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# Social Determinants of Sexual Networks, Partnership Formation, and Sexually Transmitted Infections

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Adaora A. Adimora and Victor J. Schoenbach

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## Social Determinants of Sexually Transmitted Infection

Social factors have long been recognized as important determinants of health [1]. In recent years, social determinants—“the conditions in which people are born, grow, live, work and age, including the health system” (WHO Commission on Social Determinants) [2]—have attracted increasing attention as fundamental causes of disparities in health status between individuals and populations. Although most studies about social determinants address chronic, non-communicable diseases, a recent examination of the social epidemiology literature from 1975 to 2005 found 44 review articles with infectious disease outcomes, with the majority focused on HIV/AIDS [3]. The emphasis on HIV is perhaps not surprising, since HIV and other sexually transmitted infections (STI) are by their nature social diseases. Researchers have recently begun to trace the pathways between social determinants and HIV/STI [4–7]. The expression of sexuality, a perva-

sive influence in human society, is shaped by society. Social factors of all kinds, including those related to education, occupation, neighborhoods, migration, urbanization, mobility, affluence, media, religion, substance use, incarceration, and technological change, can influence sexual behaviors, partnership formation, and sexual networks, with resultant effects on STI dissemination. This chapter explores some of the primary modern-day social determinants of heterosexual partnering and sexual networks relevant to HIV/STI, particularly in the USA, where STI rates exceed those of all other industrialized countries [8].

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## Determinants of STI Transmission

Key determinants of the extent of spread of an STI from an infected person to others are the likelihood of transmission during sexual contact, sexual contact rate and sexual network patterns, and duration of infectiousness of an infected person. The likelihood of transmission depends partly on the prevalence of infection in the pool of potential sexual partners [9]. Effective health care, including prompt and appropriate diagnosis and curative treatment, shortens the length of time during which infected people remain infectious. Even treatment that is not curative may reduce infectiousness. Most notably, antiretroviral therapy (ART) for HIV-infected patients decreases their levels of HIV viremia and likely decreases their infectiousness to others, an observation that

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A.A. Adimora, M.D., M.P.H. (✉)  
Division of Infectious Diseases, UNC School  
of Medicine, 130 Mason Farm Road, CB #7030,  
Chapel Hill, NC 27599-7030, USA  
e-mail: Adimora@med.unc.edu

V.J. Schoenbach, Ph.D.  
Department of Epidemiology, UNC Gillings School  
of Global Public Health, 2104D McGavran-Greenberg,  
CB #7435, Chapel Hill, NC 27599-7435, USA

has generated enthusiasm for expanded testing and treatment [10]. Other prominent strategies for reducing STI dissemination are use of condoms, which reduce transmission efficiency, and initiatives to reduce contact with infected partners through sex education to discourage early onset of coitus and reduce overall number of sex partners.

## Condom Use

Consistent and correct male condom use decreases the risk of STIs (and of pregnancy) [11]. Consistent condom use results in 80% reduction in the incidence of heterosexual HIV transmission [12]. The most common cause of condom failure is lack of use during one or more episodes of intercourse [13]. The proportion of the US women who have ever used a condom has substantially increased during the past two decades. Among the US women respondents in the NSFG 1982, 1995, and 2002 cycles who had ever had sexual intercourse, 52%, 82%, and 90%, respectively, reported ever having used condoms. Among the US women respondents in the 2002 NSFG, aged 15–44 who had ever had sexual intercourse, 92% of non-Hispanic White and non-Hispanic Blacks and 78% of Hispanic women had ever used a male condom. Much smaller proportions (5% of Black women and 1% of Hispanic and non-Hispanic White women) have ever used a female condom [14]. *Consistent* condom use, however, is much less common; for example, in 2002 only 30% of the US men and 25% of the US women reported having used a condom during most recent sexual intercourse. Moreover, of those at risk for HIV because of STD treatment within the past year or high-risk sexual behaviors or drug use, 60% overall (55% men, 68% women) did not use a condom during last intercourse [15].

## Health Care

Because treatment of an infected individual may protect current and future sexual partners, health care is a powerful force in STI dynamics. Health care availability and quality are important social

determinants of health [16]. Disparities in access to health care are much greater in the United States than in other industrialized countries, and contribute to the dramatic racial and ethnic disparities in rates of chronic diseases and STIs, including HIV [17]. In 2008, 46.3 million people in the US (15.4% of the population) lacked health insurance. Hispanics (32% uninsured), Blacks (19%), and Asian Americans (17%) are considerably more likely to be uninsured than Whites (10%) [18]. Health care reform, finally enacted in 2010, will reduce the number of uninsured persons by about half. However, differences in comprehensiveness of coverage, required co-pays and deductibles, and allowed reimbursement rates (which reduce the number of providers available to patients who rely on Medicaid) will continue to affect actual access to health care services. There are also powerful nonfinancial barriers to access, such as residential segregation, facility hours of operation and location, and availability of transportation. Even when access to care is equivalent, compared to Whites, African Americans are more likely to receive low-quality health care, with resultant increased mortality [17].

Effective health care involves access to medications as well as to services. Access to medications has been a long-standing problem for many patients with chronic health conditions. State AIDS Drug Assistance Programs provide medications to low-income, uninsured people with HIV infection in the US. However, the economic crisis that began in 2007, with the resulting unprecedented demand for program services due to increased unemployment, caused many of these state programs to run out of funding during 2010, rendering them unable to provide medications to eligible clients and placing more than 1,000 people on waiting lists as of May 2010 [19]. In the absence of ART these individuals will be more infectious to people in their sexual network, many of whom are likely also individuals of lower socioeconomic status.

## Sex Education

Comprehensive sex education programs have been found to be effective in reducing risky

sexual behavior among youth [20]; yet a campaign by religious and political conservatives led to state laws and federal funding restrictions on sex education programming in public schools that presented condoms as effective in preventing STI. A great expansion in federal funding for public school sex education (more than \$1.5 billion over nearly 30 years) took place beginning in the 1980s to support abstinence-until-marriage sex education, notwithstanding the lack of data to support its effectiveness in reducing risky behavior [21]. Over 80% of abstinence-only curricula used by grantees of the largest federal abstinence-only initiatives contained false, misleading, or distorted information about reproductive health, including efficacy of condoms for preventing infection [22]. Youth exposed to such programs were significantly less likely to perceive condoms as efficacious for preventing STIs [22]. A recent randomized trial of a theory-based abstinence-only intervention in African-American middle school youth found reduced onset of intercourse at 24 months post randomization compared to a health-promotion control group and no difference in self-reported condom use among sexually active participants. The authors noted, however, that the intervention did not meet federal criteria, was not moralistic, and did not criticize the use of condoms [23].

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## Sexual Network Patterns and Behaviors Influence STI Rates

In the abstract, the world is a vast network of sexual partnerships and potential partnerships. Most adults are connected to another adult, sometimes more than one, and many have been connected to others in the past. With sufficient interconnectedness, sexual pathogens could spread throughout the entire population. However, most people form relatively few partnerships, typically with people of similar age, race/ethnicity, and socioeconomic class [24]. A small percentage, though, has many partners, including partners with varied social, demographic, and risk characteristics. This proportionately small

but relatively more active subset creates interconnected networks that can dramatically affect STI spread.

People's propensity to acquire sexual partners varies by age, gender, marital status, biological influences, psychological characteristics, and personal circumstances [25]. Social, economic, and political factors affect these propensities and also the environment in which they are expressed. Together, individual and social factors determine the number, configuration, and dynamics of sexual partnerships over time, creating the networks that enable STI to propagate.

## Long-Term Monogamy

The major institutions that directly govern sexual activity in contemporary society are family, religious institutions, and the legal system [26]. These institutions tend to support and protect long-term heterosexual monogamy over other partnering patterns. To the extent that people remain in long-term monogamous relationships (whether heterosexual or homosexual), sexual acquisition and transmission of infection outside the dyad will not occur.

Historically, most Americans have spent a substantial proportion of their sexually active adult lives in long-term monogamous relationships, which have served as the foundations on which families were created. However, during the latter part of the twentieth century the dominance of this traditional family structure has declined as a result of the rising age at marriage, increasing cohabitation among unmarried young adults, increases in nonmarital childbearing (and decreases in marital childbearing), and rising divorce rates [27]. For example, the percentage of the US women aged 25–29 years who had never married rose from 12% in 1970 to 48% in 2008; the corresponding percentage for men rose from 20% to 61%. Meanwhile, households with unmarried couples have increased, accounting for 4.6% of all households in Census 2000 [28]. Although many cohabiting adults eventually marry their partner, many do not.

## Serial Monogamy

The long-term decline in the age of first sexual intercourse has been “one of the best recognized trends in sexual behavior in the USA in the twentieth century,” according to Turner et al. (p. 177) [29]. That trend combined with the rising age at marriage has, over time, led to an interval on the order of a decade during which teenagers and young adults are unmarried but sexually active. The sexual partnerships during this period are typically of short term even if monogamous (“serial monogamy”), and their number has grown across successive birth cohorts. For example, for the 1950s birth cohort about 50% of men and 30% of women report having had five or more sexual partners since age 18 [29]. The number of recent partners is smaller: 71% of the US adults aged 18–59 years had only one sex partner during the past year and an additional 12% had no partners (p. 177). However, 39% had more than one partner during the past 5 years (p. 178) [24]. Young adults are the most likely to have multiple recent partners; e.g., 32% of adults aged 18–24 years reported having multiple partners during the past year (p. 177) [24].

The set of all partners an individual has had comprised a sexual network through which a sexually transmitted pathogen can travel or may have traveled. As individuals change partners networks can interconnect. With serial monogamy, however, STI can travel only from past partners through the index person to future partners, not the reverse.

## Timing of Partnerships: “The Gap” and Concurrency

Serial monogamy creates much greater opportunity for STI spread than does long-term monogamy. But the transmission potential of serial monogamy is influenced by the length of the interval between sequential partners—or “gap length” [30]. STIs are transmitted only if one partner is infected and contact occurs during the infectious period. Because a number of STIs have a restricted period of maximum infectiousness

due to treatment or an immune response, longer monogamous partnerships or longer gaps between partnerships make it more likely that a person infected by a new partner will become less infectious by the time a subsequent partnership begins. More than half of the women reporting serial monogamy in the 1995 National Survey of Family Growth had a gap length shorter than the mean infectivity periods of some bacterial STI. Younger women (aged 15–19) were most likely to experience a short gap [30]. Similarly, more than half (59%) of 18–39-year-old male and female participants in a Seattle telephone survey reported a gap of less than 6 months, a time period within the infectious periods of Chlamydia, gonorrhea, syphilis, HIV, HSV, and HPV [31].

When the date of first intercourse with a new partner comes before the date of last intercourse with a previous partner, the gap length is less than zero. Such overlapping (“concurrent”) partnerships add an additional dimension of transmission potential to the partners of the index person, and to their partners’ partners in turn. Concurrent partnerships can permit even more rapid spread of an infection throughout a population than the same number of sequential monogamous partnerships for several reasons. First, if a person with concurrent partners becomes infected from one partner, transmission to a concurrent partner can occur without the delay involved in ending the first partnership and beginning a new one (i.e., no protective gap). Second, in sequential monogamy, when a person becomes infected by a new partner, the previous partners are not exposed to the new infection. With concurrent partnerships, however, the continuing contact with partners acquired earlier means that they become (indirectly) exposed to infections acquired from subsequent partners [32].

People who have concurrent partnerships experience the same risk of acquiring STIs as do people who have the same number of partners sequentially, but *partners* of people who have concurrent partnerships have increased risk of acquiring infection. Concurrency has been associated with transmission of Chlamydia, syphilis, and HIV infection [33–35]. Concurrent partnerships are more common among unmarried

people, younger people, men, and people whose partners are nonmonogamous [36–38]. More than half (54%) of the adolescents with 2 or more partners in a national survey had concurrent partnerships [39].

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## Assortative and Dissortative Mixing

Most sexual partnerships are relatively assortative with respect to demographic characteristics, meaning that partners tend to have similar ages, race/ethnicity, educational backgrounds, and religious affiliations [24]. The reason is that sex partners are usually drawn from among the people with whom one comes into contact in social situations. Thus, people's sex partners generally resemble the social composition of their immediate social networks. Laumann et al. describe several mechanisms that increase the likelihood that social situations will bring together people with similar demographic characteristics [24]. First, some settings, such as public schools, community colleges, bars, and churches mainly attract people who live nearby. Because geographic areas are often segregated by race and income, social settings and events that draw from these areas are primarily composed of people who are similar with respect to these characteristics. Second, the social situations (schools, churches, jobs, etc.) themselves bring together people with similar interests and education. Third, social network relationships often bring people to social situations; people may choose to participate in the events because of the people they know. For example, acquaintances and friends refer people for jobs and invite them to parties and cultural events, thereby increasing the homogeneity of the participants. Finally—and most directly—potential partners are often introduced by a mutual acquaintance, an occurrence that increases the likelihood of partnership formation between similar people [24].

Assortative mixing enables STIs to circulate within a demographic stratum, leading to differentials in STI incidence and prevalence across strata. With assortative mixing, higher prevalence in a stratum means that sexual contact will

present greater risk of transmission among persons in that stratum than among persons in lower prevalence strata. Dissortative mixing is a behavior with a lower risk of STI acquisition for a person in a high-prevalence subgroup but a higher risk for persons from a lower prevalence subgroup. Mixing that is random (partners are selected in proportion to their population distribution) with respect to a characteristic tends to equalize STI prevalence across groups with and without that characteristic.

Although a number of studies have examined mixing among individuals at high risk for STIs (for example, [40]), fewer have evaluated the extent of mixing in the general population. Dissortative mixing is more common among some populations, such as adolescents: 45% of sexually active adolescents in AddHealth reported partners who were at least 2 years younger or older than them; 42%, 14%, and 15%, respectively, of Latino, White, and Black youth had partners of different race/ethnicity [39]. Among San Francisco adults with two or more sex partners in the preceding year, the prevalence of mixing was substantial, with 40% of respondents reporting partners from at least two age groups or ethnic groups. These “heavy mixers” were significantly more likely to have antibodies to HSV-2 [41]. Mixing across different age groups is associated with HIV infection among young MSM [42, 43]. An analysis of sexual mixing patterns among African Americans in North Carolina revealed relatively discordant sexual mixing—especially among the general population of women—a group whose behavior was otherwise relatively at low risk [44]. For example, only 20% of male, compared to 40% of female, high school graduates had a recent partner who had not finished high school. These results were attributed in part to the low ratio of black men to black women.

“Bridging” occurs when individuals whose partnerships are not exclusively assortative connect networks that are otherwise sexually separate from each other. By connecting these otherwise isolated networks, bridging permits infections to spread between them. The level of bridging is thus a critical population-level

parameter. A telephone survey of 18–39-year-old adults in Seattle evaluated the potential for bridging between respondents and their last two partners with respect to greater than 5-year age difference, education, bisexual activity, race, and spatial separation of residences; 74% reported dissortative mixing by at least one of the attributes examined [45]. A 1996 study in Thailand demonstrated that women outside the sex industry were placed at substantial risk for HIV infection by the women’s high prevalence of male partners who had sex with commercial sex workers (CSWs) (17%), used condoms inconsistently with both CSWs and their non-CSW partners (73%), and were more likely to be HIV+ (OR 2.2). The study calculated that for every 100 sexually active men, 30 women in the general population had been exposed to HIV in the preceding year [46]. A study in Cambodia identified a substantial minority of men (20.5% of the military, 15.7% of police, and 14.7% of motodriver) as bridgers who had unprotected sex with both high- and low-risk female sex partners [47].

## Racially Segregated Sexual Networks

The long history and continued persistence of racial segregation in the USA has strongly promoted assortative mixing by race, which for African Americans has probably weakened the tendency toward assortative mixing by social stratification characteristics such as education, income, and wealth. Notwithstanding the many changes that have taken place in American society since the mid-twentieth century and the dismantling of the legal framework that enforced racial segregation in housing, employment, schools, and other settings including marriage and adoptions, African Americans and whites often still live, learn, work, worship, socialize, recreate, obtain health care, and retire in largely separate worlds. This *de facto* segregation is important to the structure of sexual networks, because people tend to choose sex partners from the neighborhoods where they live [48]. Segregation may be especially critical to the networks of young people, given continuing—and

increasing—racial segregation in schools [49, 50]. Concentration of Black people and other ethnic minority populations in urban areas and “white flight” to the suburbs have increased the physical separation of living areas to such an extent that school integration can require transferring children across school district lines. Meanwhile, racial segregation in higher education persists due to the concentration of African Americans in Historically Black Colleges and Universities (HBCUs) (in 2001, HBCUs conferred more than 20% of the bachelor’s degrees earned by African Americans) [51] and increased underrepresentation of minorities at flagship institutions in states that banned affirmative action practices [52]. Even in multiracial settings, interracial mixing may be limited.

Racial segregation of sexual networks enables the huge Black–White disparity in STI rates to persist in several ways. Most directly, infections that enter the Black community are less likely to be eliminated because of less access to quality health care, and are more likely to remain within the Black population because of limited interracial sexual mixing. Moreover, the imbalanced sex ratio and other factors discussed above promote sexual network patterns that enhance STI dissemination in the Black population. Furthermore, racially segregated sexual networks provide relative protection to the White population, reducing the immediacy of the STI problem to the population with greater structural power to direct resources and shape public policies to control STI.

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## Sexual Network Influences from Movement of People and Information

### Travel and Migration

Technological advances and economic forces that have occurred during the past 50 years have resulted in unprecedented mobility of the world’s population. Sexual contact while traveling, whether for tourism, business, or long-term migration, is relatively common; an estimated 5–50% of short-term travelers have sexual contact, and the proportion is higher among longer

term travelers [53]. Among 1,018 US Peace Corps volunteers who reported information on their sexual behavior, 61% reported having at least one sex partner during their stay abroad, and about 40% of sexually active volunteers reported having a local partner [54]. Sexual activity while traveling is most likely to occur among those who are male, young, traveling without a long-term partner, heavy alcohol consumers, users of recreational drugs, traveling for a long time, regular visitors to the same location, or people with other markers for high-risk sexual activity, such as early age at first intercourse, frequent casual sex in the traveler's country of origin, greater number of partners, and history of extramarital sex [55].

Travel frees people from social taboos and norms that inhibit their sexual freedom [53]. Sexual contact while traveling often results in dissortative mixing, as people from one geographic locale interact with those from another setting. Travelers and their sex partners are potentially important bridges between geographically separated populations. Indeed, many of the early HIV cases in North America were linked to a Canadian flight attendant who had numerous sexual contacts while traveling extensively [56]. The role of migrant workers, CSWs, and long-distance truck drivers in the HIV epidemic has been well established [57].

Several factors increase travelers' vulnerability to STIs. Some researchers, for example, note a higher frequency of casual partners and unprotected sex—sometimes because of substance use or unplanned or unexpected sexual opportunities [58–60]. Moreover, male travelers may interact with CSWs whose prevalence of STIs is high, while female business and recreational travelers may have sexual contact with male travelers or local men who have had contact with sex workers [58]. Economic inequality between wealthier tourists and sex workers in the countries they visit promotes exchange of sex.

Migration into the USA from many countries has increased during the past 20 years. The term acculturation refers to the changes that occur in both cultures when two cultures meet [61], but the minority culture usually changes more than

does the mainstream culture [62]. When minority groups acculturate, they tend to adopt the sexual behaviors of the larger culture, as increasing contact with the mainstream group introduces new norms and values [62]. Minnis et al. observed a lower prevalence of some sexual risk behaviors (first sexual intercourse before age 17, multiple partners) among foreign-born Latinas than among both non-Latinas and US-born Latinas [63]. Compared to their US-born counterparts, foreign-born Asian and Latino youth are less likely to use illicit drugs and to participate in sexual risk behaviors [64]. Some researchers have noted an association between increased acculturation and some higher risk sexual behaviors, such as increased partner number [65] and earlier age at first sexual intercourse [66], among more acculturated adult and adolescent Hispanics in the USA [65, 66].

Undocumented immigrants typically do not have a legal right to work and may be forced into the informal economy—often in low-paying service and manufacturing jobs—or, in some cases, commercial sex work. In areas where large number of men migrate alone to send wages home to their families, the resulting unbalanced sex ratios can promote “development of a commercial sex industry to service the unpartnered male population” [67]. Undocumented migrants often have limited access to health care and may be unable to obtain treatment for STIs.

Sex workers themselves may migrate to wealthier countries in order to exchange sex. Moreover, people who migrate because of poverty are at increased risk of engaging in commercial sex work; refugees or undocumented workers may be ineligible for legitimate employment. Sex traffickers transport people—especially women and children—for the express purpose of forced commercial sex. In a literature review of sex trafficking in the USA [68], Schauer and Wheaton envision the possibility that in the next 10 years sex trafficking will replace drug trafficking as the number one international crime. It is estimated that the USA is the second largest international destination (after Germany), receiving 18,000–50,000 women and children/year.

## Media

Sociologists recognize the media as among the most significant agents in development of sexual behavior through young adulthood [69]. Popular music adolescents listen to most often is mainly about love, sex, and relationships. At least half of the girls aged 12–15 read magazines, such as *Teen* and *Seventeen*, whose major theme is how girls can make themselves attractive enough to get and hold onto a boy [70]. The media influences people's norms and attitudes. Communication researchers posit that the mass media impacts sexual norms and behavior by framing how people think about sex, displaying and reinforcing a consistent set of sexual and relationship norms, and seldom demonstrating sexually responsible models [71].

Television shows have substantial sexual content, and the amount of this content has increased in recent years. A Kaiser Family Foundation study examined a representative sample of 1,154 shows' broadcast in 2004 and 2005—covering the full range of genres other than daily newscasts, sports events, and children's shows—and determined the prevalence of shows with some type of sexual content [72]. Seventy percent of all shows (and 77% of those broadcast during prime time on the major networks) have sexual content—an increase compared to 56% of all shows in the first study in 1998 and 64% in 2002. 68% of all shows included talk about sex, and 35% of all shows portrayed sexual behaviors. Shows with sexual content had an average of 5.0 sexual scenes per hour, compared to 3.2 scenes in the 1998 study. Prime-time and top teen shows had even more sexual content with, respectively, 5.9 and 6.7 sexual scenes per hour. Among all shows in the sample, sexual intercourse was either depicted or strongly implied in 11%. As a result of the greater percentage of shows with sexual content and their greater average number of sexual scenes per show, the 2005 study found nearly twice the number of sexual scenes in the overall program sample as that observed in 1998, when Kaiser first conducted this study. Nearly half (45%) of the 20 shows most popular with teens include sexual behavior, and an additional 25% include some other kind

of sexual content. About one in ten characters involved in sexual intercourse appeared to be teens or young adults. References to safer sex, sexual risks, and sexual responsibilities rarely appeared, and an increase noted in 2002 has not been sustained since then [72].

Despite extensive information about the extent of sexual content on American television, considerably less is known about whether the media's sexual content influences people's sexual behavior [71]. Most research has tended to focus on adolescents. In general, there is agreement among findings that increased exposure to sexual content in media is associated with “more permissive attitudes toward sexual activity, higher estimates of the sexual experience and activity of peers, and more and earlier sexual behavior among adolescents” p. 186 [73]. For example, a survey of 1,011 Black and White middle school students in the Southeastern USA revealed that adolescents who are exposed to more sexual content in the media, “and who perceive greater support from the media for teen sexual behavior, report more sexual activity and greater intentions to engage in sexual intercourse in the near future.” [74]. Media influence was significantly associated with sexual behaviors and intentions—even after controlling for the influence of other important sources of socialization, such as family, peers, religion, and school. A longitudinal study of 1,017 middle school students examined whether exposure to sexual content in TV, movies, music, and magazines at baseline during ages 12–14 predicted sexual behavior 2 years later [75]. Although the relationship between media exposure and sexual behavior was not statistically significant among Black youth, White adolescents in the top quintile of sexual content exposure at baseline were more than twice as likely to have had sex by age 14–16 as those in the lowest quintile, even after controlling for baseline sexual behavior and other relevant factors.

Causal inference from observational studies such as the above is problematic, since it seems likely that adolescents with stronger sexual interests for reasons other than their media exposure are both more likely to consume sexual media content and also more likely to become sexually



active. However, causal potential can be derived from evidence suggesting that mass media can promote sexual health. For example, mass media can be a positive influence on young women's sexual health and development by providing (1) information on sexuality and sexual health through mainstream magazines, newspapers, and radio and (2) diverse portraits of women and female sexuality that can function as models of sexual behavior [76]. Kaiser Family Foundation surveys of regular viewers who watched the TV series *ER* demonstrated that adults learned about HPV and emergency contraception after watching episodes of shows that contained story lines about these topics [77]. A 3-month safer sex televised public service advertisement campaign to increase safer sexual behavior among at-risk young adults in a Kentucky city resulted in significant increases in condom use, condom use self-efficacy, and behavioral intentions among the target group that viewed the ads compared to the control city [78].

"Entertainment-education" uses media to present educational content in an entertainment format to influence audiences' knowledge, attitudes, and behavior. This format has been used in developing countries and occasionally in the USA and other industrialized countries. Viewers of an entertainment-education soap opera in India reported changes in opinions about family planning and sexual behaviors that resulted from viewing the program, such as deciding to undergo a vasectomy, delaying daughters' age of marriage, and development of more negative attitudes toward dowries [79]. In Nigeria, two of the country's most famous singers, Onyeka Onwenu and King Sunny Ade, released two hit songs and accompanying music videos to promote sexual responsibility. During the music campaign contraceptive use increased from 16% to 26% among the target audience of youth and young adults, aged 15–35 [80].

## The Internet

The Internet has profoundly altered many spheres of living including social and sexual networks. It is estimated that there were more than

250 million users in North America and 1.7 billion users in the world in 2009 [81], numbers that are certain to grow from initiatives such as the Federal Communications Commission's National Broadband Plan [82] and Google's experimental fiber network initiative [83]. People go online through computers at home, at work, in libraries, and in recreation facilities, as well as through portable or handheld devices accessing WiFi networks. The proliferation of access channels is expanding the range of people who make use of e-mail, special interest groups, chat rooms, Web surfing, file swapping, and/or social networking tools such as MySpace, Facebook, LinkedIn, Twitter, Flickr, YouTube, and Second Life. Explosive growth of social networking sites and associated Web 2.0 technologies is one of the most dramatic developments in Internet technology [84].

Thanks to social networking sites Americans now publicly disseminate an enormous amount of personal information and images that used to be seen primarily by family and close friends. The ability to find people and to get information about them through the Internet creates numerous opportunities to form social relationships and facilitates the process of becoming acquainted. Not surprisingly, a significant fraction of the population uses the Internet to find sex partners. Features that drive the Internet's popularity for sexual interactions include its accessibility, affordability, acceptability, and opportunities it provides for anonymity, learning about and experimenting with different aspects of sexuality or sexual practices, locating a much larger pool of potential sex partners, and more quickly meeting and communicating with potential partners [85, 86].

A 2005 Pew telephone survey of 3,215 US adults identified 2,252 Internet users [87]. Most (55%) of the single people looking for relationships said it was difficult to meet people in the areas where they lived. Respondents indicated a variety of ways to use the Internet related to sex partners: flirting, online dating Websites, finding an off-line venue like a nightclub or singles event where they might meet someone to date, use of e-mail or instant messaging by a third party who introduced them to a potential date, participation

in online groups where they hoped to meet people to date, searching for information about someone they had dated in the past, maintenance of a long-distance relationship, searching for information about someone they were currently dating or were about to meet for a first date, and breaking up with a partner.

Slightly more than one in ten respondents (240) used online dating services. Among these online daters, 64% agreed that online dating helps people find a better match because they have access to a larger pool of people to date, and about half agreed that online dating is easier than other methods. 43% of people who used online dating sites actually followed through with a date, with online romances resulting in a long-term relationship or marriage among 17%. Online daters were younger and more likely to be employed; 18% of all online adults aged 18–29 have visited a dating site, compared to 11% of people aged 30–49, 6% of those aged 50–64, and 3% of those aged 65 or older. Online daters reported that they liked to try new things and tended to be less religious and to have relatively liberal social attitudes with respect to gender roles and gay marriage. Interestingly, the study did not find statistically significant differences in online dating use across race/ethnicity or educational levels.

A Dutch study also found no relationship between online dating and either income or education but found that the most active online daters were older (age 40), perhaps because of the relative difficulty this age group has in finding partners through traditional strategies. Divorced people were much more likely to use dating sites [88]. Interestingly, counter to the hypothesis that people use the Internet to compensate for social deficits in the off-line world, people involved in online dating did not report high levels of dating anxiety. As the Internet has become so widely used, the online and off-line populations have become increasingly alike [88].

Along with new opportunities for finding and connecting with sexual partners, the Internet has created new opportunities for transmitting HIV and other STIs—and also new opportunities for public health control activities [84, 89]. A study of clients at the Denver Public Health HIV testing

site in 1999 and 2000 found that 15.8% had used the Internet to find sex partners, and 65.2% of these clients reported having had sex with a partner they found online [89].

Most of the published research concerning the Internet and sexual risk behaviors has been done among men who have sex with men (MSM), as they were among the first groups to take advantage of this medium to find partners. According to a meta-analysis published in 2006, 40% of MSM used the Internet to look for sex partners [90]. White race/ethnicity, increased age, history of unprotected anal intercourse, multiple anal intercourse partners, and engaging in sexual activity at a sex club or a bathhouse have been associated with meeting sexual partners through the Internet [91]. MSM who sought partners online were more likely to engage in unprotected anal intercourse with male sex partners than were MSM who did not (odds ratio 1.68 [90]). Similarly, a study in a London HIV testing clinic found that both MSM and heterosexuals who used the Internet to find sex partners were significantly more likely to have had high-risk sex with a casual partner than those who did not use the Internet for this purpose. However, people who sought sex through the Internet were just as likely to meet their high-risk casual partners offline as online, suggesting that people willing to engage in risky behavior were seeking sex via the Internet, rather than engaging in riskier behavior because of the Internet [92]. Thus, the Internet may not be responsible for stimulating high-risk behaviors, since high-risk behavior may simply be a characteristic of those who seek sex online [84]. Nevertheless, whether or not the Internet promotes risky behaviors, it certainly facilitates them, particularly among people already inclined to engage in them.

Use of the Internet to find sex partners facilitates intentional sexual mixing of both assortative and dissortative varieties. Websites open only to members of particular subgroups (e.g., the “The Right Stuff,” “Latin Singles”) facilitate assortative mixing. But some Websites (e.g., <http://www.interracialmatch.com>) draw people seeking partners of different cultures, races, and ethnicities. It is not yet clear whether this expanded

opportunity for dissortative mixing will lead to a significant change in sexual mixing patterns of Americans [67].

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## Macrosocial Influences on Sexual Partnering and STI Epidemiology

Individuals' choice of partners and the acceptability of different partnership arrangements are influenced by the social environment. A key environmental variable in this regard is the sex ratio, the importance of which has been noted by Guttentag and Secord [93]. The principles of microeconomics provide a useful model of how the sex ratio (ratio of the number of men to the number of women) influences individual choices. Individual behavior is influenced by perceived costs and benefits of different choices. In a market situation in which people seek to maximize benefits and minimize costs, relatively scarce but desirable resources command higher prices than less desirable or more plentiful resources [94, 95]. When there is a relative shortage of eligible males, such males command a higher "price." Because men in this setting have advantageous alternatives, they are less dependent on any individual female partner. Conversely, women in a low-sex-ratio environment have fewer advantageous alternatives and are therefore more dependent on a given partnership. "Dyadic power" refers to the relative strength of a partner's bargaining position. When desirable males are in relatively shorter supply, their dyadic power enables them to negotiate more favorable "terms of trade," which may include the freedom to have multiple female partners even if the female partners prefer exclusive partnerships [93].

Gender inequality derives not only from men's greater average physical strength and aggressiveness, which carry with them the potential for intimate partner violence, but also from the substantially greater economic rewards and resources they enjoy in most societies. Gender inequality affects sexual behaviors, sexual networks, and STI transmission in a variety of ways. Low sexual relationship power among women is associated with decreased condom use [96]. Lack

of economic independence, particularly when combined with a low sex ratio, can persuade some women to begin or maintain relationships they would otherwise end [97]. Non-volitional sex and intimate partner violence increase women's vulnerability to STIs; women who are victims of violence or who live in fear of violence can seldom implement risk reduction measures, such as condom use, reduction in partner numbers, or avoidance of partners with high-risk behaviors [98–100].

## Structural Power

The term "structural power" refers to economic, political, and legal power, which augment each other, and enable dominant groups in society to "influence and shape social customs and practices, which in turn are a powerful source of control over people's lives." [93] (p. 26). Structural power is held by those nearer the top of socioeconomic hierarchies and serves to reinforce those hierarchies, as privileged persons protect themselves and limit the scope of action ("agency") of those of lower socioeconomic and/or minority status [101]. Population health is powerfully influenced by these social class gradients [102] both because those at the lower end of the scale lack important resources for health and because their environment and opportunities are shaped by those nearer the top of the distribution of money, resources, and power [2]. Through the pathways of differential economic, political, and legal power and resulting social class gradients, structural power affects not only health but also sexual partnering and ultimately STI epidemiology as well.

## Incarceration

Incarceration—a stark application of structural power—disrupts existing partnerships, affecting sexual networks and partnering patterns [5]. When one member of a partnership is incarcerated, the remaining partner may pursue other partnerships to make up for the loss of social and

sexual companionship and material contributions. Resumption of the original partnership when the incarcerated partner is released creates a situation of concurrent partnerships. Such “separational concurrency” may be common among people whose partners are frequently incarcerated [103]. Perhaps for this reason, incarceration of a sex partner was a risk factor for concurrent partnerships among young men and women in Seattle and Black men and women from the general population in the southern US [104, 105].

Meanwhile, the partner who is incarcerated may form new, sometimes coercive, sexual connections with a pool of individuals among whom the prevalences of high-risk behaviors, HIV infection, and other STIs are high—in a setting where condoms are typically illegal [106–109]. Inmates may also join gangs and develop new long-term ties with antisocial networks [110]. These new associations may connect individuals who were previously at low risk for HIV infection with subgroups whose HIV prevalence is high, so that when inmates return to the community their new associations may lead to sexual partnerships with higher risk partners. A history of incarceration also reduces one’s employment prospects [111], which increases risk of poverty and further destabilizes long-term partnerships [112, 113].

Because of the proportion of people and ethnic groups affected, incarceration also adversely affects the community. The US has the highest incarceration rate in the world [114], with about 1% of all US adults in jail or prison in 2007 [115], and over 3.2% of all adult US residents (7.3 million people) on probation, in jail or prison, or on parole at the end of 2008 [116]. Blacks and Hispanics are disproportionately incarcerated, partly as a reflection of ongoing and pervasive racial bias in sentencing of young Black and Hispanic men [117]. In 2008, 3.2% of all US Black men (and 0.15% of Black women) were in federal or state prisons [118]. Among men 25–29 years old in 2002, 10.4% of Blacks and 2.4% of Hispanics, compared to 1.2% of White men, were in prison [119]. Cumulative risk of prison incarceration for 30–34-year-old men born between 1965 and 1969 was 2.91% for Whites,

compared to 20.5% for Blacks [120]. Incarceration on this scale contributes to high unemployment rates in minority communities, shrinking the proportion of financially viable male partners. Incarceration thus reduces the already low ratio of marriageable men to women [4]. High incarceration rates also can influence community norms and create an environment in which “jail culture is normative,” as evidenced by trends in clothing and music [110] (p. 224). These norms are likely to influence sexual behavior and sexual networks. In addition, the heavy reliance on incarceration to control drug and crime problems has stressed state budgets and decreased spending for programs, such as education, that can improve communities and the lives of their residents [115].

### **Poverty, Income Inequality, and Discrimination**

Numerous studies have documented poverty’s association with mortality and morbidity, including HIV and other STIs (for example, [121–123]). Evidence indicates that in addition to poverty, income *inequality* is itself harmful to health [124–126]. Increases in income inequality, such as those observed in the US, have been associated with increased STI rates [127, 128]. For many Blacks, racism and discrimination are a constant feature of the contextual landscape, which differs dramatically from that of Whites. Residential segregation by race has been one of the most prominent features of racial discrimination in the US. Marked residential segregation by race persists, particularly in urban areas, and is maintained not only by individual actions but also by long-standing structural mechanisms, such as discrimination by banks and realtors [129]. Segregation concentrates poverty and other deleterious social and economic influences within racially isolated groups and thus increases the risk of socioeconomic failure of the segregated group [129]. Segregation has effects in addition to those mediated by lower individual income. For example, compared with the children of middle-income White families, children of middle-income Black

families are more likely to be exposed to violence, poverty, drugs, and teenage pregnancy in the neighborhoods where they live [129].

Poverty and racism affect sexual health directly and through a variety of pathways—typically by decreasing the personal agency of those who are affected and placing them “in harm’s way.” [130]. For example, following the decline in housing prices that helped precipitate the 2008–2009 recession, prosecutors and other officials in several US cities filed lawsuits against Wells Fargo for targeting subprime mortgages at Blacks and Hispanics compared to Whites with similar incomes [131]. 55% of loans to African Americans, 40% to Hispanics, and 35% to Native Americans were subprime loans—compared to 23% to Whites. Women received less favorable lending terms than men [132]. As a result, disproportionate numbers of minority homeowners have experienced or still face foreclosure. The problem is most acute for people who are both poor and the objects of discrimination. Thus in the US one expects—and sees—worse health among the racial minorities who are most likely to experience both poverty and racial/ethnic discrimination: African Americans, Hispanics, and Native Americans, groups who disproportionately experience other societal hardships as well.

Institutional racism is a key factor underlying the enduring racial disparities in income, education, housing, neighborhood quality, government services, political power, morbidity, and mortality [129, 133–136]. Krieger describes five pathways through which discrimination can harm health [137]. Pathways with direct relevance to sexual networks and spread of STIs include economic and social deprivation, residential segregation, targeted marketing of legal and illegal psychoactive substances, and inadequate health care from health care facilities and from specific providers [137].

Poverty and stresses induced by racism tend to destabilize marriage and other long-term partnerships and behaviors; the poor are less likely to marry and less likely to stay married [112]. Women are more likely to be poor, and poverty can further distort gender roles. Poor women may be more likely to stay in relationships that

increase their risk of STI and are in some cases less able to negotiate safer sexual behaviors, such as condom use. In these ways, poverty and racism can have profound effects on partnering and networks.

## Homelessness

Homelessness in the US has dramatically increased in the past 20 years, with an estimated 3.5 million people now experiencing homelessness annually [138]. The number of homeless who are living on the streets of New York City, for example, soared 34% between 2009 and 2010, a phenomenon attributed to the 2008–2009 economic recession [139]. Still others are unstably housed with family or friends. Although estimates of racial/ethnic composition vary by region of the country, the homeless population is estimated to be 42% Black, 39% White, 13% Hispanic, 4% Native American, and 2% Asian [138]. About 26% of homeless people are mentally ill, while 13% are physically disabled, and 2% are HIV infected [138, 140].

Homelessness is strongly associated with HIV infection [141, 142]. The rate of AIDS diagnosis among people admitted to public shelters in the city of Philadelphia was nine times that of the city’s general population [142]. Moreover, a longitudinal study revealed a dose–response relationship between housing status and HIV risk behavior, with the homeless demonstrating higher risk than those in unstable housing, and both of these groups at higher risk than people with stable housing [143].

Housing can affect sexual risk behaviors through a variety of pathways. People may trade sex for shelter [143]. Lack of housing may prevent people from keeping condoms accessible [144, 145]. In addition, housing affects the structure of social networks, and social network norms and values influence individuals’ risk behaviors [144, 146]. Housing may also affect relationships with sexual partners. Homelessness is associated with exposure to intimate partner violence, which may in turn increase HIV risk behavior; sexual coercion and the threat of violence may prevent

women from refusing sexual contact or negotiating condom use [144, 145].

Aidala and Sumartojo note that although much of the literature concerning homelessness and its health risks has focused on the characteristics of individuals that put them at risk for homelessness, housing is a manifestation of social and economic inequalities—and further contributes to these inequalities [147]. The risk of becoming homeless in a given community depends largely upon contextual factors, including employment security, adequacy of social services, government policies, institutional practices, and availability of affordable housing. These factors are for the most part outside the individual's control [147]. For example, foreclosures resulting from the subprime mortgage crisis that contributed to the 2008–2009 recession caused homeowners to lose their dwellings. But an additional cause of the related increase in homelessness in US cities was foreclosures on rental properties. In such foreclosures, tenants may be forced out on short notice, unable to recover their security deposits, and highly vulnerable [140].

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## Conclusions

Social factors are major determinants of the epidemiology of STI, through both direct and indirect pathways. Causes of STI include lack of preventive knowledge, lack of preventive behavior, lack of prompt and effective health care, and social network patterns that facilitate STI dissemination. Although this chapter has focused on social and sexual networks of heterosexuals, we acknowledge that networks of MSM and men who have sex with men and women are also critically important. Social factors influence availability and access to accurate and useful knowledge about sexuality and STI avoidance, encourage or constrain preventive behavior, facilitate or obstruct access to quality health care, and facilitate some partnerships and obstruct or disrupt others. Causes also include underlying conditions and factors that shape desires and attitudes, alter choices and availability of options, and lead to a multitude of adverse outcomes including

exposure to STI. Communicable infections, especially those that spread person-to-person, are inherently social. Thus it is almost axiomatic that social determinants are the major drivers of STI epidemiology. Over 50 years ago the British epidemiologist Jerry Morris wrote, “Society largely determines health; ill-health is not a personal misfortune due often to personal inadequacy but a social misfortune due, more commonly, to social mismanagement and social failure.” [148].

The US needs a new approach to public health—an approach that promotes design and implementation of programs that effectively address the social determinants of STIs and other health outcomes; increasing evidence indicates that such interventions will have the greatest public health impact [149]. This new approach will require researchers and public health practitioners to forge and strengthen collaborations among communities, academia, government, and private sector [150]. These collaborations will be needed not only to develop and implement interventions but also to document that these strategies have favorable cost-effectiveness profiles and to find ways for the program providers to capture the cost savings so that interventions become scalable and sustainable.

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