CHAPTER 9

RACIAL/ETHNIC PATTERNS OF AIDS IN THE UNITED STATES

For many reasons it is important to consider differences and similarities in the racial/ethnic (r/e) patterns of AIDS cases in the United States (U.S.). Although most AIDS cases in the U.S. have occurred in white homosexual men, the *per capita* risk of AIDS is generally higher in Blacks and Hispanics. Understanding AIDS case rates and growth rates in r/e subgroups of a risk group can lead to more focused educational or prevention programs. Moreover, cross–checking r/e distributions between related risk groups and between regions provides a simple measure of the confidence which can be placed in the data. Time trends in r/e AIDS cases are analyzed in Chapter 10.

A primary source of r/e data is the January 1992 issue of HIV/AIDS Surveillance Report published by the Centers for Disease Control (CDC, 1992). The r/e distributions given by the percentages in three r/e groups in Tables in this Chapter are calculated from AIDS case data taken from these CDC Tables. Tables 1.1, 1.2 and 1.3 in Chapter 1 give the AIDS cases through December 1991 by exposure category and race/ethnicity for male adults/adolescents, female adults/adolescents and pediatric (< 13 years old) cases. The r/e distributions of AIDS cases are very useful for cross–checking data in related risk groups, but a better measure of connection of the r/e groups is the relative risk. Using the risk for whites as a basis, the relative risk in an r/e group is the ratio of the AIDS incidence per hundred thousand in the r/e group to the AIDS incidence per hundred thousand in whites. Relative risks in r/e groups in the U.S. were analyzed earlier by Selik et al. (1988).

In Section 9.1, the r/e distributions of cumulative AIDS cases in risk groups are compared with the r/e distribution of the U.S. population. In Section 9.2, the r/e distributions of cumulative reported AIDS cases are compared for exposure categories which are related by sexual contacts between males and females. The r/e distributions of AIDS cases in exposure categories related by perinatal transmission are considered in Section 9.3. Possible explanations for observed differences in the r/e distributions are presented. In Section 9.4 the r/e patterns of cases in three subregions of the Northeast (NE) part of the U.S. are analyzed and compared with those in the U.S. The discussion in Section 9.5 summarizes the r/e patterns in the U.S. and NE subregions.

9.1 Racial/Ethnic Patterns of AIDS Cases and Relative Risks

The r/e distributions of cumulative AIDS cases in risk groups of men, women and children can be compared with the r/e distribution of the population in the U.S. In 1985 in the U.S. about 78% of the population was white (not Hispanic), about 12% was black (not Hispanic), about 7% was Hispanic and about 3% was other (Asian/Pacific Islander or American Indian/Alaskan Native) (U.S. Bureau of the Census, 1989). For convenience these categories are referred to as white, black, Hispanic and other. In Table 9.1 57% of the cumulative AIDS cases

Table 9.1. AIDS cases and percentages by race/ethnicity, age group, and sex, reported through December 1991, in the United States.

	Adults/Adolescents							
	Males		Females		Children <13 years old		Total	
Race/ethnicity	No.	(%)	No.	(%)	No.	(%)	No.	(%)
White, not Hispanic	104,180	(57%)	5,466	(26%)	739	(21%)	110,385	(53%)
Black, not Hispanic	47,037	(26%)	11,156	(53%)	1844	(53%)	60,037	(29%)
Hispanic	28,624	(16%)	4,400	(21%)	854	(25%)	33,878	(16%)
Asian/Pacific Islander	1,153	(1%)	105	(0%)	17	(0%)	1,275	(1%)
American Indian/ Alaskan Native	269	(0%)	45	(0%)	8	(0%)	322	(0%)
Total	181,696	(100%)	21,225	(100%)	3,471	(100%)	206,392	(100%)

in adult/adolescent males are white, 26% are black, 16% are Hispanic and 1% are other. Note that the r/e distribution of AIDS cases in males is much different from the r/e distribution of the population. A more detailed analysis of this difference and possible explanations for it are given below by examining risk groups of males.

For adult/adolescent females in Table 9.1, about 26% of cumulative AIDS cases are white, 53% are black, 21% are Hispanic and less than 1% are other. Comparing these percentages with the U.S. population percentages, it is clear that AIDS is much more likely for black and Hispanic females than for females in the white or other groups. R/e differences in AIDS in females in exposure categories are examined below and in Section 9.3. The r/e group of "other" is not usually considered in later analyses since the number of AIDS cases in this group is small. Cumulative AIDS cases in children less than 13 years old are about 21% white, 53% black and 25% Hispanic so that, as in females, AIDS is much more likely for black and Hispanic children than for white children. More details on pediatric AIDS cases in exposure categories are given below and in Section 9.3.

Overall annual case rates per 100,000 people are different among the r/e groups. Table 9.2 gives the AIDS cases and annual rates by r/e groups reported in 1991 in the U.S. (CDC, 1992). Among males the relative risk of AIDS is 3.4 for blacks, 2.5 for Hispanics, 1.0 for whites, 0.3 for Asians/Pacific Islanders and 0.3 for American Indian/Alaskan natives. Among females the relative risk of AIDS is 14.5 for blacks, 7.4 for Hispanics, 1.0 for whites, 0.5 for Asians/Pacific Islanders, and 0.9 for American Indian/Alaskan natives. Among children less than 13 years old, the relative risk of AIDS is 18 for black children, 5 for Hispanic children, 1 for white and Asian/Pacific Islander children, and 1.5 for American Indian/Alaskan native children. Racial/ethnic percentage distributions of AIDS cases are compared for sexually–related exposure categories of males and females in Section 9.2 and for perinatally–related exposure categories in Section 9.3.

Table 9.2. AIDS cases and annual rates per 100,000 population by race/ethnicity, age group, and sex, reported in the United States in 1991.

	Adults/Adolescents							
	Males		Females		Children <13 years old		Total	
Race/ethnicity	No.	Rate	No.	Rate	No.	Rate	No.	Rate
White, not Hispanic	20,716	27.8	1,358	1.7	142	0.4	22,216	11.7
Black, not Hispanic	11,059	95.3	3,102	24.6	400	7.4	14,561	49.2
Hispanic	6,850	69.9	1,213	12.6	133	2.0	8,196	31.4
Asian/Pacific Islander	247	8.5	24	0.8	4	0.3	275	3.7
American Indian/ Alaskan Native	65	9.2	12	1.6	2	0.6	79	4.4
Total	39,093	39.3	5,730	5.4	683	1.4	45,506	17.8

It is useful to compare the r/e distributions of cumulative AIDS cases in risk groups of men, women and children with the r/e distributions of the population which is about 78% white, 12% black and 7% Hispanic. Table 9.3 is constructed from data in Tables 1.1 and 1.2 in Chapter 1. In Table 9.3 the r/e distribution of cumulative AIDS cases in homosexual/bisexual males is 70% white, 17% black and 11% Hispanic so the relative risk is 1.6 for black males and 1.7 for Hispanic males and 1.0 for white males. Possible explanations are that black and Hispanic males are more likely to be homosexual/bisexual than white males, that black and Hispanic homosexual males are more likely to engage in risky behavior, or that black and Hispanic homosexual males are more likely to get HIV infection than white homosexual males.

The r/e distributions of AIDS cases in Table 9.3 for homosexual male IVDUs is 57% white, 27% black and 15% Hispanic so that the relative risk is 3.1 for black males, 2.9 for Hispanic males and 1.0 for white homosexual male IVDUs. Possible explanations are that black and Hispanic males are more likely to be homosexual IVDUs who share needles or that black and Hispanic male homosexuals are more likely to get an HIV infection than their white counterparts. The r/e distribution for AIDS cases for male IVDUs is 20% white, 48% black and 32% Hispanic so that the relative risk is 16 for black, 18 for Hispanic, and 1.0 for white IVDU males. Possible explanations are that black and Hispanic males are much more likely to be needle–sharing IVDUs than white males, or that they are more likely to get HIV infection than white males.

The r/e distribution of cumulative AIDS cases in Table 9.3 for female IVDUs is 21% white, 58% black and 20% Hispanic. Thus the relative risk is 18 for black female IVDUs, 11 for Hispanic female IVDUs, and 1.0 for white female IVDUs. Note that the relative risks for black male and female IVDUs are similar, but that the relative risks for Hispanic IVDUs are somewhat different. It is possible that black and Hispanic females are significantly more likely to be IVDUs than white females, or that they are more likely to get HIV infection than white females.

Table 9.3. AIDS cases by exposure category and race/ethnicity, reported through December 1991, in the United States.

male/female exposure category	White, not Hispanic No.	(%)	Black, not Hispanic No.	(%)	Hispanic No.	(%)	Total No.
male homosexual/bisexual contact	83,205	(70%)	20,540	(17%)	13,240	(11%)	118,362
female–sex with bisexual male	343	(53%)	216	(33%)	78	(12%)	651
male homosexual IV drug user	7,547	(57%)	3,578	(27%)	1,925	(15%)	13,135
male (heterosexual) IV drug user	7,017	(20%)	16,798	(48%)	11,083	(32%)	35,048
female–sex with IV drug user	859	(19%)	2,244	(50%)	1,343	(30%)	4,484
male–sex with IV drug user	483	(26%)	1,077	(57%)	313	(17%)	1,882
female IV drug user	2,268	(21%)	6,185	(58%)	2,191	(20%)	10,705
male–hemophilia/ coagulation disorder	1,373	(82%)	127	(8%)	137	(8%)	1,671
female–sex with person with hemophilia	78	(83%)	10	(11%)	4	(4%)	94
male–sex with person with hemophilia	7	(70%)	1	(10%)	2	(20%)	10
female–hemophilia/ coagulation disorder	29	(69%)	10	(24%)	3	(7%)	42
male born in Pattern II country	8	(0%)	1,779	(99%)	11	(1%)	1,805
female–sex with person born in Pattern II country	10	(13%)	63	(83%)	2	(3%)	76
male–sex with person born in Pattern II country	40	(41%)	48	(49%)	9	(9%)	98
female–born in Pattern II country	5	(1%)	709	(99%)	3	(9%)	718
male–receipt of blood transfusion blood components or tissue	1,938	(72%)	418	(16%)	259	(10%)	2,679
female–sex with transfusion recipient with HIV infection	102	(63%)	28	(17%)	28	(17%)	161
male–sex with transfusion recipient with HIV infection	43	(54%)	19	(24%)	16	(20%)	79
female–receipt of blood transfusion, blood components or tissue	1,055	(63%)	349	(21%)	220	(13%)	1,668
male–other/undetermined	2,287	(37%)	2,269	(37%)	1,432	(23%)	6,114
female–sex with HIV–infected person, risk not specified	303	(28%)	514	(48%)	236	(22%)	1,065
male–sex with HIV–infected person, risk not specified	232	(29%)	383	(47%)	197	(24%)	813
female–other/undetermined	414	(27%)	828	(53%)	292	(19%)	1,561

The r/e distribution of AIDS cases in people with hemophilia/coagulation disorder cannot be simply compared to the r/e distribution of the population since some r/e groups in this category are more likely to have had other risk factors and some are more likely to have received single donor blood products (Stehr–Green et al., 1988). The r/e patterns of AIDS cases in people born in Pattern II countries clearly implies that nearly all of them are black.

In Table 9.3 the r/e distribution of AIDS cases in males who received blood transfusions, blood components or tissue is 72% white, 16% black and 10% white which is reasonably close to the r/e distribution of the population. For females who received blood transfusions, etc., the r/e distribution is 63% white, 21% black and 13% Hispanic so that the per capita AIDS case rate in these black and Hispanic females is about twice that in whites. This could be due to more frequent blood transfusions in black and Hispanic women.

In Table 9.3 the r/e distribution of cumulative AIDS cases in males in the other/undetermined category is 37% white, 37% black and 23% Hispanic. Comparing this with the r/e distribution of all male AIDS cases in Table 9.1 shows that black and Hispanic males with AIDS are about twice as likely to be in the other/undetermined category as white males with AIDS. For females in the other/undetermined category, the r/e distribution of AIDS cases is 27% white, 53% black and 19% Hispanic which is close to the r/e distribution for all females with AIDS in Table 9.1. Thus white, black and Hispanic women with AIDS are all about equally likely to be in the other/undetermined category.

In Table 1.3 it is clear that most AIDS cases in children are perinatal from mothers who have or are at risk for HIV infection; these exposure categories are analyzed in Section 9.3. For children with hemophilia/coagulation disorder in Table 1.3, the r/e distribution is 69% white, 13% black and 16% Hispanic. Compare this to the r/e distribution of the population which is 78% white, 12% black and 7% Hispanic. It is possible that Hispanic children are more likely to be hemophilic or that Hispanic hemophilic children are more likely to get AIDS, but these explanations are probably too simplistic since the treatment received is not uniform for the r/e groups (Stehr–Green et al., 1988). For children who received blood transfusions, blood components or tissue, the r/e distribution of AIDS cases in Table 1.3 is 53% white, 22% black and 23% Hispanic. This r/e distribution does not match that of the U.S. population. As in females it is possible that blood transfusions are more common for Hispanic and black children.

9.2 Exposure Categories Related by Sexual Contacts

Racial/ethnic distributions of cumulative AIDS cases are compared for male and female exposure categories which are connected by sexual contacts between individuals in the categories. Table 9.3 contains the cumulative numbers of reported AIDS cases and percentages in three r/e groups for many exposure categories. Because the number of cases are usually small in the r/e groups of Asian/Pacific Islander and American Indian/Alaskan native, these r/e groups are not considered in this section.

9.2.1 Relating Exposure Categories

Many of the comparisons in this section assume that sexual pairing occurs primarily within the racial/ethnic groups so that the r/e percentages should match for exposure categories connected by sexual pairing. Of course, there is some pairing across r/e boundaries; however, the assumption above is reasonable if the pairing between people in different r/e groups is relatively infrequent and the cross pairings between men in a first group and women in a second group are nearly balanced by cross pairings between women in the first group and men in the second group.

The comparisons of r/e distributions in related exposure groups in this and succeeding sections are based on various assumptions. A typical comparison in this section is between the exposure categories of male (heterosexual) intravenous drug users (IVDUs) and (non–IVDU) females who have had sex with a male IVDU. It seems that the r/e distributions between these two directly–connected exposure categories should match, but this involves some implicit assumptions. A possible connecting chain is that:

1. the cumulative reported AIDS cases in females who have had sex with IVDU males is related to
2. the cumulative AIDS cases in these females, which is related to
3. the history of HIV incidence of these females who have had sex with IVDU males, which is related to
4. the history of HIV prevalence of IVDU males, which is related to
5. the history of HIV incidence in IVDU males, which is related to
6. the cumulative AIDS cases in IVDU males, which is related to
7. the cumulative reported AIDS cases in IVDU males.

Before discussing the relationships between the 7 items above, it is important to note that the details of the relationships do not have to be understood; all that is necessary is that the relationships between the numbered items are approximately the same for all of the r/e groups so that the overall relationship between 1 and 7 is the same for all of the r/e groups. If the history of underreporting is the same for all r/e groups, then the relationships between 1 and 2 above and also between 7 and 6 are the same for all r/e groups. If the progression from HIV infections to AIDS is similar historically for all r/e groups, then the relationship between 2 and 3 is the same for all r/e groups. A similar assumption implies that the relationship between 5 and 6 is the same for all r/e groups. Note that the relationship of 2 to 3 is not the same as the relationship of 6 to 5 since the HIV epidemic in females who have had sex with IVDU males is at an earlier stage than the HIV epidemic in IVDU males; i.e., the HIV incidence curve for these females rises later than the HIV incidence curve for the males since the females get the HIV infections from the infected males.

Item 3 is related to item 4 since the HIV incidence in these females at a given time is approximately proportional to the HIV prevalence in their male partners and the susceptible fraction of the females; it is assumed that this relationship is approximately the same for all r/e groups. Item 4 is related to item 5 since the HIV prevalence in these males at a given time is

related to the history of HIV incidence in these males and their progression to AIDS and death; it is assumed that this relationship is approximately the same for all of the r/e groups.

Thus the expectation that the r/e distributions of cumulative reported AIDS cases should match between the two exposure categories is based on the assumption that sexual pairing occurs primarily within the r/e groups and that the overall relationship between the two exposure categories is the same for the r/e groups. When the r/e distributions do not match for two related exposure categories, there could be many possible explanations; for example, the relationships between some items in the connecting chain above could be different in different r/e groups. When the r/e distributions do not match in the comparisons below, some possible explanations are given.

9.2.2. Homosexual/Bisexual Males

It would be expected that the racial/ethnic distributions of AIDS cases should match for the female exposure category of sex with a bisexual male and the exposure category of bisexual male. The exposure category of bisexual male is not in Table 9.3, but the r/e percentage distribution for bisexual males is about 59% white, 28% black and 12% Hispanic (J. Karon, personal communication). This r/e distribution matches reasonably well to that of the exposure category of females who had sex with a bisexual male. Note that the r/e distributions of bisexual males and males with homosexual/bisexual contact do not match very well. A possible explanation is that bisexual behavior is more common among black men than among whites and Hispanics. This observation that black homosexual/bisexual men may be more likely to be bisexual is consistent with reports in the sociology literature (Darrow, personal communication). Chu et al. (1992) reported that among 65,389 men who had sex with men, 26% were bisexual. Bisexual behavior was reported by 41% of black men, 31% of Hispanic men and 21% of white men in those men who had sex with men.

In Table 9.3 the r/e distribution of AIDS cases in males with homosexual/bisexual contact and IV drug use is 57% white, 27% black and 15% Hispanic. For each r/e group these percentages are between those for males with homosexual/bisexual contact and males with IV drug use. Since the r/e distribution for homosexual/bisexual IVDU males is closer to that of homosexual/bisexual males, the males with homosexual contact and IV drug use may behave more like homosexual/bisexual males than like IVDUs and hence may be more likely to be infected through homosexual contacts then through needle–sharing contacts with IVDUs.

9.2.3. Intravenous Drug Users

Consider cumulative reported AIDS cases in the exposure categories of male (heterosexual) IVDUs and female IVDUs. Although about the same percentages (20% and 21%) are whites in these exposure categories, 58% of female IVDUs are black compared to 48% black for male (heterosexual) IVDUs and 20% of females are Hispanic compared to 32% Hispanics for male (heterosexual) IVDUs. For all (heterosexual) IVDUs about 23% of AIDS case occur in females and 77% in males; this seems to suggest that 23% of IVDUs are females and 77% are males. For

(heterosexual) IVDUs, about 24% of AIDS cases occur in females among whites, about 27% occur in females among blacks and only about 17% occur in females among Hispanics. This does not mean Hispanic females are less likely to be IVDUs than white and black females. Recall the implications from Section 9.2 that black males and females may be about 16 to 18 times as likely to be IVDUs as white males and females, but that his likelihood ratio may be about 16 for Hispanic males and 11 for Hispanic females. Although a smaller percentage of Hispanic IVDUs are females, Hispanic females are much more likely to be IVDUs than white females but slightly less likely than black females.

Two exposure categories connected by sexual contacts are male (heterosexual) IVDUs and females who had sex with IVDUs. Indeed, these two categories are used as the typical example at the beginning of this section. The r/e percentages in Table 9.3 for these categories match remarkably well. This suggests that the relationship between the HIV and AIDS epidemics in these two exposure categories is about the same for the r/e groups and that reporting for these two categories may be reasonably accurate.

The exposure categories of female IVDUs and males (heterosexual) who had sex with female IVDUs are also connected through sexual contacts. However, Des Jarlais (personal communication) believes that the exposure category of (non–IVDU) male (heterosexual) who had sex with female IVDUs is often used for men who should be in another category; he believes that it is rare for a female IVDU to have a sexual partner who is not also an IVDU. Nevertheless, the r/e distributions in Table 9.3 for these two groups show some consistency with slightly more white males then would be expected and slightly fewer Hispanic males than expected.

Based on his knowledge of IVDUs in New York City, Des Jarlais (personal communication) estimated that about 2/3 of IVDU males have female sexual partners who are not IVDUs, about 1/4 have female sexual partners who are also IVDUs, and very few have no sexual partner. He also estimated that nearly all IVDU females have a male sexual partner who is also an IVDU, and very few have partners who are not IVDUs or no sexual partner. This would mean that the exposure category of males (heterosexual) who had sex with an IVDU woman would be nearly empty and, indeed, in the New York City data, this exposure category is nearly empty.

It is possible to check the consistency of the estimates above of Des Jarlais if it is assumed that the numbers of HIV infected persons in the exposure categories are proportional to the numbers of AIDS cases in the exposure categories. If 77% of IVDUs are male and 25% of all male (heterosexual) IVDUs have a female sexual partner who is also an IVDU and there is a one to one correspondence, then 84% of female IVDUs must have a male sexual partner who is also an IVDU since $0.25 \times 0.77 = 0.84 \times 0.23$. This calculated 84% is consistent with the estimate that nearly all female IVDUs have a male sexual partner who is also an IVDU; the remaining 16% of female IVDUs would have no sexual partner or a male sexual partner who is not an IVDU.

9.2.4. Other Sexually–Related Categories

In Table 9.3 the r/e percentage distributions of AIDS cases for people with hemophilia/coagulation disorder and their sexual partners should match. Although the number of AIDS cases in females who had sex with a person with hemophilia is small, the percentage

distribution matches reasonably well to that for AIDS cases in males with hemophilia/coagulation disorder. The number of AIDS cases in males who had sex with a female with hemophilia is too small to compare r/e distributions.

Now consider people born in Pattern II countries and their sexual partners. Although in Table 9.3 the number of AIDS cases is small for females in the exposure category of sex with a person born in a Pattern II country, the r/e distribution for this category matches reasonably well with that of AIDS cases for males born in Pattern II countries. This is not surprising since nearly everyone in these exposure categories is black.

The r/e distribution in Table 9.3 for males in the exposure category of sex with a person born in a Pattern II country is very different from that for females born in a Pattern II country. One explanation of the difference could be that a significant number of white males had sex with black females born in Pattern II countries; indeed, the data suggest that for women born in Pattern II countries, about half of these sexual partners are white and half are black. Another possibility is that many white men in this exposure category of sex with a woman born in a Pattern II country are misclassified.

Although the number of AIDS cases in Table 9.3 in males and females who had sex with recipients of transfusions, blood components or tissue is relatively small, these r/e distributions match reasonably well with the distributions of AIDS cases for the female and male recipients, respectively. Since the population is 78% white, 12% black and 7% Hispanic, it might be expected that this distribution would also hold for AIDS cases in recipients of blood transfusions, blood components or tissue. This distribution matches reasonably well for males, but not as well for females. The data suggests that black and Hispanic females may receive blood transfusions, blood components or tissue relatively more frequently than white females.

For the exposure categories of other/undetermined which contain miscellaneous and leftover AIDS cases, one might not expect matching of the r/e distribution of the AIDS cases in these categories and AIDS cases in the corresponding sexual partner category. Surprisingly, the r/e distributions of AIDS cases in Table 9.3 do match reasonably well for both males and females in the other/undetermined categories and female and male AIDS cases in the category of sex with HIV–infected person, risk not specified.

9.2.5. Estimating HIV Transmission

It was recently estimated that there are approximately one million people in the United States who are infected with HIV (CDC, 1990b). The cumulative number of AIDS cases reported in the U.S. at the end of 1991 was 206,392 (CDC, 1992). Since cumulative actual AIDS cases are slightly greater than cumulative reported AIDS cases, the ratio K of cumulative HIV incidence to cumulative AIDS cases is now approximately between 4 and 5 for all people in the U.S. As cumulative AIDS cases increase in the future, the ratio K will decrease towards the value one. Of course, the ratio K not only changes with time, but is also different for different risk groups. If only a few AIDS cases have appeared in a risk group, then the value of K would be large; however, the value of K would decrease as the epidemic progresses and the cumulative AIDS incidence increases in the risk group. Since children progress more rapidly to AIDS than adults,

values of K for risk groups of children would be lower than if a similar HIV epidemic were occurring in adults.

The AIDS case data in Table 9.3 can be used to obtain some information on HIV transmission between people in exposure categories related by sexual contacts. As a concrete example, consider the exposure categories of male (heterosexual) IVDUs and (non–IVDU) female sexual partners of male IVDUs. For the ratio K defined in the previous paragraph, let K_1 be the current value for male (heterosexual) IVDUs and K_2 be the current value for female sexual partners of male IVDUs. Then the average number D of female sexual partners of male IVDUs infected per new HIV case in male (heterosexual) IVDUs who have female sexual partners is

$$D = \frac{\text{cumulative HIV incidence in female sexual partners of male IVDUs}}{\text{cumulative HIV incidence in male IVDUs who have female sexual partners}}$$

$$= \frac{K_2(\text{cumulative AIDS cases in female sexual partners of male IVDUs})}{K_1(\text{cumulative AIDS cases in male IVDUs})(\text{fraction who have female sexual partners})}$$

If K_2 were equal to K_1 at the current time, then they would cancel out in the last quotient above and the result would be an estimate of D. However, early in an HIV epidemic there are fewer AIDS cases per HIV case than later and the HIV infections in the female sexual partners occur later than the HIV infections in the male IVDUs, so that K_2 is probably somewhat greater than K_1. Thus

$$D \geq \frac{\text{cumulative AIDS cases in female sexual partners of male IVDUs}}{(\text{cumulative AIDS cases in male IVDUs})(\text{fraction who have female sexual partners})}$$

so that the right side is a lower bound on D for female sexual partners of male IVDUs. If reporting delays are similar for these females and males, then cumulative reported AIDS cases can be used in the numerator and denominator of the quotient above. Analogous quotients apply for other exposure categories related by sexual transmission.

Table 9.4 contains data from Table 9.3 on the cumulative reported AIDS cases for exposure categories and the categories related by sexual transmission. In Table 9.4 the fractions of male and female IVDUs with non–IVDU sexual partners are those estimated in a paragraph above. Since 72% of males over age 20 are married (World Almanac, 1988), this 72% is a reasonable estimate for the percent of adult males who have a female sexual partner. Since 44% of blood transfusion recipients are age 65 or older and 58% of transfusion recipients are women (NHLBI, 1985), many female transfusion recipients do not have a sexual partner so that the fraction 0.50 is used in Table 9.4. The last column in Table 9.4 contains the estimates of the quotient above, which are obtained using the values in the first three columns. These are estimates of lower bounds on the average number D of sexual partners infected per HIV case.

Table 9.4. Estimates of lower bounds on the average number D of sexual partners infected per HIV case.

exposure category	AIDS cases	fraction with sexual partners	AIDS cases in sexual partners	lower bound on D
male (heterosexual) IVDUs	35,048	0.67	4,484	0.19
female IVDUs	10,705	0.08	1,882	2.20
males–hemophilia/coagulation disorder	1,671	0.72	94	0.08
males–born in Pattern II country	1,805	0.72	76	0.06
females–born in Pattern II country	718	0.72	98	0.19
males–blood transfusion recipients	2,679	0.72	161	0.08
females–blood transfusion recipients	1,668	0.50	79	0.09
males–other/undetermined	6,114	0.72	1,065	0.24
females–other/undetermined	1,561	0.72	813	0.72

The value 2.20 for (non–IVDU) male sexual partners of female IVDUs appears to be unrealistically large; it would still be too large if the fraction of female IVDUs with (non–IVDU!) male sexual partners were as large as 0.16. Thus this calculation reinforces the previous suggestion that many males in this exposure category may be misclassified. The value of 0.72 for male sexual partners of females in the other/undetermined category also seems too high, but this is not surprising due to the miscellaneous nature of this category.

The remaining seven estimates for lower bounds for values in Table 9.4 range from 0.06 to 0.24 so that this range seems plausible. The lower bound 0.19 for D occurs for (non–IVDU) female sexual partners of male IVDUs and for male sexual partners of females born in Pattern II countries. For hemophiliacs and blood transfusion recipients, there have been almost no new HIV infections since early 1985 when the testing of blood for HIV was started. Since HIV incidence does not increase, but AIDS cases continue to occur in these groups, the ratio K would be smaller for these groups than for their sexual partners where new HIV cases are still occurring. Hence, K_2/K_1 would be larger than if the HIV epidemic had continued in hemophiliacs and blood transfusion recipients. Thus it is not surprising that the quotient estimates for these groups in Table 9.4 are lower. The range 0.08 to 0.09 for hemophiliacs and blood transfusion recipients is enough lower that there may also be other factors involved. For example, the types of sexual interactions might be safer or less likely to result in HIV transmission than the sexual interactions occurring between male IVDUs and their sexual partners. It is not clear why the estimated lower bound (0.06) is low for males born in Pattern II countries.

Table 9.5. AIDS cases by exposure category and race/ethnicity, reported through December 1991 in the United States.

female/pediatric exposure category[1]		White, not Hispanic No.	(%)	Black, not Hispanic No.	(%)	Hispanic No.	(%)	Total No.
IV drug use	(female)	2,268	(21%)	6,185	(58%)	2,191	(20%)	10,705
	(pediatric)	224	(16%)	833	(58%)	365	(26%)	1,430
sex with IV drug user	(female)	859	(19%)	2,244	(50%)	1,343	(30%)	4,484
	(pediatric)	91	(15%)	269	(45%)	238	(39%)	603
sex with bisexual male	(female)	343	(53%)	216	(33%)	78	(12%)	651
	(pediatric)	22	(36%)	24	(39%)	14	(23%)	61
sex with person with hemophilia	(female)	78	(83%)	10	(11%)	4	(4%)	94
	(pediatric)	9	(69%)	3	(23%)	1	(8%)	13
born in Pattern II country	(female)	5	(1%)	709	(99%)	3	(0%)	718
	(pediatric)	1	(0%)	241	(99%)	2	(1%)	244
sex with person born in Pattern II country	(female)	10	(13%)	63	(83%)	2	(3%)	76
	(pediatric)	0		13	(93%)	0		14
sex with transfusion recipient with HIV infection	(female)	102	(63%)	28	(17%)	28	(17%)	161
	(pediatric)	4	(31%)	4	(31%)	4	(31%)	13
sex with HIV–infected person, risk not specified	(female)	303	(28%)	514	(48%)	236	(22%)	1,065
	(pediatric)	30	(21%)	70	(49%)	40	(28%)	144
receipt of blood transfusion, blood components or tissue	(female)	1,055	(63%)	349	(21%)	220	(13%)	1,668
	(pediatric)	22	(37%)	25	(42%)	13	(22%)	60
undetermined	(female)	414	(27%)	828	(53%)	292	(19%)	1,561
	(pediatric)	62	(18%)	222	(63%)	65	(18%)	354

[1]The pediatric exposure category describes the category of their mothers who are with or at risk for HIV infection.

9.3 Perinatally–Related Exposure Categories

Table 9.5 contains data on cumulative AIDS cases reported through 1991 for pediatric categories and corresponding exposure categories for females. The AIDS case data are taken directly from Tables 1.2 and 1.3 in Chapter 1. Racial/ethnic percentage distributions are compared for pediatric and female exposure categories connected by perinatal transmission.

A typical comparison of r/e distributions in this section is for AIDS cases for IVDU females and pediatric AIDS cases with a mother who was at risk due to IVDU. One assumed chain of connections in this case is that the cumulative reported pediatric AIDS cases with an IVDU mother is related to the cumulative number of AIDS cases in this group; which is related to the history of HIV incidence in these children, which is related to the history of HIV prevalence in female IVDUs, which is related to the history of HIV incidence in this group, which is related to the cumulative reported AIDS cases in female IVDUs. As in the previous section it is assumed that the relationships in this connecting chain are the same for all r/e groups so that the overall relationships are also the same. In particular, it is assumed that both the birthrates and the fractions infected by HIV infected mothers are constant and equal for the r/e groups.

For the category of IVDU in Table 9.5, the percentage distributions for females and pediatric cases do not match since there are fewer pediatric AIDS cases than expected in whites and more than expected in Hispanics. This same pattern also occurs in the four other exposure categories: sex with IVDU, sex with bisexual male, sex with HIV–infected person (risk not specified) and receipt of blood transfusions, blood components or tissue. What are possible explanations for the pattern observed in the five categories where there are fewer pediatric AIDS cases than expected in whites and more than expected in Hispanics?

Most of the mismatching above of the r/e distributions can be explained by the differences in birthrates in the r/e groups. In 1985 in the U.S. the births per 1000 women, aged 18 to 44 were 66.9, 76.4 and 107.3 for whites, blacks and Hispanics, respectively (World Almanac, 1988). Thus the birth rate for Hispanic females is 1.6 times as large as for white females and is 1.4 times as large as for black females. In Table 9.5 the ratios of pediatric AIDS cases to female AIDS cases for white, blacks and Hispanics, respectively are: 0.10, 0.13 and 0.17 for the IVDU category, 0.11, 0.12 and 0.18 for the sex with IVDU category and 0.06, 0.11 and 0.18 for the sex with bisexual male category. For these three categories the Hispanic ratios divided by the white ratios are 1.7, 1.6 and 3.0 and the Hispanic ratios divided by the black ratios are 1.3, 1.1 and 1.6; these quotients are roughly consistent with the birth rate quotients of 1.6 and 1.4 obtained above. Thus most of the mismatchings of r/e distributions between pediatric and female AIDS cases in perinatally related categories are explained by the higher birth rates for Hispanic women.

The birth rate for black women is between that for white and Hispanic women so that the matching of percentages for blacks in Table 9.5 is reasonably good. A category where the percentage match is not as good for blacks is the sex with bisexual male category, but the total pediatric AIDS cases (61) in this category is small so that misclassification of a few pediatric cases, particularly in black children , could greatly affect this r/e distribution of pediatric AIDS cases. On the other hand, the large percentage of black pediatric AIDS cases in this category

reinforces the earlier suggestions that bisexual behavior may be more common among black homosexual/bisexual males than among white or Hispanic homosexual/bisexual males.

Some of the categories in Table 9.5 have so few pediatric cases that the r/e distributions between pediatric and female AIDS cases could not be expected to match; such categories are sex with person with hemophilia, sex with person born in Pattern II countries and sex with transfusion recipient with HIV. The r/e distributions of AIDS cases in females and children match well for the category of born in a Pattern II country, but they should match since nearly all AIDS cases here are black. For the category of blood transfusion recipients, the r/e distributions do not match well. This may be because the number of pediatric cases is small (60) or because the r/e distribution of pediatric cases depends on the r/e distribution of blood transfusions in women of child–bearing age; data in Section 9.2.4 suggest that blood transfusions are more common in black and Hispanic females. Despite the miscellaneous nature of the undetermined category, the r/e distribution of AIDS cases in females and children are reasonably close.

In a manner similar to the approach in Section 9.2, it is possible to obtain quantitative information about HIV transmission from HIV infected females to their offspring. At a given time the average number E of offspring infected per new HIV case in a female in a specified category is

$$E = \frac{\text{cumulative HIV incidence in offspring of these females}}{\text{cumulative HIV incidence in females in the category}}$$

$$= \frac{K_3(\text{cumulative AIDS incidence in offspring of these females})}{K_4(\text{cumulative AIDS incidence in females in the category})}$$

$$\approx \frac{\text{cumulative AIDS incidence in offspring of these females}}{\text{cumulative AIDS incidence in females in the category}}$$

The constant K_3 might be expected to be greater than the constant K_4 since the HIV epidemic is occurring later in the children, but K_3 would also be lower since children progress more rapidly to AIDS than adults. If these two factors balance out, then K_3 would be approximately equal to K_4 so that the last quotient may be a reasonable approximation to E. Table 9.6 contains cumulative AIDS case data taken from Table 9.5 and also contains the quotients above as estimates of E values.

For six of the ten exposure categories in Table 9.6, the estimates of E are between 0.13 and 0.23 so that they are fairly close together. This suggests that in most exposure categories, for every new HIV case in a female, one can expect approximately 0.18 HIV cases in a child. For females who have had sex with a bisexual male, the estimate of 0.10 for E is lower, but this was also a problem category because of r/e distribution mismatching in Tables 9.3 and 9.5. The low estimate in Table 9.6, together with the mismatching in Tables 9.3 and 9.5, suggest that there may be underreporting or misclassification of white females who were exposed through sex with bisexual males. For females born in Pattern II countries, the estimate of 0.34 for E is about

Table 9.6. Estimates of the average number E of offspring infected per HIV case in females.

female exposure category	AIDS cases	AIDS cases in their offspring	estimates of E
IVDUs	10,705	1,430	0.13
sex with male IVDUs	4.484	603	0.13
sex with hemophilic males	651	61	0.09
born in Pattern II country	218	244	0.34
sex with male born in Pattern II country	76	14	0.18
sex with transfusion recipient with with HIV infection	161	13	0.08
sex with HIV–infected person, risk not specified	1,065	144	0.14
recipient of blood transfusion, blood components or tissue	1,668	60	0.04
undetermined	1,561	354	0.23

twice that for most of the other categories; it is possible that these black females are twice as likely to have children as females in the other categories. For females infected through blood transfusions, the estimate of 0.04 for E is very low, but this is easy to explain since many women receiving blood transfusions are beyond child–bearing age. In blood transfusion recipients, only 0.34 of adult/adolescent AIDS cases are between 13 and 44 (CDC, 1992).

9.4 Racial/Ethnic Patterns of AIDS Cases in the Northeast Region

It is interesting to carry out these same r/e pattern analyses in the Northeast (NE) region of the U.S. Comparisons of three subregions of the NE with each other and with the entire U.S. yield some interesting results. Estimates of yearly AIDS incidences through 1990 in risk groups in the U.S. and three subregions of the NE region of the U.S. have been obtained from the Centers of Disease Control. The risk–undetermined AIDS cases have been redistributed and the data have been adjusted for reporting delays using methods described in Karon et al. (1989). The total consistent cases as described in Chapter 10 are used here. Graphs of these incidence data as a function of time are given in Chapter 10.

The three subregions of the NE region are: region A consisting of New York City, region B consisting of the rest of New York State, New Jersey (minus Philadelphia MSA), Connecticut and Rhode Island, and region C consisting of Maine, New Hampshire, Vermont, Massachusetts, Pennsylvania and the portion of Philadelphia MSA in New Jersey. Total consistent case data are arranged by risk groups and r/e categories for the U.S. and NE regions A, B and C in Tables 9.7–9.9 and 9.12–9.13. These Tables also include r/e percentage distributions and cases per 100,000 population (in each r/e category). The population sizes and r/e percentage

distributions on July 1, 1985 (U.S. Bureau of the Census, 1989) are 185.0 million (78%) white, 28.8 million (12%) black, and 17.5 million (7%) Hispanic for the U.S. In subregion A, there are 7.9 million (65%) white, 2.2 million (18%) black, and 1.7 million (14%) Hispanic. In subregion B, there are 14.1 million (82%) white, 1.9 million (11%) black, and 1.0 million (6%) Hispanic. In subregion C, there are 18.5 million (82%) white, 1.4 million (7%) black, and 0.3 million (1.6%) Hispanic. These tables are useful for comparisons in the following subsections.

9.4.1. Racial/Ethnic Patterns of AIDS Cases in Risk Groups in NE Subregions

For homosexual/bisexual males the AIDS cases per 100,000 r/e population in Table 9.7 are higher for black and Hispanic males than for white males. In particular, the AIDS case rates for blacks and Hispanics are about 1.5 times those of whites in the U.S. and in region A, about 2 times in region B and about 3 times in region C. Note that the cumulative AIDS cases per 100,000 population in New York City are about 2 to 3 times higher than in the U.S. and in regions B and C. This is not surprising since New York City is usually thought to be a preferred place to live by many homosexual men.

From data on male homosexual IVDUs in Table 9.7, the AIDS case rates per 100,000 r/e population are much higher for blacks and Hispanics than for whites. Specifically, the case rates for blacks and Hispanics are about 2 to 3 times those for whites in the U.S., about 4 times in region A, about 6 times in region B and about 9 times in region C. Note for blacks and Hispanics, the cumulative AIDS case rates per 100,000 r/e population in regions B and C are almost as high as those in New York City (region A).

The patterns for male (heterosexual) IVDUs in Table 9.8 are interesting. The AIDS cases per 100,000 population in blacks and Hispanics are always at least 10 times those for whites in the U.S. and in regions A, B and C. For whites the AIDS cases per 100,000 population are about the same in the U.S. and region C and are about 4 times higher in region A (New York City) and region B. For black male (heterosexual) IVDUs the AIDS cases per 100,000 population are about the same in the U.S. and region C, and are about 4 times as high in regions A and B. For Hispanic male IVDUs, the AIDS cases per 100,000 population in regions A, B and C are about 3 to 5 times higher than those in the U.S. In summary, the higher AIDS cases per 100,000 population occur in blacks and Hispanics in regions A and B and in Hispanics in region C. The next highest rates occur in blacks in region C and then for whites in regions A and B. These results suggest that black and Hispanic males are much more likely to be needle–sharing IVDUs than white males or that they are more likely to get an HIV infection, and that the AIDS epidemic in IVDUs is focused in the NE part of the U.S.

The patterns of female IVDUs in Table 9.9 are similar to those for male IVDUs. Namely, the AIDS cases per 100,000 population for blacks and Hispanics are usually more than 10 times those for whites. For whites the AIDS case rates are about the same in the U.S. and region C and are about 3 to 5 times higher in regions A and B; this pattern for white female IVDUs is the same as for white male IVDUs. The pattern for black female IVDUs is similar since the AIDS cases per 100,000 population are similar in the U.S. and region C and are about 4 times higher in regions A and B. For Hispanic female IVDUs the AIDS case rate increases steadily from the U.S. to region

Table 9.7. Total consistent AIDS cases by exposure category and race/ethnicity, through December 1990, with percentages and cases per 100,000 population in the U.S. and the three NE subregions.

region	exposure category	White, not Hispanic		Black, not Hispanic		Hispanic		Total
		No. rate	(%)	No. rate	(%)	No. rate	(%)	No. rate
US	male homosexual/ bisexual contact	73.913 40.0	(71%)	17,878 62.1	(17%)	11,030 63.0	(11%)	104,020 45.0
	male homosexual IV drug user	6,572 3.6	(61%)	2,994 10.4	(28%)	1,151 6.6	(11%)	10,852 4.7
A	male homosexual/ bisexual contact	8,681 109.9	(57%)	3,371 153.2	(22%)	2,870 168.8	(19%)	15,154 128.4
	male homosexual IV drug user	393 5.0	(32%)	464 21.1	(37%)	370 21.8	(30%)	1,240 10.5
B	male homosexual/ bisexual contact	3,732 26.5	(69%)	1,105 58.2	(20%)	558 55.8	(10%)	5,431 31.9
	male homosexual IV drug user	312 2.2	(43%)	298 15.7	(41%)	98 9.8	(14%)	721 4.2
C	male homosexual/ bisexual contact	4,328 23.4	(75%)	1,212 86.6	(21%)	213 71.0	(4%)	5,778 28.6
	male homosexual IV drug user	279 1.5	(53%)	209 14.9	(40%)	37 12.3	(7%)	529 2.6

B to region C to region A with a 7 factor difference between the U.S. and region A. As for male IVDUs, the highest AIDS cases per 100,000 population occurred in blacks and Hispanics in regions A and B and in Hispanics in region C.

9.4.2 Exposure Categories Related by Sexual Contacts in NE Subregions

Two exposure categories linked by sexual contacts are male (heterosexual) IVDUs and females with male IVDU partners. In the U.S. the r/e percentage distributions from Table 9.8 are 22% white, 51% black and 26% Hispanic for male (heterosexual) IVDUs and 20% white, 54% black and 24% Hispanic for females with male IVDU sexual partners. Thus these r/e distributions match well. In region A (New York City) the r/e distributions from Table 9.8 are 15% white, 44% black and 41% Hispanic for male (heterosexual) IVDUs and 11% white, 44%

Table 9.8. Total consistent AIDS cases by exposure category and race/ethnicity, through December 1990, with percentages and case rates per 100,000 population in the U.S. and the three NE subregions.

region	exposure category	White, not Hispanic		Black, not Hispanic		Hispanic		Total
		No. rate	(%)	No. rate	(%)	No. rate	(%)	No. rate
US	male heterosexual IV drug user	5,6433 3.1	(22%)	13,308 46.2	(51%)	6,787 38.8	(26%)	25,918 11.2
	female–sex with IV drug user	735 0.4	(20%)	1,981 6.9	(54%)	868 4.7	(24%)	3,640 1.6
A	male (heterosexual) IV drug user	1,423 18.0	(15%)	4,208 191.3	(44%)	3,942 231.9	(41%)	9,633 81.6
	female–sex with IV drug user	146 1.8	(11%)	565 25.7	(44%)	546 32.1	(43%)	1,277 10.8
B	male (heterosexual) IV drug user	1,488 10.6	(24%)	3,341 175.8	(54%)	1,367 136.7	(22%)	6,222 36.6
	female–sex with IV drug user	166 1.2	(23%)	408 21.5	(58%)	133 13.3	(19%)	709 4.2
C	male (heterosexual) IV drug user	369 2.0	(27%)	553 39.5	(41%)	421 140.3	(31%)	1,354 6.7
	female–sex with IV drug user	59 0.3	(32%)	80 5.7	(43%)	47 15.7	(25%)	186 0.9

black and 43% Hispanic for females with male IVDU sexual partners. These r/e distributions in region A match reasonably well. In region B the r/e distributions from Table 9.8 are 24% white, 54% black and 22% Hispanic for male (heterosexual) IVDUs and 23% white, 58% black and 19% Hispanic for females with male IVDU partners. As in region A these r/e distributions match reasonably well. In region C the r/e distributions from Table 9.8 are 27% white, 41% black and 31% Hispanic for male (heterosexual) IVDUs and 32% white, 43% black and 25% Hispanic for females with male IVDU sexual partners. These r/e distributions in region C do not match as well as in those in regions A and B. The reasons for this mismatching are unknown, but the ratios in the left half of Table 9.10 suggest that there may be some misclassification in the white r/e category in region C. Either too many white females with AIDS are put in the sex with male IVDU category or too few white males with AIDS are put in the heterosexual IVDU

Table 9.9. Total consistent AIDS cases by exposure category and race/ethnicity, through December 1990, with percentages and case rates per 100,000 population in the U.S. and the three NE subregions.

region	exposure category	White, not Hispanic		Black, not Hispanic		Hispanic		Total
		No. rate	(%)	No. rate	(%)	No. rate	(%)	No. rate
US	female IV drug user	1,785 1.0	(22%)	4,885 17.0	(61%)	1,309 7.5	(16%)	8,052 3.5
	male–sex with IV drug user	409 0.2	(28%)	826 2.9	(56%)	193 1.1	(13%)	1,483 0.6
A	female IV drug user	444 5.6	(15%)	1,580 71.8	(53%)	943 55.5	(32%)	2,989 25.3
	male–sex with IV drug user	15 0.2	(20%)	35 1.6	(46%)	23 1.4	(30%)	76 0.6
B	female IV drug user	431 3.1	(24%)	1,199 63.1	(67%)	159 15.9	(9%)	1,796 10.6
	male–sex with IV drug user	71 0.5	(31%)	105 5.5	(45%)	45 4.5	(19%)	232 1.4
C	female IV drug user	150 0.8	(37%)	176 12.6	(44%)	68 22.7	(17%)	401 2.0
	male–sex with IV drug user	32 0.2	(41%)	34 2.4	(43%)	8 2.7	(10%)	79 0.4

category. Except for whites in region C the ratios of AIDS cases in female partners of male IVDUs and AIDS cases in male (heterosexual) IVDUs are all very similar in the left half of Table 9.10.

Two additional exposure categories linked by sexual contacts are female IVDUs and males who had sex with female IVDUs. In the U.S. the r/e distribution from Table 9.9 are 22% white, 61% black and 16% Hispanic for these females and 28% white, 56% black and 13% Hispanic for these males. Thus these r/e distributions do not match very well in the U.S. In region A the r/e distributions from Table 9.9 are 15% white, 53% black and 32% Hispanic for these females and 20% white, 46% black and 30% Hispanic for these males. Again, the r/e distributions do not match very well. In region B the r/e distributions from Table 9.9 are 24% white, 67% black and 9% Hispanic for these females and 31% white, 45% black and 19% Hispanic for these males. These r/e distribution do not match well. In region C the r/e distributions from Table 9.9 are 37% white, 44% black and 17% Hispanic for these females and 41% white, 43% black and 10% Hispanic for these males. The r/e distributions here also do not match well.

Table 9.10. Ratios of AIDS cases (from Tables 9.8 and 9.9) by race/ethnicity and region for exposure categories related by sexual contacts in the U.S. and the three NE subregions.

	AIDS cases in female partners / AIDS cases in male IVDUs			AIDS cases in male partners / AIDS cases in female IVDUs		
region	white	black	Hispanic	white	black	Hispanic
U.S.	0.13	0.15	0.13	0.23	0.17	0.15
A	0.10	0.13	0.14	0.03	0.02	0.02
B	0.11	0.12	0.10	0.16	0.09	0.28
C	0.16	0.14	0.11	0.21	0.19	0.12

The variability of the ratios in the right half of Table 9.10 compared to the left half is consistent with the observed mismatchings of r/e distributions. One pattern in the right half of Table 9.10 is that the ratios for region A (New York City) are much smaller than in the U.S. and regions B and C. This is consistent with the belief of Des Jarlais and others in New York City that very few men who are sexual partners of female IVDUs are not IVDUs. The erratic nature of the entries in the right half of Table 9.10 suggests that there may be many misclassifications in the exposure category of males who have a female IVDU sexual partner.

As in Section 9.2.5, it is possible for the NE subregions to estimate a lower bound on the average number D of sexual partners infected per new HIV case. The estimated lower bounds on D are shown in Table 9.11. For male (heterosexual) IVDUs these lower bounds generally agree in the U.S. and the NE subregions, but for female IVDUs and their sexual partners the lower bounds differ greatly. As in Section 9.2.5, these data suggest that some male AIDS cases may be misclassified as sexual partners of female IVDUs or that female IVDUs are highly efficient transmitters of HIV.

9.4.3 Perinatally–Related Exposure Categories in the NE Subregions

The r/e distributions can be compared for exposure categories connected by perinatal HIV transmission. First, consider the categories of pediatric AIDS cases with a mother who is an IVDU and female IVDUs in Table 9.12. In region A the r/e distributions are 9% white, 53% black and 37% Hispanic for these pediatric AIDS cases and 15% white, 53% black and 32% Hispanic for female IVDUs. These r/e distributions do not match very well; the r/e distributions for the U.S. and regions B and C are as bad or worse. Part of the mismatching can be explained as in Section 9.3 by the higher birth rate for Hispanics which is 1.6 times the birth rate for whites and 1.4 times that for blacks. Table 9.13 contains the r/e distribution for pediatric AIDS cases with a mother who is the sexual partner of an IVDU.

Table 9.11. Estimates of lower bounds on the average number D of sexual partners infected per HIV case in the U.S. and the three NE subregions.

region	exposure category	AIDS cases	fraction with sexual partners	AIDS cases in sexual partners	lower bound on D
US	male (heterosexual) IVDUs	25,918	0.67	3,640	0.21
A	male (heterosexual) IVDUs	9,633	0.67	1,277	0.20
B	male (heterosexual) IVDUs	6,222	0.67	709	0.17
C	male (heterosexual) IVDUs	1,354	0.67	186	0.21
US	female IVDUs	8,052	0.08	1,483	2.26
A	female IVDUs	2,989	0.08	76	0.32
B	female IVDUs	1,796	0.08	232	1.61
C	female IVDUs	401	0.08	79	2.46

Instead of looking at r/e percentage distributions it is better to look at the ratios of pediatric AIDS cases to female AIDS cases in the associated mother category; recall from Section 9.3 that this ratio is an estimate of the average number E of offspring infected per HIV case in females. These ratios as estimates of E are given in Table 9.14 of females who are IVDUs and females who have had male IVDU sexual partners. Note that the ratios in the r/e categories in the U.S. generally agree on the left and right sides of Table 9.14. This agreement reinforces the concept that most of the differences in these estimates of E can be explained by differences in birth rates in the r/e groups. In particular for female IVDUs the E estimates for Hispanics are 1.4 times that of blacks and 1.8 times that of whites; these are roughly consistent with the birth rate for Hispanics being 1.4 times that of blacks and 1.6 times that of whites (World Almanac, 1988).

In Table 9.14 the estimates of E in region A are somewhat like those in the U.S. in Table 9.6, but the estimates of E in regions B and C are more erratic. In the left half of Table 9.14 the low ratio for whites in region C suggests that there may be some underreporting of white pediatric AIDS cases with an IVDU mother or overreporting of female IVDUs. On both sides of Table 9.14 the estimates of E seem somewhat high for Hispanics in region C, which suggests overreporting in children or underreporting of AIDS cases in Hispanic females in region C (such underreporting could also explain why AIDS cases in female IVDUs are only 11% of all IVDU cases in region C). The large estimate of 0.26 for Hispanics in region B on the left side and the large estimate of 0.18 for blacks in region C on the right side do not have any obvious explanations.

Table 9.12. Total consistent AIDS cases by exposure category and race/ethnicity, through December 1990, with percentages and case rates per 100,000 population in the U.S. and the three NE subregions.

region	exposure category	White, not Hispanic		Black, not Hispanic		Hispanic		Total
		No. rate	(%)	No. rate	(%)	No. rate	(%)	No. rate
US	female IV drug user	1,785 1.0	(22%)	4,885 17.0	(61%)	1,309 7.5	(16%)	8,052 3.5
	pediatric–mother with IV drug use	178 0.1	(15%)	693 2.4	(59%)	268 1.5	(13%)	1,171 0.5
A	female IV drug user	444 5.6	(15%)	1,580 71.8	(53%)	943 55.5	(32%)	2,989 25.3
	pediatric–mother with IV drug use	45 0.6	(9%)	257 11.7	(53%)	178 10.7	(37%)	485 4.1
B	female IV drug user	431 3.1	(24%)	1,199 63.1	(67%)	159 15.9	(9%)	1,796 10.6
	pediatric–mother with IV drug use	50 0.4	(21%)	143 7.5	(60%)	42 4.2	(18%)	240 1.4
C	female IV drug user	150 0.8	(37%)	176 12.6	(44%)	68 22.7	(17%)	401 2.0
	pediatric–mother with IV drug use	8 0.1	(14%)	25 1.8	(44%)	21 7.0	(37%)	57 0.3

9.5 Discussion

Compared to the racial/ethnic distribution of the population in the United States, AIDS cases occur relatively more frequently in blacks and Hispanics than in whites. The relative frequencies of AIDS cases in r/e groups in the U.S. are analyzed in Section 9.1 for adult/adolescent males and females and for children. These values are not given here since the relative frequencies of AIDS in r/e groups for risk categories are more interesting.

The cumulative AIDS cases in homosexual/bisexual males per 100,000 r/e population size are consistently 1.5 to 3 times higher for blacks and Hispanics than for whites in the NE subregions and in the U.S. Moreover, these AIDS case rates are 2 to 3 times higher in New York City than in the rest of the NE region and in the entire U.S. Possible explanations are that males are slightly more likely to be homosexual/bisexual if they are black or Hispanic or if they live in New York City.

Table 9.13. Total consistent pediatric AIDS cases by exposure category and race/ethnicity, through December 1990, with percentages and case rates per 100,000 population in the U.S. and the three NE subregions.

region	exposure category	White, not Hispanic		Black, not Hispanic		Hispanic		Total
		No. rate	(%)	No. rate	(%)	No. rate	(%)	No. rate
US	female–sex with IV drug user	735 0.4	(20%)	1,981 6.9	(54%)	868 4.7	(24%)	3,640 1.6
	pediatric–mother with sex with IV drug user	72 0.0	(16%)	224 0.8	(49%)	142 0.8	(31%)	459 0.2
A	female-sex with IV drug user	146 1.8	(11%)	565 25.7	(44%)	546 32.1	(43%)	1,277 0.8
	pediatric–mother with sex with IV drug user	12 0.2	(7%)	65 3.0	(39%)	83 4.9	(49%)	168 1.4
B	female-sex with IV drug user	166 1.2	(23%)	408 21.5	(58%)	133 13.3	(19%)	709 4.2
	pediatric–mother with sex with IV drug user	13 0.1	(17%)	42 2.2	(54%)	17 1.7	(22%)	78 0.5
C	female-sex with IV drug user	59 0.3	(32%)	80 5.7	(43%)	47 15.7	(25%)	186 0.9
	pediatric–mother with sex with IV drug user	7 0.0	(18%)	14 1.0	(37%)	15 5.0	(39%)	38 0.2

The cumulative AIDS cases in male (heterosexual) and female IVDUs per 100,000 r/e population size are at least 10 times higher for blacks and Hispanics than for whites in the three NE subregions and in the U.S. These AIDS case rates in male (heterosexual) IVDUs are between 3 and 10 times higher than in female IVDUs. The AIDS case rates for black (heterosexual) male IVDUs is highest in regions A and B, and lowest in region C. For Hispanic male (heterosexual) IVDUs, the AIDS case rates are highest in region A and are also quite high in the regions B and C. The data suggest that people are much more likely to be IVDUs or IVDUs who develop AIDS if they are black or Hispanic or if they are males or if they live in the NE region of the U.S.

In the U.S. the cumulative AIDS cases in male homosexual IVDUs per 100,000 r/e population size are 2 to 3 times larger for blacks and Hispanics than for whites. In the three NE subregions, the AIDS case rates for blacks and Hispanics are 4 to 10 times higher than for whites. Since these men have both homosexual behavior and IVDU behavior, it is not surprising that the

Table 9.14. Estimates of the average number E of offspring infected per HIV case in females by race/ethnicity and region in the U.S. and the three NE subregions.

	estimates of E for female IVDUs			estimates of E for females who had sex with male IVDUs		
region	white	black	Hispanic	white	black	Hispanic
U.S.	0.11	0.14	0.20	0.10	0.11	0.16
A	0.10	0.16	0.19	0.08	0.12	0.15
B	0.12	0.12	0.26	0.08	0.10	0.13
C	0.05	0.14	0.31	0.12	0.18	0.32

ratios above comparing r/e groups are between those of homosexual/bisexual men and those of male (heterosexual) IVDUs.

Comparisons of the r/e distributions of AIDS cases in females who have had sex with a bisexual male with AIDS cases in homosexual/bisexual males suggest that black homosexual/bisexual males may be slightly more likely to be bisexual than white or Hispanic homosexual/bisexual males.

With one minor exception described in Section 9.4.2, there is good matching in the three NE subregions and in the U.S. of the r/e percentage distributions of cumulative AIDS cases in male (heterosexual) IVDUs and females who have had sex with male IVDUs. The r/e distributions of cumulative AIDS cases do not match well in any NE subregion or in the U.S. for female IVDUs and (non IVDU) male sexual partners of females IVDUs. A possible explanation is that it is difficult to decide if a male belongs in this exposure category of having a female IVDU sexual partner, but not being an IVDU, so that many misclassifications occur.

In Section 9.2 the average number D of sexual partners infected per HIV case has been defined and an expression for a lower bound on D has been obtained. Estimates in Table 9.4 of these lower bounds range from 0.19 for male (heterosexual) IVDUs and females born in Pattern II countries to 0.00–0.09 for hemophiliacs, blood transfusion recipients and males born in Pattern II countries. The data seem to imply that for every 6 new HIV cases in male (heterosexual) IVDUs with female sexual partners, at least one HIV case occurs in their female sexual partners.

The r/e distributions of cumulative AIDS cases in the U.S. match reasonably well in Table 9.3 for the following exposure categories and their sexual partners: 1) males with hemophilia or coagulation disorder, 2) males born in Pattern II countries, 3) males who received blood transfusions, 4) females who received blood transfusions, 5) males in the other/undetermined category and 6) females in the other/undetermined category. The data suggest that black and Hispanic females may receive blood transfusions slightly more frequently than white females.

The r/e distribution of cumulative AIDS cases do not match at all for females born in Pattern II countries and males who have had sex with a female born in a Pattern II country. Nearly all AIDS cases in these females are black, but about half of the AIDS cases in their male

sexual partners category are black and half are white. Although some of the white males could be misclassifications, it is more likely that many white males did have sex with blacks females from Pattern II countries.

For many exposure categories of children and females related through perinatal transmission, the racial/ethnic distributions of AIDS cases do not match very well since the percentage of pediatric AIDS cases is consistently low for whites and high for Hispanics. However, as noted in Sections 9.3 and 9.4.3, this pattern can usually be explained since the birth rate for Hispanic females is 1.6 times that for white females. For many exposure categories, the estimates in Table 9.6 suggest that for each 6 or 7 new HIV cases in females, there is approximately 1 new HIV case in a child. Deviations from this pattern noted in Section 9.4.3 suggests that there may be some under or overreporting in pediatric or female cases in some r/e groups in some NE subregions.