4,409</td>
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<td>Drug dependence</td>
<td>16,412</td>
<td>14,124</td>
<td>18,003</td>
<td>19,474</td>
<td>24,917</td>
<td>29,176</td>
<td>24,188</td>
<td>16,309</td>
<td>19,143</td>
<td>19,238</td>
<td>25,438</td>
<td>23,275</td>
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<td>Chronic liver disease and cirrhosis</td>
<td>22,717</td>
<td>23,407</td>
<td>24,851</td>
<td>21,191</td>
<td>20,377</td>
<td>18,014</td>
<td>12,440</td>
<td>10,977</td>
<td>9,937</td>
<td>10,414</td>
<td>9,923</td>
<td>8,924</td>
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<tr>
<td>Conditions originating in the perinatal period</td>
<td>52,650</td>
<td>48,880</td>
<td>54,600</td>
<td>51,285</td>
<td>57,390</td>
<td>62,203</td>
<td>67,857</td>
<td>57,195</td>
<td>56,030</td>
<td>47,709</td>
<td>46,082</td>
<td>39,125</td>
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<td>Suicide</td>
<td>11,661</td>
<td>12,306</td>
<td>11,608</td>
<td>11,588</td>
<td>9,673</td>
<td>11,164</td>
<td>13,705</td>
<td>13,327</td>
<td>12,667</td>
<td>12,180</td>
<td>11,881</td>
<td>11,901</td>
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<tr>
<td>Disease of nervous system</td>
<td>6,462</td>
<td>5,575</td>
<td>6,472</td>
<td>5,450</td>
<td>7,019</td>
<td>6,201</td>
<td>7,369</td>
<td>5,581</td>
<td>5,260</td>
<td>6,165</td>
<td>6,345</td>
<td>4,846</td>
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<td>All other causes</td>
<td>98,234</td>
<td>96,581</td>
<td>96,183</td>
<td>102,236</td>
<td>118,201</td>
<td>117,968</td>
<td>105,599</td>
<td>92,053</td>
<td>88,074</td>
<td>81,546</td>
<td>75,959</td>
<td>68,298</td>
</tr>
</tbody>
</table>

* YPLL, years of potential life lost; HIV, human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome.


18,430 to 14,820 years among women. Declines in YPLL due to malignant neoplasms were significantly different among men and women, with declines of nearly 20 percent among men and essentially no change among women.

The contribution of HIV/AIDS to total YPLL had a greater relative effect among men than among women. For men, YPLL increased from 3.6 percent in 1983 to 34.5 percent in 1994 (table 2), whereas the contribution of HIV/AIDS to total YPLL among women increased from 1.1 percent in 1983 to 28.2 percent in 1994. Although the proportion of total YPLL accounted for by HIV/AIDS was greater for men than for women in each of the 12 years of observation, the gap between the sexes has narrowed over time. For example, the male:female ratio of proportionate YPLL attributed to HIV/AIDS was 3.3:1 in 1983, but declined to 2.2:1 by 1988, and in 1994 was only 1.2:1.

Race/ethnicity differences in premature mortality

Premature mortality decreased steadily for non-Hispanic whites between 1983 and 1994, declining from 150,967 to 135,027 years. However, increases in YPLL occurred among both blacks and Hispanics during this period. Among blacks, total YPLL increased by more than 20 percent, from 179,176 to 215,826 years. An even greater proportional increase (48 percent) was observed among Hispanics, where YPLL rose from 89,869 to 132,869 years. Among blacks and Hispanics, homicide contributed more
years to premature mortality than did either heart disease or malignant neoplasms in every year of observation, in contrast to non-Hispanic whites, for whom YPLL due to homicide was less than half of that due to either of these other conditions.

The contribution of HIV/AIDS to total YPLL had a greater relative effect among Hispanics than among the other racial/ethnic groups. In 1983, both whites and Hispanics had 3.1 percent of their total YPLL attributable to HIV/AIDS, but in 1994, they had 29.4 and 36.7 percent, respectively (table 2). For blacks, YPLL increased from 2.4 percent in 1983 to 34.4 percent in 1994. Although the proportion of total YPLL accounted for by HIV/AIDS was greater for
require several caveats regarding the quality of our females than among males (12).

plained in part by the increasing proportion of diag-

AIDS cases over time among females (11) and

Some historical events occurring during this period require several caveats regarding the quality of our data, but do not substantially alter our conclusions. For example, deaths attributed to HIV/AIDS between 1983 and 1986 did not have a specific nosologic code and were estimated by combining deaths from the most frequent opportunistic illnesses associated with immune deficiency, so they may have been underestimated. Conversely, deaths attributed to pneumocystis were found to be a substantial proportion of the underlying causes of deaths among deceased persons diagnosed with AIDS prior to 1987 in New York City, which would tend to overestimate mortality associated with pneumonia/influenza (1). To avoid the complexities of the often subtle differences in causes of death among persons diagnosed with AIDS compared with deaths due to AIDS, we used vital statistics rather than AIDS surveillance data in calculating premature mortality (13). It should also be noted that changes in YPLL for specific causes may be related to changes in etiologic factors, advances in early diagnosis and treatment, or population changes. The observed reductions in heart disease and malignant neoplasms and the monotonic increase in HIV/AIDS through the years may, in part, reflect differential migration by age. Out-migrants from New York City during the 12 years of this study were more likely to be older, US-born Americans, whereas in-migrants tended to be younger, US-born or foreign immigrants (14).

Richard Rogers has noted that people generally die from degenerative diseases, communicable diseases, or causes due to social pathologies (15). To some extent, the relative importance of these causes are age dependent, with infectious diseases such as HIV/AIDS and social pathologic causes such as homicide, suicide, and drug abuse much more prevalent among younger persons and degenerative diseases such as heart disease, cancer, and circulatory conditions having a much greater impact among the elderly.

While degenerative conditions such as heart disease, neoplasms, cerebrovascular disease, and diabetes still represent major causes of death in New York City, their relative influence on premature mortality has changed over time, primarily from improvements in mortality from these causes.

Social pathologies such as homicide, suicide, accidents, and cirrhosis of the liver emerged during the 1980s as important causes of premature mortality, but varied substantially between men and women, with deaths due to external causes having a much greater influence on premature mortality among men. Deaths due to cirrhosis, most of which are associated with chronic alcohol abuse, declined in recent years, but are still more than twice as prevalent among men as among women.

The emergence of the HIV/AIDS epidemic in the
Effect of HIV/AIDS on Premature Deaths in New York City

early 1980s and the subsequent impact on premature mortality represents one of the most important public health issues facing New Yorkers in this century. Our examination of the effects of different causes of death on premature mortality reinforces the importance of public health efforts to influence behaviors known to be associated with elevated mortality among some groups. Violence, drug abuse, unsafe sexual contact, and other behaviors with negative morbidity and mortality consequences require prevention programs to reduce unnecessary loss of life. Understanding the underlying nature and changing trends of premature mortality provides the information necessary for designing and implementing public health programs and for the rational allocation of limited resources among competing priorities in morbidity reduction.

REFERENCES


APPENDIX TABLE 1. Leading causes of death in New York City, New York, with corresponding ICD-9* codes

<table>
<thead>
<tr>
<th>Causes of death</th>
<th>ICD-9* codes</th>
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<tbody>
<tr>
<td>Diseases of heart</td>
<td>393–398, 402, 404–429</td>
</tr>
<tr>
<td>Malignant neoplasms, including neoplasms of lymphatic and hematopoietic tissues</td>
<td>140–208</td>
</tr>
<tr>
<td>Cerebrovascular diseases</td>
<td>430–438</td>
</tr>
<tr>
<td>HIV* infection†</td>
<td>042†–044‡</td>
</tr>
<tr>
<td>Accidents and adverse effects</td>
<td>E800–E949</td>
</tr>
<tr>
<td>COPD* and allied conditions</td>
<td>490–496</td>
</tr>
<tr>
<td>Pneumonia and influenza</td>
<td>480–487</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>250</td>
</tr>
<tr>
<td>Homicide</td>
<td>E960–E975, E990–E999</td>
</tr>
<tr>
<td>Chronic liver disease and cirrhosis</td>
<td>571</td>
</tr>
<tr>
<td>Suicide</td>
<td>E950–E959</td>
</tr>
<tr>
<td>Conditions originating in the perinatal period</td>
<td>760–779</td>
</tr>
<tr>
<td>Drug dependence</td>
<td>304, E850.0, E854.1, E855.2, E858.8</td>
</tr>
<tr>
<td>Hypertension with or without renal disease</td>
<td>401, 403</td>
</tr>
<tr>
<td>Disease of nervous system</td>
<td>320–389</td>
</tr>
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</table>

* ICD-9, International Classification of Diseases, Ninth Revision; HIV, human immunodeficiency virus; COPD, chronic obstructive pulmonary disease.
† Estimated for 1983 deaths as ICD-9 code 279.1, deficiency of cell-mediated immunity; code 136.3 for Pneumocystis carinii pneumonia; and code 173.9 for Kaposi's sarcoma.
‡ Not part of ICD-9; added by the United States in 1987.