

## ORIGINAL ARTICLE

# Can Changes in Sexual Behaviors Among High School Students Explain the Decline in Teen Pregnancy Rates in the 1990s?

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**Purpose:** To explore the utility of using national data from high school students to explain changes in national declines in pregnancy rates. Although declines in teen pregnancy and birthrates in the 1990s have been welcome news to those interested in adolescent health and welfare, the reasons for these declines are not readily apparent. Previous attempts to explain these declines focused on the period before 1995 and did not directly calculate the impact of improved contraceptive use.

**Methods:** The national Youth Risk Behavior Survey provided estimates for sexual activity and contraceptive use among teens aged 15-17 years between 1991 and 2001 (n = 31,058). These data were combined with method-specific contraceptive failure rates (CFRs) derived from the 1988 and 1995 National Survey of Family Growth and pregnancy rates from the National Vital Statistics System. We calculated weighted-average CFRs (WACFR) and used the annual rate of change in the WACFR and sexual activity to estimate their relative contributions to the annual change in risk of pregnancy. Weighted least-squares regression in SUDAAN was used to test change over time.

**Results:** Between 1991 and 2001, annual rates of change in sexual behaviors were -1.7% for sexual experience and -1.6% for the WACFR. Improvements in WACFR resulted primarily from a decline in use of withdrawal (from 20% to 13%) and use of no method (from 17% to 13%) and an increase in condom use (40% to 51%). Recent sexual intercourse (i.e., intercourse during the past 3 months among teens who had ever had intercourse) did not change over time. The change in the estimated risk of pregnancy closely approximated the annual decline in the pregnancy rates for blacks and Hispanics but underestimated the actual decline for whites. Overall, 53% of the decline in pregnancy rates can be attributed to decreased sexual experience (95%CI 26% to 79%) and 47% to improved contraceptive use (95%CI 21% to 74%).

**Conclusions:** Use of school-based behavior data reflects well the pregnancy experience for school-age black and Hispanic adolescents, but does not track well with the pregnancy risk of white adolescents. Care should be taken in attributing changes in pregnancy rates to changes in behavior, given broad confidence intervals around these estimates. These data suggest that both delayed initiation of sexual intercourse and improved contraceptive practice contributed equally to declines in pregnancy rates among high school-aged teens during the 1990s; however, estimates varied among racial and ethnic groups. © Society for Adolescent Medicine, 2004

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Key behaviors leading to an adolescent pregnancy include whether a young woman has initiated sexual intercourse, her current sexual activity, and use of contraception [1]. The nation, through *Healthy People 2010*, has set specific goals for delaying initiation of sexual intercourse, increasing abstinence among sexually experienced adolescents, increasing the use of contraception, including combined-method contraception, increasing the use of condoms, and decreasing teen pregnancy [2]. In 2000, 333,000 adolescents under the age of 18 in the United States became pregnant and 166,000 gave birth [3]; early adolescent childbearing is associated with adverse social and health consequences for the mother and the child [4]. A recent report from the U.S. House of Representatives found that the steep decline in teen birth rates during the 1990s has substantially reduced the number of children living in poverty and living in families headed by single mothers [5].

Enormous changes in adolescent sexual behavior have occurred over the past 40 years. Beginning in the late 1960s, the proportion of teen women who had ever had sexual intercourse increased substantially through 1988 [6–9]. Since 1988, national data suggest that this historical trend has stopped or has reversed [10,11]. Between 1991 and 2001, sexual experience (i.e., ever having had sexual intercourse) among young women in high school decreased from 51% to 43% [11].

Contraceptive use among teens has also changed remarkably over time. In the 1970s, the birth control pill was the most common contraceptive method, followed by condoms and withdrawal [6]. Condom use among adolescents increased dramatically in the 1980s, as the use of birth control pills declined [12]. Increases in condom use resulted in an increased use of contraception at first intercourse [13]. From 1988 into the mid-1990s, condom use continued to increase, as pill use decreased and new long-acting hormonal methods were introduced [10,14]. Data on high school students indicate that condom use increased as pill use and use of withdrawal declined [11,15].

National data on teen pregnancy, including both births and abortion, first became available in the United States in the 1970s. Changes in rates of birth, abortion, and pregnancy are not always parallel. Pregnancy rates among teens were relatively stable from 1976 until 1986 and then increased from 1986 to 1990 [16–18]. Birth rates among teens aged 15 to 17 years have generally declined since 1960; a notable exception was a 27% increase from 1986 to 1991 [18]. Abortion rates for teens rose during the 1970s, were

relatively stable in the 1980s, and have declined since 1988 [3,4,18–20]. Since 1991, teen birth, abortion, and pregnancy rates have declined steadily, although at similar but not identical rates [3,4,16,19]. Declines in teen birth rates between 1991 and 2001 have been greater among younger teens (36% for teens aged 15–17 years) compared with older teens (19% for teens aged 18 to 19 years) [21].

Several previous attempts have been made to explain declines in adolescent pregnancy rates [10,18,22–25]; three of these studies [22–24] have attempted to mathematically calculate the contributions of delayed initiation of sexual intercourse and/or improved contraceptive use on pregnancy rates. All three focused on the pregnancy decline before 1995; similar analyses have not been conducted using data for the period since 1995. Only one of these studies [24] considered statistical variation in estimating change. These previous studies have not attempted to directly calculate the impact of improved contraceptive use based on adolescent self-report of contraceptive use; rather, they have estimated the impact of changing contraceptive use as the residual effect after estimating the impact of changing involvement in sexual intercourse on pregnancy rates. These analyses have generally compared data from the 1988 and 1995 National Survey of Family Growth (NSFG) or used 1995 NSFG data, given its detailed information on sexual activity and contraceptive use among a national sample of teens. Unfortunately, the years the NSFG were conducted do not correspond with the years of declining pregnancy rates. Between 1988 and 1991, teen pregnancy rates increased, and since 1991 they have declined [3,4,18,26]. The change in the pregnancy rate between 1988 and 1995 among younger teens (aged 15 to 17 years) was a decline of only 4.6%. In our analyses we focused on younger teens (aged 15 to 17 years) and on the period from 1991 to 2001, and directly estimated the impact of a changing mix of contraception on pregnancy rates. We used biennial national data from the Youth Risk Behavior Survey (YRBS) from 1991 to 2001, because it provides data for time points corresponding to the pregnancy decline.

The two objectives for this study were to explore the utility of using biennial national data on sexual behaviors of high school students from the YRBS to explain declines in pregnancy rates from 1991 to 2000, and, if useful for this purpose, to explore the relative contributions of changes in sexual experience (i.e., ever having had intercourse) and contraceptive use to declining pregnancy rates among

school-aged youths in the United States since 1991. We combined behavior data from the YRBS, published contraceptive failure rates from the NSFG, and data on teen pregnancy rates from the National Center for Health Statistics (NCHS).

### *Methods*

For these analyses we worked with public use datasets available from the Centers for Disease Control and Prevention (CDC); the collection and availability of data from each system has been reviewed for human subjects protection at CDC. We used the following data sources: YRBS for data on sexual behavior and contraceptive use, NSFG for contraceptive failure rates, and NCHS data for pregnancy rates. NCHS pregnancy rates combine data on adolescent births from National Vital Statistics system (NVSS), fetal loss estimates from the NSFG, and abortion data from the Alan Guttmacher Institute (AGI). Sexual behavior and contraceptive data for each year were used to estimate changes in pregnancy risk over time. These estimates of pregnancy risk were compared to the actual change in pregnancy rates to see if our method for estimation of pregnancy risk based on behavioral data from school-attending adolescents aged 15 to 17 years matched the pregnancy experience of school youth aged 15 to 17 years. Finally, we estimated the percentage of the change in pregnancy risk that could be attributed changes in sexual behavior and contraceptive use.

### **Survey Data Systems**

Both the YRBS and the NSFG use multistage, stratified, clustered sampling, and they over-sample minority youths to produce national estimates. Because the NSFG is a household survey, it includes both in-school and out-of-school youths. The YRBS includes only youth who are enrolled in school and present on the day that the survey is initially administered or on one of several make-up days. Complete information about the design of each has been published elsewhere [27–29].

The YRBS is a national probability sample of adolescents in public and private schools grades 9 to 12, conducted every 2 years since 1991. The YRBS uses self-administered paper and pencil interviews in classroom settings and employs a combination of active and passive parental permission, depending on the usual practices of the sampled school.

The NSFG, which was our source of information on CFRs, is a periodically conducted survey that collects detailed information on fertility and fertility-related events among individuals of reproductive age. For the 1988 and 1995 round of data collection, trained interviewers conducted face-to-face interviews (FTFIs) with women aged 15 to 44 years, in respondents' homes. Both written parental permission and adolescent assent were required for teenagers under the age of 18 years. A self-administered questionnaire lasting 5 to 15 minutes covered many of the most sensitive questions, but the data presented here come from responses to the FTFI questions.

### **Sexual Behavior Data**

For our study, data from the YRBS provided estimates for changes in sexual experience (ever had sexual intercourse), current sexual activity (sexual intercourse during the past 3 months), and method of contraceptive use at last sexual intercourse for the years 1991 to 2001. By combining the data from the two questions on contraceptive and condom use, the rates of dual use were calculated. The YRBS questions on condom and contraceptive use have been consistently worded during this period, although Depo-Provera was first added as a response category in 1999. Norplant is not listed as a response category; NSFG data from 1995 suggest that Norplant use among younger teens is relatively low [10]. We limited data to women aged 15 to 17 years because this age group is well represented in the YRBS and pregnancy data are available for this age group.

### **Contraceptive Failure Rates**

The NSFG provided information to calculate contraceptive failure rates (CFRs), which are used to describe the efficacy of specific methods of contraception in preventing pregnancy. Typical-use CFRs are life table estimates of the number of pregnancies occurring among 100 women using a specific contraceptive method over a 12-month period, as the method is commonly used. Published failure rates for the first year of typical use of specific contraceptive methods were used [30]. These failure rates were calculated by combining samples from the 1988 and 1995 NSFG and were adjusted for underreporting of abortion. (Failure rates were not statistically significantly different between the 2 years.) CFRs for specific contraceptive methods varied widely (Table 1).

**Table 1.** First-Year Contraceptive Failure Rates, United States Women<sup>a</sup>

|                                   | < 18 Years | 15–44 years         |                     |          |
|-----------------------------------|------------|---------------------|---------------------|----------|
|                                   |            | White, Non-Hispanic | Black, Non-Hispanic | Hispanic |
| Pill only                         | 7.4        | 6.0                 | 11.5                | 12.8     |
| Condoms only                      | 14.5       | 11.6                | 24.1                | 18.8     |
| Pill and condom <sup>b</sup>      | 1.1        | 0.7                 | 2.8                 | 2.4      |
| Withdrawal                        | 24.8       | 24.5                | 33.8                | 19.5     |
| Injection                         | 3.5        | 3.5                 | 3.8                 | 3.4      |
| Injection and condom <sup>c</sup> | 0.5        | 0.4                 | 0.9                 | 0.6      |
| Some other method <sup>d</sup>    | 12.4       | 11.2                | 18.1                | 15.5     |
| No method <sup>e</sup>            | 85.0       | 85.0                | 85.0                | 85.0     |
| Not sure <sup>f</sup>             | 85.0       | 85.0                | 85.0                | 85.0     |
| Never had sex                     | 0.0        | 0.0                 | 0.0                 | 0.0      |

<sup>a</sup> First-year contraceptive failure rates (CFR) for women under 18 years, based on 1988 and 1995 National Survey of Family Growth (NSFG), corrected for abortion underreporting. Race/ethnic-specific CFR based on all age women reporting specific race/ethnicity. All data from Ranjit et al. ([30], see Table 6) unless noted otherwise.

<sup>b</sup> Use of condoms and pill at last intercourse is calculated using two separate questions, failure rate for pill with condom use calculated by multiplying of failure rate for individual methods.

<sup>c</sup> Use of condoms and injection at last intercourse is calculated using two separate questions, failure rate for injection with condom use calculated by multiplying of failure rates for individual methods.

<sup>d</sup> Overall CFR for all methods used from Ranjit et al. ([30], see Table 4).

<sup>e</sup> Data for 1988 and 1995 NSFG not available, data from Trussell et al. 1998 [31].

<sup>f</sup> CFR for no method used.

Remarkably, method-specific rates for teens aged 15 to 17 years were similar to women overall, whereas rates did vary considerably by race and ethnicity. Method-specific CFRs stratified by both age and race and ethnicity were not available; instead, we used race- and ethnic-specific rates for all women. Recent data for the failure rate for nonuse of contraception were not available; this failure rate was based on data from Trussell [31]. A small percentage (3% to 5%) of the women reported “some other method” or “not sure” as their method at last intercourse. Women who were not sure were assigned the failure rate for no method use. For women reporting some other method, we assigned the overall CFR (Table 4 in [30]). Failure rates for the combined method at last intercourse (i.e., condom and pill or injection and condom) were estimated by multiplying the method-specific failure rates for the two methods.

### Data on Pregnancies

Pregnancy rates are comprised of birth, abortion, and fetal loss data. The National Vital Statistics System at NCHS collects birth data from state and territorial health departments. The NCHS uses these data to calculate age-specific birth rates [21,32]. Estimates of fetal loss are calculated using the pregnancy calendar data in the NSFG. Abortion estimates come from AGI, which combine survey data from abortion providers with demographic characteristics of women having abortions reported by the National

Center for Chronic Disease Prevention and Health Promotion [19,33]. Rates for births, abortions, fetal losses, and pregnancies are calculated by combining numerator data with age-specific population estimates for a given year provided by the U.S. Census Bureau. Given the availability of revised intercensal estimates for denominators based on the 2000 census, the NCHS has revised the pregnancy rates for 1991 to 1997 and added rates for 1998–2000, using the revised denominators [3,21].

In this study, we compared the rate of change in the estimated risk of pregnancy (based on changes in sexual experience) for 1991 through 2001 with the actual rates of change in pregnancy rates for 1991 to 2000. To make the changes in rates comparable, we calculated the annual rates of change using end points (i.e., 1991 and either 2000 or 2001) and using a geometric rate of change. The annual rate of geometric change in each rate (expressed as a percentage) is equal to  $([\text{rate at time } 2 / \text{rate at time } 1]^{1/(t_2-t_1)} - 1)$  times 100.

### Analysis Method

To calculate the estimated risk of pregnancy, we multiplied the percentage of teens who were sexually experienced by their risk of pregnancy based on a weighted-average contraceptive failure rate (WACFR) for each year. WACFRs were calculated by summing the product of each method-specific failure rate and the proportion of women using that method

**Table 2.** Percentage Who Have Ever Had Sexual Intercourse or Had Recent Sexual Intercourse<sup>a</sup>, Females Aged 15–17 Years Attending School, United States, 1991–2001, Youth Risk Behavior Survey

|  | 1991 | 1993 | 1995 | 1997 | 1999 | 2001 | % Change<br>1991–2001 | Annual %<br>Change <sup>b</sup><br>1991–2001 | <i>p</i> Value <sup>c</sup> |
|--|------|------|------|------|------|------|-----------------------|--|-----------------------------|
| Ever had sexual intercourse  |      |      |      |      |      |      |                       |  |                             |
| All  | 50.6 | 50.7 | 52.1 | 48.4 | 47.6 | 42.7 | –15.6%                | –1.7%  | 0.0004                      |
| White, non-Hispanic  | 47.3 | 48.1 | 48.9 | 44.7 | 44.0 | 40.8 | –13.7%                | –1.5%  | 0.0026                      |
| Black, non-Hispanic  | 75.1 | 68.8 | 66.8 | 67.2 | 66.2 | 53.8 | –28.4%                | –3.3%  | 0.0002                      |
| Hispanic   | 44.5 | 50.0 | 55.0 | 48.1 | 44.4 | 44.9 | 0.9%                  | 0.1%   | 0.1960                      |
| Had recent sexual intercourse, as percentage of all sexually experienced teens |      |      |      |      |      |      |                       |  |                             |
| All  | 74.9 | 73.6 | 77.6 | 77.7 | 74.9 | 77.1 |                       |  |                             |
| White, non-Hispanic  | 76.5 | 72.8 | 78.9 | 82.1 | 76.8 | 77.2 |                       |  |                             |
| Black, non-Hispanic  | 71.4 | 75.3 | 75.3 | 71.2 | 74.3 | 75.5 |                       |  |                             |
| Hispanic   | 74.3 | 78.6 | 70.8 | 70.7 | 73.4 | 79.4 |                       |  |                             |
| Sample size  |      |      |      |      |      |      |                       |  |                             |
| All  | 4365 | 6020 | 4000 | 5948 | 5636 | 5089 |                       |  |                             |
| White, non-Hispanic  | 1855 | 2491 | 1568 | 1880 | 2052 | 2395 |                       |  |                             |
| Black, non-Hispanic  | 1082 | 1402 | 1442 | 1750 | 1585 | 1013 |                       |  |                             |
| Hispanic   | 1126 | 1691 | 751  | 1746 | 1445 | 1193 |                       |  |                             |

<sup>a</sup> Sexual intercourse during the past 3 months, among all adolescents aged 15–17 years.

<sup>b</sup> Annual percentage change based on a geometric rate of change.

<sup>c</sup> Significance testing based on weighted least squares regression for annual rate of change.

in each year. For each year from 1991 to 2001:  $WACFR = \sum (\% \text{ of females using method } x * CFR \text{ for method } x)$ , where  $x =$  each specific method. The estimated pregnancy risk =  $(WACRF * \% \text{ sexually experienced})$ .

We also conducted a parallel set of analyses considering currently sexually active (sexual intercourse in the past 3 months). These analyses found similar patterns to those using sexual experience.

We calculated decline over time in the estimated pregnancy rate using weighted least-squares regression in SUDAAN, which corrects for the clustering inherent in complex survey designs [34]. For these analyses, women who were not sexually experienced were assigned a  $CFR = 0$ . We calculated the confidence intervals (CIs) of the annual rates of change in Table 4 using a first-order Taylor series.

The percentage of the decline in pregnancy rate due to the decline in sexual experience is estimated as:  $(\log [\% \text{ sexual experience in 2001} / \% \text{ sexual experience in 1991}])$  divided by  $[(\log [\% \text{ sexual experience in 2001} / \% \text{ sexual experience in 1991}]) + (\log [\% \text{ CFR in 2001} / \% \text{ CFR in 1991}])]$ . This number is multiplied by 100 to convert it to a percentage. The percentage of the decline in pregnancy rate owing to improved contraceptive use is estimated as  $(100\% \text{ minus } [\% \text{ decline owing to change in sexual experience}])$ .

### Alternative Analyses

Given the inherent imprecision in timing in the estimation of pregnancies among teens aged 15 to 17

years on the basis of the sexual behavior of teens aged 15 to 17 years, we also conducted alternative analyses using behavioral data from teens aged 14 to 16 years. This imprecision occurs because sexual behaviors resulting in a conception precede a pregnancy outcome by a variable interval. For example, births among teens aged 15 to 17 years are conceived about 9 months earlier when the teens are between 14 and 17 years. Our alternative analyses used data on sexual experience and recent sexual activity among teens aged 14 to 16 years instead of the data for teens aged 15 to 17 years.

### Results

The pregnancy rate among teens aged 15 to 17 years between 1991 and 2000 declined 33% over 9 years (4.3% per year, from 79.5 per 1000 females in 1991 to 53.5 per 1000 females in 2000). Pregnancy rate declines were similar for non-Hispanic blacks (5.5%) and for non-Hispanic whites (5.2%) and these were higher than those among Hispanics (2.5%).

Table 2 describes changes in the percentage of teen women aged 15 to 17 years who reported ever having had sexual intercourse and those reporting sexual intercourse during the past 3 months. Overall, sexual experience declined 16%; 14% among whites and 28% among blacks, but did not change among Hispanics. The data for Hispanics suggests an increase from 1991 to 1995 and a decline thereafter. We calculated recent sexual activity as the percentage of

adolescents who have had sexual intercourse during the past 3 months (numerator) among those who have ever had sexual intercourse (as the denominator). This percentage ranged between 71% and 82% with no discernable trends over time, either overall or among white, black, or Hispanic teens.

Our alternative analyses, which examined sexual experience and sexual activity among teens aged 14 to 16 years, found similar patterns of change over time in sexual experience and in recent sexual activity. For example, the 10-year decline in sexual experience among 14- to 16-year-olds was 15%, compared to 16% for 15- to 17-year-olds. Similar patterns of change were found among the total sample and among black, white, and Hispanic teens (data not shown).

Table 3 shows changes over time in contraceptive method use at last sexual intercourse among sexually active adolescent women aged 15 to 17 years. Consistent with published data from the YRBS on all high school students [15], these data show a decrease in pill use, an increase in condom use, and a decrease in use of withdrawal. The decline in pill use may have reversed overall and among whites in 2001, although this small upward trend was not statistically significant. The use of methods with the highest failure rates declined: the use of no method dropped from 17% to 13% and the use of withdrawal declined from 20% to 13%. Data on injectable contraceptive use in the YRBS were first collected in 1999. Total injectable use, either with or without a condom, was 6% in 2001. The use of a hormonal method was 24% in 1991 (all pill use) and 26% in 2001 (combining pill and injection). Dual use, the use of a hormonal method with a condom at last intercourse, increased from 3% in 1991 to 7% in 2001. (In 1991, the only hormonal contraceptive recorded was the pill, whereas in 2001, hormonal methods include the pill and Depo-Provera.) Among users of hormonal methods, 29% also used a condom at last intercourse. The use of "other" methods was low and relatively constant, except for a small increase in 1997; this small increase may represent the use of injection. The WACFR declined from 27.1 to 23.1 (15%,  $p = .0048$ ). Similar trends were found for contraceptive use at last sexual intercourse among sexually active and sexually experienced teens.

Similar trends were found among non-Hispanic whites and blacks and Hispanics in the use of pills, the condom, and withdrawal. Pill use is most common among whites and condom use is the most common among blacks. Remarkably, the use of no method declined steadily among blacks (26% to 12%)

and Hispanics (33% to 20%) but not among whites (12% in both 1991 and 2001). The WACFR did not change between 1991 and 2001 for whites (22.0 to 20.1;  $p = .2138$ ) but declined 20% among blacks and 24% among Hispanics.

Alternative analyses examining contraceptive use among sexually active and sexually experienced teens aged 14 to 16 years found similar patterns of change in the WACFR overall and among blacks, whites, and Hispanics (data not shown). For example, the WACFR declined 14.8% for sexually active 15- to 17-year-olds and 14.0% for sexually active 14- to 16-year-olds.

Table 4 presents the change in estimated pregnancy risk based on the percentage of sexually experienced and WACFRs and compares these to actual annual changes in the rates of pregnancy. (Considering current sexual activity in our calculations we found similar results.) Declining sexual experience and improving contraceptive use both contributed to the decline in estimated pregnancy rates. Between 1991 and 2001, sexual experience declined 1.7% per year and WACFR declined 1.6%, giving a decline in estimated pregnancy risk of 3.2%. Between 1991 and 2000, pregnancy rates fell at an annual rate of 4.3% per year. The 95% CI for the change in estimated pregnancy risk (95% CI,  $-4.8\%$  to  $-1.6\%$ ) includes the actual rates of decline for pregnancies (4.3%).

Estimated pregnancy risk declined 2.3% annually for non-Hispanic whites (95% CI,  $-4.4\%$  to  $-0.1\%$ ), 5.4% for non-Hispanic blacks (95% CI,  $-7.1\%$  to  $-3.8\%$ ), and 1.9% for Hispanics (95% CI,  $-4.5\%$  to  $0.8\%$ ), underestimating the actual decline in the pregnancy rates for non-Hispanic whites (5.5%) and closely approximating the annual decline for non-Hispanic blacks (5.2%) and Hispanics (2.5%).

Table 4 also presents the proportion of the change in pregnancy risk that can be attributed to declining sexual experience and improved contraceptive use. Overall, 53% of the decline in pregnancy rates can be attributed to decreased sexual experience (95% CI, 26% to 79%) and 47% to improved contraceptive use (95% CI, 21% to 74%). For racial and ethnic subgroups, these attributions were as follows: for whites, 64% for sexual experience (95% CI, 12% to 100%) and 36% for contraceptive use (95% CI, 0% to 88%); for blacks, 60% for sexual experience (95% CI, 45% to 74%) and 40% for contraceptive use (95% CI, 26% to 54%); and for Hispanics, 0% for sexual experience (95% CI, 0% to 100%) and 100% for contraceptive use (95% CI, 0% to 100%).

**Table 3.** Contraceptive Method Use at Last Sexual Intercourse, Sexually Active Females Aged 15–17 Years Attending School, United States, 1991–2001, Youth Risk Behavior Survey

| Method                            | % of Adolescents Using Method |      |      |      |      |      | % Change<br>1991–2001 | Annual % Change <sup>b</sup><br>1991–2001 | <i>p</i> Value <sup>c</sup> |
|-----------------------------------|-------------------------------|------|------|------|------|------|-----------------------|---|-----------------------------|
|                                   | 1991                          | 1993 | 1995 | 1997 | 1999 | 2001 |                       |   |                             |
| <b>All</b>                        |                               |      |      |      |      |      |                       |   |                             |
| Pill only                         | 20.6                          | 15.8 | 15.4 | 12.4 | 12.6 | 14.6 |                       |   |                             |
| Condoms only                      | 36.5                          | 43.9 | 45.9 | 46.6 | 47.5 | 46.0 |                       |   |                             |
| Pill and condom                   | 3.1                           | 3.7  | 3.0  | 5.1  | 4.2  | 5.1  |                       |   |                             |
| Withdrawal                        | 19.6                          | 17.1 | 15.6 | 16.3 | 12.4 | 12.7 |                       |   |                             |
| Injection                         | na                            | na   | na   | na   | 3.8  | 3.7  |                       |   |                             |
| Injection and condom              | na                            | na   | na   | na   | 1.2  | 2.3  |                       |   |                             |
| Some other method                 | 2.5                           | 2.3  | 2.2  | 4.4  | 1.4  | 1.9  |                       |   |                             |
| No method                         | 17.2                          | 16.1 | 17.5 | 14.7 | 16.1 | 13.0 |                       |   |                             |
| Not sure                          | 0.5                           | 1.1  | 0.5  | 0.4  | 1.0  | 0.8  |                       |   |                             |
| Weighted average CFR <sup>a</sup> | 27.1                          | 26.7 | 27.2 | 25.1 | 25.7 | 23.1 | –14.8%                | –1.6%                                     | .0048                       |
| n                                 | 1652                          | 2287 | 1670 | 2211 | 1970 | 1682 |                       |   |                             |
| <b>White, non-Hispanic</b>        |                               |      |      |      |      |      |                       |   |                             |
| Pill only                         | 23.7                          | 17.9 | 20.4 | 16.6 | 16.1 | 18.9 |                       |   |                             |
| Condoms only                      | 36.7                          | 45.0 | 45.3 | 42.7 | 43.2 | 44.0 |                       |   |                             |
| Pill and condom                   | 3.0                           | 2.6  | 3.0  | 6.4  | 5.7  | 6.1  |                       |   |                             |
| Withdrawal                        | 21.4                          | 17.6 | 15.5 | 16.5 | 12.6 | 11.5 |                       |   |                             |
| Injection                         | na                            | na   | na   | na   | 3.8  | 3.6  |                       |   |                             |
| Injection and condom              | na                            | na   | na   | na   | 1.5  | 2.4  |                       |   |                             |
| Some other method                 | 2.6                           | 2.5  | 1.7  | 4.0  | 1.6  | 0.9  |                       |   |                             |
| No method                         | 12.4                          | 13.6 | 13.8 | 13.6 | 14.7 | 12.3 |                       |   |                             |
| Not sure                          | 0.3                           | 0.9  | 0.3  | 0.3  | 0.8  | 0.3  |                       |   |                             |
| Weighted average CFR <sup>a</sup> | 22.0                          | 23.2 | 22.5 | 22.3 | 22.6 | 20.1 | –8.6%                 | –0.9%                                     | .2138                       |
| n                                 | 683                           | 874  | 596  | 689  | 672  | 741  |                       |   |                             |
| <b>Black, non-Hispanic</b>        |                               |      |      |      |      |      |                       |   |                             |
| Pill only                         | 15.3                          | 11.8 | 6.7  | 6.4  | 7.8  | 5.6  |                       |   |                             |
| Condoms only                      | 36.5                          | 43.1 | 55.0 | 54.2 | 65.4 | 57.3 |                       |   |                             |
| Pill and condom                   | 4.8                           | 7.1  | 3.9  | 5.4  | 2.1  | 1.5  |                       |   |                             |
| Withdrawal                        | 14.8                          | 12.7 | 14.3 | 13.9 | 5.6  | 10.6 |                       |   |                             |
| Injection                         | na                            | na   | na   | na   | 1.9  | 4.6  |                       |   |                             |
| Injection and condom              | na                            | na   | na   | na   | 1.5  | 2.9  |                       |   |                             |
| Some other method                 | 2.7                           | 2.4  | 2.4  | 3.7  | 0.7  | 3.7  |                       |   |                             |
| No method                         | 25.7                          | 22.4 | 16.9 | 15.8 | 14.8 | 12.1 |                       |   |                             |
| Not sure                          | 0.3                           | 0.6  | 0.8  | 0.6  | 0.4  | 1.7  |                       |   |                             |
| Weighted average CFR <sup>a</sup> | 38.3                          | 36.2 | 34.5 | 33.3 | 31.6 | 30.7 | –19.8%                | –2.2%                                     | .0001                       |
| n                                 | 581                           | 725  | 730  | 812  | 678  | 391  |                       |   |                             |
| <b>Hispanic</b>                   |                               |      |      |      |      |      |                       |   |                             |
| Pill only                         | 13.6                          | 13.0 | 5.6  | 7.5  | 5.6  | 4.9  |                       |   |                             |
| Condoms only                      | 27.8                          | 34.2 | 34.6 | 38.2 | 44.7 | 45.2 |                       |   |                             |
| Pill and condom                   | 0.3                           | 0.9  | 1.5  | 2.3  | 1.7  | 4.9  |                       |   |                             |
| Withdrawal                        | 20.7                          | 24.9 | 18.3 | 19.8 | 17.2 | 16.3 |                       |   |                             |
| Injection                         | na                            | na   | na   | na   | 0.9  | 2.2  |                       |   |                             |
| Injection and condom              | na                            | na   | na   | na   | 0.6  | 0.4  |                       |   |                             |
| Some other method                 | 2.3                           | 1.3  | 6.2  | 2.9  | 3.7  | 4.6  |                       |   |                             |
| No method                         | 32.7                          | 23.2 | 33.0 | 28.4 | 21.9 | 19.8 |                       |   |                             |
| Not sure                          | 2.7                           | 2.5  | 0.9  | 0.9  | 3.6  | 1.8  |                       |   |                             |
| Weighted average CFR <sup>a</sup> | 41.4                          | 35.1 | 40.6 | 37.4 | 34.9 | 31.6 | –23.7%                | –2.7%                                     | .0310                       |
| n                                 | 308                           | 561  | 258  | 547  | 461  | 410  |                       |   |                             |

<sup>a</sup> Weighted average contraceptive failure rate (WACFR), based on method-specific CFRs and proportion using each method; estimates based on the contraceptive behavior of sexually active adolescents.

<sup>b</sup> Annual percentage change based on a geometric rate of change.

<sup>c</sup> Significance testing based on weighted least squares regression.

## Discussion

Remarkable declines occurred in rates of pregnancy among adolescent women during the past decade.

Overall, rates among teens aged 15 to 17 years declined by one-third. Our method of estimating pregnancy risk, using behavioral data from the national YRBS and contraceptive effectiveness data

**Table 4.** Annual Rates of Change<sup>a</sup> in Sexual Experience, Weighted-Average Contraceptive Failures Rates, Estimated Pregnancy Risk, and Actual Pregnancy Rates and Estimated Percentage of Pregnancy Change Attributed to Changes in Sexual Experience and Contraceptive Use, Females Aged 15–17 Years Attending School, United States, 1991–2001

|                     | Sexual Experience 1991–2001 | Weighted Average CFR <sup>b</sup> 1991–2001 | Estimated Pregnancy Risk <sup>c</sup> 1991–2001 | Estimated Pregnancy Risk, 95% CI 1991–2001 | Actual Pregnancy Rate <sup>d</sup> 1991–2000 | % of Pregnancy Change Attributable to |                      |        |               |
|---------------------|-----------------------------|---|---|--|--|---------------------------------------|----------------------|--------|---------------|
|                     |                             |   |   |  |  | Sexual Experience                     | Contraceptive Change | 95% CI |               |
| All                 | -1.7%                       | -1.6%                                       | -3.2%   | -4.8% to -1.6%                             | -4.3%  | 52.7%                                 | 26.5 to 78.8%        | 47.3%  | 21.1 to 73.5% |
| White, non-Hispanic | -1.5%                       | -0.9%                                       | -2.3%   | -4.4% to -0.1%                             | -5.5%  | 63.9%                                 | 12.1 to 100%         | 36.1%  | 0 to 87.9%    |
| Black, non-Hispanic | -3.3%                       | -2.2%                                       | -5.4%   | -7.1% to -3.8%                             | -5.2%  | 59.9%                                 | 45.6 to 73.6%        | 40.1%  | 26.4 to 54.4% |
| Hispanic            | 0.1%                        | -2.7%                                       | -1.9%   | -4.5% to 0.8%                              | -2.5%  | 0.0%                                  | 0 to 100%            | 100.0% | 0 to 100%     |

<sup>a</sup> Annual percentage change based on a geometric rate of change.

<sup>b</sup> Contraceptive failure rate, based on contraceptive behavior of sexually experienced teens.

<sup>c</sup> Change in pregnancy risk that would be expected based on changes in sexual experience, contraceptive use, and contraceptive failure rates.

<sup>d</sup> National Center for Health Statistics data [3].

from the NSFG, provided a good but not perfect fit to actual rates. For non-Hispanic black and Hispanic teens, the racial and ethnic groups in this analysis with the highest pregnancy rates, changes in data on pregnancy risk derived from school-based behavioral data closely reflected the actual changes in pregnancy rates; such data underestimated the actual rates for non-Hispanic whites. One should be cautious in interpreting data for Hispanic teens, as reported sexual experience was not linear and confidence intervals for change estimates were relatively larger.

These data suggest that both delayed initiation of sexual intercourse and improved contraceptive practice contributed equally to declines in pregnancy rates among high school-aged teens during the 1990s. Between 1991 and 2001, sexual experience declined overall, with the largest declines among non-Hispanic black adolescents. At the same time, contraceptive efficacy appears to have increase (based on WACFR data), primarily as a result of decreasing use of withdrawal as a method and of decreasing nonuse of contraception, in addition to increasing condom use. The overall use of hormonal methods changed little because the declining pill use was offset by the increasing use of Depo-Provera. Condom use and dual use (use of condoms with a hormonal method) both increased. Overall, dual use remained relatively uncommon, although the use of a condom among users of hormonal methods was relatively more common (more than one-fourth of users).

School-based data did not track well with the pregnancy risk of white adolescents aged 15 to 17 years at risk of pregnancy. For non-Hispanic white teenagers, our estimates for the change in pregnancy risk underestimated actual declines. Pregnancy rates are lower among whites than other racial and ethnic groups, and more white teens who become pregnant may have dropped out of school before the pregnancy occurred. As such, changes in the risk of pregnancy in white adolescents may not be well reflected by school-based data. These data for white teens may have lacked statistical power, given relatively smaller changes in sexual behaviors than for other teens. For white teenagers, the change in recent sexual activity (-1.4% per year;  $p = .06$ ) and the change in WACFR (-0.9%;  $p = .2050$ , using contraceptive data from sexually experienced teens) were both nonsignificant, whereas the changes in sexual experience (-1.5;  $p = .0026$ ) and the estimated pregnancy risk estimates (-2.3%;  $p = .01$ ) were statistically significant.

One explanation for our underestimate of the actual change in pregnancy rates among white teens is that contraceptive efficacy for specific methods may be improving among these adolescents. For example, more correct or consistent use of condoms over time would reduce the actual contraceptive failure for condoms. In our study we treated contraceptive failure as a constant because data from the NSFG suggested that CFRs had not changed between 1988 and 1995 [30] and other data are not available. The next cycle of the NSFG, conducted in 2002, will provide an updated source for estimating condom effectiveness and consistency.

Our study is not directly comparable to previous studies examining behavioral explanations for declining teen pregnancy rates. These previous studies have focused on the teen pregnancy decline occurring during the early 1990s and have generally focused on teens aged 15 to 19 years [22–24]. Nor have these studies directly examined changing patterns of contraceptive use and the impact of these on pregnancy rates. We believe that future studies should attempt to estimate contraceptive impact based on self-reported contraceptive use and method-specific contraceptive failure rates.

### Limitations of the Study

Potential limitations in these analyses include a lack of behavioral data for nonstudents, imprecision inherent in estimating pregnancies among teens aged 15 to 17 years based on sexual behaviors of teens aged 15 to 17 years, lack of data in the YRBS for frequency of intercourse and the correctness and consistency of contraceptive use (noted above), use of contraceptive at last intercourse as a marker for overall contraceptive use, potential changes in reporting bias, unavailability of CFRs stratified by age, race, and ethnicity, and large confidence intervals for estimates of change in pregnancy risk.

YRBS data are limited to adolescents attending high school. Pregnancy, sexual activity, and failure to use contraceptives are significantly more common among out-of-school youth [35]. Teens may drop out of school and then become pregnant or may become pregnant and then drop out. Data from the National Center for Education Statistics (NCES) suggest that approximately 3.9% of teens aged 16 years and 7.6% of teens aged 17 years have dropped out, with slowly declining dropout rates over time [36]. NCES status dropout rates (defined as the percentage of persons ages 16–24 who have dropped out) are higher for Hispanics and blacks than for whites, and higher

among males than among females. When looking at just 16- and 17-year-old females, a somewhat different story emerges. No detectable differences exist between the propensity for white and black 16- and 17-year-old females to drop out of high school (5.2% vs. 4.2%). However, both of these groups were less likely than Hispanic 16- and 17-year-old females to drop out (9.9%) (estimates from the October 2000 Current Population Survey, personal communication with Chris Chapman and Jerry West, NCES, June 24, 2003).

Estimates are not available for the percentage of teen pregnancies or teen births that occur to out-of-school and in-school youths. Given these dropout rates, a sizable proportion of teens aged 15 to 17 years who become pregnant are still in school at the time that they become pregnant. Moreover, trends in contraceptive use among youths in school, such as increasing condom use or use of new hormonal methods, presumably parallel trends among youths who are out of school. Trends in sexual behaviors among teens, including sexual intercourse and condom use, are generally consistent over time among household and school surveys [37].

There is a lag time between sexual and contraceptive behaviors and the end of a pregnancy, particularly for pregnancies ending in a live birth. As such, adolescents who complete a pregnancy between age 15 and 17 years are systematically younger at the time of conception. This makes the exact estimation of pregnancy risk problematic. For example, the percentage of adolescents who are sexually experienced increases rapidly between 14 and 17 years of age. However, this lag effect should be relatively constant over time and has little effect on temporal changes in rates.

Risk of pregnancy is directly related to the frequency of intercourse among sexually experienced teens. YRBS provides a single measure of coital frequency (i.e., intercourse during the past 3 months). Teen sexual behavior is often sporadic, with a minority of adolescents being consistently sexually active over the course of 1 year [10,39]. Within the YRBS, one-fourth of sexually experienced teens had not had sexual intercourse during the preceding 3 months. Given this crude measure of intercourse frequency, we found no change over time in sexual activity among sexually experienced teens. Declining frequency of sexual intercourse cannot be ruled out as a potential contributor to declining pregnancy rates.

Temporal changes in contraceptive efficacy for specific methods might also influence changes in

pregnancy rates. Data on method failure using NSFG, corrected for the underreporting of abortion, is one of the standard ways of calculating method-failure rates in the United States. Previous studies using the NSFG did not find evidence for changes in method-specific effectiveness between 1988 and 1995 [30].

YRBS provides limited information about sexual and contraceptive behaviors. Data on the use of Norplant or other less common methods are not collected. Data on injectable contraception were first collected in 1999. Data on post-coital contraception are not collected in YRBS. One recent study of women receiving abortions [38] suggested that post-coital contraception may explain as much as 43% of the decline in abortions between 1994 and 2000.

Potential changes over time in reporting bias of sexual behaviors are possible and virtually impossible to detect in national reporting systems. For example, given an increasingly conservative social climate, fewer teens may report sexual experience. However, such a reporting bias would likely overestimate behavior change, and we found no evidence for such an effect.

Another limitation for these analyses was the use of CFRs by race and ethnicity for women of all ages, because CFRs were not available by age and race and ethnicity. Whereas failure rates for adolescents are similar to older women, our methodology cannot account for potential interaction effects between age and race and ethnicity.

Finally, our method of estimating the decline in pregnancy risk over time had large confidence intervals, particularly for Hispanics, despite the large sample size and statistical power offered by the national YRBS dataset. This is primarily the consequence of calculating an index of pregnancy risk from two estimates (for sexual experience and contraceptive failure) that also have confidence intervals. Flanigan has also noted this potential problem in estimating declines in pregnancy risk [24]. Estimates for Hispanics were also large because the decline in sexual experience for this group was not linear; rather, this percentage rose from 1991 to 1995 and fell from 1995 to 2001. Given these considerations, care should be taken in attributing changes in pregnancy rates over time to changes in behavior, given broad confidence intervals around such trend estimates.

### Implications

Using several national data sources can compensate for limitations of specific sources and provide a

better explanation of trends in adolescent pregnancy than using a single data source. Our method of estimating pregnancy risk from behavioral data of youths attending school generally provided a reasonably good fit to the data on actual pregnancies, particularly for the two large racial/ethnic groups with the highest pregnancy rates; it also provides some insight into how declining involvement in sexual intercourse and changing contraceptive practices are influencing teen pregnancy for this group. These data suggest that declines in teen pregnancy rates resulted from both delay in initiation of intercourse and improved contraceptive use.

Improved contraceptive use cannot be explained by improvement in any single method. Rather, this is the result of a complex set of changes in method use, including the greater use of any method of contraception. In these data, condoms are now used by more than one-half of teen women who are sexually active, and many using contraceptive hormonal methods (more than one-fourth in 2001) also used a condom at last intercourse. These changes suggest that increased motivation to avoid an unplanned pregnancy and continued concern about human immunodeficiency virus and sexually transmitted diseases may be contributing to the recent decline in teen pregnancy rates. Future years of the YRBS and the NSFG 2002 will refine our understanding of changing adolescent behaviors.

These data find that the nation has made progress toward the twin goals of delaying initiation of sexual intercourse and improving contraceptive practice among teens [2], but also suggest that there is room for improvement in both. Overall, in 2001, 43% of the adolescent women aged 15 to 17 years in school were sexually experienced, and 13% were using no method of contraception at last sexual intercourse. This means that a substantial number of sexually active young teens will continue to become pregnant each year. Teen pregnancy prevention efforts should continue to focus on both delay in initiation of intercourse and effective contraception use for sexually active teens, based on the best available evidence of scientific effectiveness.

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