

# Patient Teenagers? A Comparison of the Sexual Behavior of Virginity Pledgers and Matched Nonpledgers

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## What's Known on This Subject

Two studies have found, by using regression, that virginity pledges delay sex, but regression cannot correct for large preexisting differences between pledgers and nonpledgers.

## What This Study Adds

We used a more robust method than regression to compare virginity pledgers with similar nonpledgers and found virtually no difference in sexual behavior or STDs and much less use of condoms.

## ABSTRACT

**OBJECTIVE.** The US government spends more than \$200 million annually on abstinence-promotion programs, including virginity pledges. This study compares the sexual activity of adolescent virginity pledgers with matched nonpledgers by using more robust methods than past research.

**SUBJECTS AND METHODS.** The subjects for this study were National Longitudinal Study of Adolescent Health respondents, a nationally representative sample of middle and high school students who, when surveyed in 1995, had never had sex or taken a virginity pledge and who were >15 years of age ( $n = 3440$ ). Adolescents who reported taking a virginity pledge on the 1996 survey ( $n = 289$ ) were matched with nonpledgers ( $n = 645$ ) by using exact and nearest-neighbor matching within propensity score calipers on factors including prepledge religiosity and attitudes toward sex and birth control. Pledgers and matched nonpledgers were compared 5 years after the pledge on self-reported sexual behaviors and positive test results for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis*, and safe sex outside of marriage by use of birth control and condoms in the past year and at last sex.

**RESULTS.** Five years after the pledge, 82% of pledgers denied having ever pledged. Pledgers and matched nonpledgers did not differ in premarital sex, sexually transmitted diseases, and anal and oral sex variables. Pledgers had 0.1 fewer past-year partners but did not differ in lifetime sexual partners and age of first sex. Fewer pledgers than matched nonpledgers used birth control and condoms in the past year and birth control at last sex.

**CONCLUSIONS.** The sexual behavior of virginity pledgers does not differ from that of closely matched nonpledgers, and pledgers are less likely to protect themselves from pregnancy and disease before marriage. Virginity pledges may not affect sexual behavior but may decrease the likelihood of taking precautions during sex. Clinicians should provide birth control information to all adolescents, especially virginity pledgers. *Pediatrics* 2009;123:e110–e120

**R**EDUCING EARLY ADOLESCENT sexual initiation is an important public health objective. Early sexual initiation is associated with sexual risk-taking, pregnancy, and sexually transmitted diseases (STDs).<sup>1,2</sup> Well-designed sex education programs that teach both abstinence and contraception can delay sexual initiation<sup>3,4</sup> and prevent pregnancy, STDs, and risky sexual behavior.<sup>1,3–5</sup> Abstinence-only sex education (AOSE) programs are defined by statute as having the “exclusive purpose [of] teaching the social, psychological, and health gains [of] abstaining from sexual activity.”<sup>6</sup> No AOSE programs have been identified as changing adolescent sexual behavior in either the congressionally mandated randomized experiment<sup>7</sup> or the

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### Key Words

sexual abstinence, sexual behavior, sexual partners, contraception, adolescent, religion and sex, Christianity, nonparametric statistics, matched-pair analysis

### Abbreviations

STD—sexually transmitted disease  
AOSE—abstinence-only sex education  
CL—confidence limit

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systematic review of well-designed AOSE studies,<sup>8</sup> but AOSE funding has increased dramatically, from \$73 million in 2001 to \$204 million in 2008.<sup>6,9</sup>

A sexual abstinence or “virginity” pledge is an oral or written promise to refrain from sexual activity, usually until marriage, administered after a multi- or single-session curriculum in religious youth groups, parochial and public schools, or large group events. The virginity pledge and 6-hour curriculum were created in 1993 by an evangelical Christian organization. The idea was subsequently spread by other Protestant and Catholic groups, which created pledges for their own AOSE programs for both religious and secular adolescents. By 1995, 13% of American adolescents reported having taken a virginity pledge.<sup>10</sup> Virginity pledges are also now used to measure AOSE program effectiveness, which the US government considers successful if they produce many virginity pledgers, irrespective of participants’ sexual behavior.<sup>6,11</sup> This standard raises the question of whether virginity pledgers are less sexually active than comparable adolescents.

Studies using regression models have shown that virginity pledgers in a nationally representative sample were less likely to become sexually active than nonpledgers 1 and 5 years after the pledge,<sup>10,12,13</sup> equally likely to have STDs 5 years after the pledge,<sup>10,13</sup> and less likely to use contraception than nonpledgers.<sup>12</sup>

A California study showed greater sexual abstinence among adolescents who made a personal resolution not to have sex but not among formal virginity pledgers.<sup>14</sup> These studies were critiqued for comparing pledgers with dissimilar nonpledgers.<sup>11</sup>

Regression models in past studies compared pledgers with the universe of nonpledgers despite dissimilarities that regression may be unable to correct.<sup>15–17</sup> One year before pledging, pledgers are more religious, less sexually experienced, and hold more negative attitudes about sex and birth control than adolescents who do not go on to take a virginity pledge.<sup>10,12</sup> Religious adolescents delay sexual initiation,<sup>18–21</sup> so virginity pledgers’ prepledge religiosity could induce abstinence without the pledge.

Given regression’s recognized limitations,<sup>15–17</sup> this article is distinctive in using matched sampling methods<sup>22–26</sup> to compare the sexual and contraceptive behavior of virginity pledgers with similar nonpledgers in a national longitudinal study 5 years after a pledge is made.

## METHODS

Matched sampling is a nonparametric method for assessing program outcomes by comparing a program group with similar nonprogram respondents.<sup>22–24</sup> We created a group of nonpledgers as similar as possible to pledgers on all prepledge factors that may influence sexual behavior, so outcome differences between pledgers and matched nonpledgers cannot be attributed to preexisting differences. Past studies compared self-selected virginity pledgers with the general population and attempted to adjust for the vast prepledge differences by using regression models.

Both matching and regression yield associative rather than causal inference, but matching creates more valid comparisons and results for 3 reasons. First, regression models rely on dubious parametric assumptions and

cannot adjust, even on average, for large differences between program and nonprogram groups.<sup>15,16,24,25</sup>

Second, matching computes outcome differences only once, after verification that the matched nonprogram group is similar to the program group. This separation ensures that the model is selected independently of the study’s results, in contrast to regression, with which it is impossible to verify model correctness without seeing the results. Third, matching allows adjustment for many more variables than does regression. In this study, I controlled for 112 variables, which would be problematic in a regression with 289 pledgers. For these reasons, matched sampling has been advocated for studies in medicine and public health<sup>27–29</sup> and is used increasingly often in the medical literature.<sup>30–34</sup>

## Data

Data are a subsample of the National Longitudinal Study of Adolescent Health (Add Health),\* a nationally representative sample of grade 7 to 12 students interviewed in 3 waves (in 1995 [wave 1], 1996 [wave 2], and 2001 [wave 3]), as described elsewhere.<sup>35,36</sup> The subsample comprises respondents who had not at wave 1 taken a virginity pledge or been sexually active, were >15 years of age, and participated in all 3 waves ( $n = 3440$ ).

Respondents <15 years of age were not asked about sex and birth control attitudes, which likely influence both virginity pledge and sexual activity, so they were excluded from analysis.

Attrition in the subsample was 12% between waves 1 and 2 and 26% between waves 2 and 3, similar to that in the larger sample. Survey weights developed for the entire sample are inadequate for a constrained subsample and were not used.

## Variables

Virginity-pledge status is the wave 2 answer to “Have you ever signed a pledge to abstain from sex until marriage?” Predictors of virginity pledge were measured at wave 1, 1 year before the pledge, and so cannot be attributed to the pledge as wave 2 factors could be. Factors for exact and nearest-neighbor caliper matching were selected from 128 potential predictors derived from past-pledge literature<sup>10,12–14</sup> and the National Institute of Mental Health integrated health behavior model<sup>37</sup>: 16 composite variables, their 85 component survey items, and 27 other items. (Major categories and example items are listed in Table 1; the full list is available in the Appendix.)

Outcome variables measure sexual behavior and STD diagnosis and prevention 5 years after the pledge, when the sample was at median 22 years of age (interquartile range: 20–23 years). STDs were diagnosed from urine-test results; all other outcomes were self-reported.

Respondents’ use of STD- and pregnancy-prevention

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**TABLE 1 Means for Pledgers Versus Nonpledgers, Before and After Matching**

	Mean		t Test	Mean After Match (n = 645)	t Test
	Pledge (n = 289)	Nonpledge (n = 3151)			
Propensity score	19.0	7.4	20.14	16.3	0.79
Negative expectations about sex index	67.2	59.5	6.12	68.8	-0.63
Positive expectations about sex index	37.0	42.4	-4.98	37.0	-0.03
Feel guilty if had sex	64.0	44.0	6.54	64.5	-0.11
Partner lose respect if had sex	29.4	18.0	4.75	29.4	0.00
Sex would be relaxing	11.8	21.4	-3.87	12.5	-0.21
Pleasure if had sex	27.0	38.1	-3.74	26.0	0.22
Birth control is bad index	40.2	32.6	6.90	38.9	0.33
Efficacy to use birth control index	54.8	58.3	-3.84	54.8	-0.05
Birth control knowledge quiz	51.3	57.1	-4.43	50.9	0.26
Partner would not agree to birth control	18.0	9.6	4.48	13.7	1.83
Birth control is looking for sex	31.5	20.3	4.44	28.5	1.17
Would plan ahead for birth control	42.6	54.9	-4.04	43.9	-0.40
Birth control is morally wrong	12.5	6.8	3.52	10.0	0.81
Birth control is a hassle	13.5	8.5	2.87	11.0	0.87
Friends know how to use condoms	14.2	21.0	-2.75	16.3	-0.87
Birth control requires too much planning	13.1	9.0	2.33	12.0	0.56
Would use birth control if aroused	34.9	41.6	-2.21	37.4	-0.74
Romantic relationship experience index	26.3	31.3	-3.24	27.1	-0.24
Touched, last 18 mo	17.6	27.1	-3.50	18.1	-0.12
Touched genitals, last 18 mo	11.4	19.3	-3.28	11.9	-0.17
Pubertal development	49.3	46.3	2.53	48.1	0.05
Will marry by age 25	57.4	53.5	2.47	55.7	0.73
Kissed, last 18 mo	40.8	47.4	-2.14	42.1	-0.36
Religious involvement index	66.1	46.4	10.72	65.9	0.03
Parent religiosity index	66.9	59.8	3.22	71.4	-0.55
Youth group weekly or more	40.8	17.6	9.52	39.1	0.43
Church attendance weekly or more	64.0	36.1	9.33	62.4	0.51
Religion very important	62.6	36.2	8.82	61.2	0.44
Born Again Christian	40.8	19.0	8.74	38.9	0.57
Parent church attendance at least weekly	46.4	32.1	4.91	49.6	-0.90
Friend risk behavior index	18.3	22.5	-2.85	16.9	0.73
≥1 of 3 best friends drinks monthly	42.9	52.5	-3.12	43.5	-0.18
≥1 of 3 best friends uses marijuana monthly	21.5	28.4	-2.53	17.9	0.91
Male	38.8	52.3	-4.42	39.0	-0.07
Asian	17.3	9.9	3.90	15.9	0.51
Parent born in the United States	58.8	70.3	-4.03	61.0	-0.69
Peabody vocabulary test score	74.3	78.4	-5.94	75.3	-0.19

Items are sorted within category in decreasing order of significance, with index/aggregate variables at top. All items have been normalized to a scale from 0 to 100. Propensity score is the estimated probability of taking a virginity pledge from a logistic regression model (Table 4). More comparisons of means are in Tables 5 through 8.

methods before marriage was measured by reported birth control and condom use in the past 12 months and at last sex and was coded as missing for married respondents.

Outcome differences were biased toward showing an effect of the pledge for 2 reasons: the pledge is an intermediate outcome of an unobserved abstinence intervention, which would be the treatment variable in an experiment; and pledgers may be less likely to report sexual activity than nonpledgers.<sup>38</sup>

### Matched Sampling

Matched sampling attempts to create a group of nonpledgers with prepledge characteristics similar to pledgers, as would be true in a randomized experiment.<sup>17,22-24</sup> Ideally, exact duplicates of every pledger could be found among the nonpledgers.<sup>31</sup> Instead, matching creates a comparison group with a similar distribution of prepro-

gram factors, which is thus the primary criterion for assessing match quality.<sup>23,24,26</sup> There are not yet standardized guidelines for choosing a matching procedure,<sup>23,27</sup> and matching methods yield similar results in simulation,<sup>23</sup> but nearest-neighbor caliper matching is generally recommended.<sup>23</sup> Exact matching can be combined with any method to make respondents identical on factors that might otherwise cause large differences, similar to blocking in randomized experiments.<sup>23,25</sup> A matching method's appropriateness is gauged postfacto by the balance achieved, so any method and choice of matching factors that result in balanced groups is considered appropriate.<sup>23,24</sup>

This study used 2 types of matching: exact matching and 3:1 nearest-neighbor matching within propensity score calipers with replacement, using the R package MatchIt.<sup>25,39</sup> The 2 exact matching factors were anticipat-

**TABLE 2 Sexual Behavior and Birth Control Use for Pledgers and Matched Nonpledgers, Wave 3**

	Means (SE)		$\Delta$ (95% CIs)	<i>t</i> Test (Effect Size <i>d</i> )
	Pledge ( <i>n</i> = 289)	Nonpledge ( <i>n</i> = 645)		
Sexual intercourse	72.66 (2.63)	76.24 (1.69)	-3.58 (-9.58, 2.43)	-1.21
Premarital sex and unmarried	53.29 (2.94)	57.09 (1.96)	-3.81 (-10.70, 3.09)	-1.08
Number times had sex in past year	22.83 (0.80)	23.68 (0.55)	-0.84 (-2.76, 1.07)	-0.86
Age first sex, <i>y</i>	21.23 (0.33)	20.73 (0.22)	0.49 (-0.28, 1.26)	1.25
Lifetime partners	3.22 (0.14)	3.52 (0.09)	-0.31 (-0.63, 0.02)	-1.86
Past year partners	1.09 (0.03)	1.20 (0.02)	-0.11 (-0.19, -0.02)	-2.45 (0.28)
Sexual intercourse, in relationship	64.36 (2.82)	63.55 (1.90)	0.81 (-5.87, 7.48)	0.24
Receive anal sex, in relationship	9.00 (1.69)	10.27 (1.20)	-1.27 (-5.41, 2.87)	-0.60
Give anal sex, in relationship	6.23 (1.42)	4.50 (0.82)	1.73 (-1.31, 4.77)	1.12
Receive oral sex, in relationship	59.17 (2.90)	57.09 (1.96)	2.08 (-4.78, 8.94)	0.59
Give oral sex, in relationship	50.87 (2.95)	51.33 (1.97)	-0.46 (-7.40, 6.48)	-0.13
Ever have partner with STD	3.46 (1.08)	5.42 (0.90)	-1.96 (-4.93, 1.01)	-1.29
Ever paid someone for sex	1.73 (0.77)	2.77 (0.65)	-1.04 (-3.18, 1.11)	-0.95
Ever been paid for sex	1.04 (0.60)	3.34 (0.71)	-2.31 (-4.53, -0.08)	-2.03 (0.21)
Chlamydia test	2.42 (0.84)	4.25 (0.74)	-1.83 (-4.26, 0.61)	-1.47
Trichomoniasis test	2.04 (0.77)	2.13 (0.53)	-0.09 (-1.94, 1.76)	-0.10
Gonorrhea test	0.00	0.00	0.00	
Ever marry	20.42 (2.38)	20.42 (1.59)	0.00 (-5.60, 5.60)	0.00
Ever divorce	2.08 (0.84)	1.50 (0.48)	0.58 (-1.21, 2.36)	0.63
Ever attracted to same sex	8.30 (1.63)	9.69 (1.17)	-1.38 (-5.41, 2.64)	-0.67
Identify as gay or bisexual	3.81 (1.13)	3.69 (0.74)	0.12 (-2.52, 2.75)	0.09
Always use condom past year	23.91 (2.13)	34.49 (1.66)	-10.58 (-16.11, -5.05)	-3.75 (0.35)
≥Most of the time use condom	42.03 (2.46)	53.70 (1.75)	-11.67 (-17.64, -5.71)	-3.84 (0.35)
≥Half the time use condom	50.72 (2.49)	61.81 (1.70)	-11.08 (-16.96, -5.20)	-3.70 (0.33)
Never use condom, past year	28.26 (2.25)	19.68 (1.39)	8.58 (3.62, 13.55)	3.39 (0.30)
Always use birth control past year	45.65 (2.48)	51.62 (1.72)	-5.97 (-11.93, -0.01)	-1.96 (0.18)
≥Most of the time use birth control	63.77 (2.40)	70.14 (1.58)	-6.37 (-11.92, -0.82)	-2.25 (0.20)
≥Half the time use birth control	69.57 (2.30)	75.93 (1.47)	-6.36 (-11.59, -1.13)	-2.38 (0.21)
Never use birth control, past year	15.22 (1.79)	14.12 (1.19)	1.10 (-3.10, 5.29)	0.51
Last sex use condom	52.17 (2.49)	54.86 (1.70)	-2.69 (-8.63, 3.26)	-0.89
Last sex use birth control	66.67 (2.35)	72.22 (1.54)	-5.56 (-10.99, -0.12)	-2.00 (0.33)
Past year had condom break	26.85 (1.96)	25.71 (1.34)	1.14 (-3.55, 5.82)	0.48

All quantities are percentage endorsing, except number of sexual partners and age at first sex. Means and SE are weighted according to frequency.  $\Delta$  is the difference in means of pledgers and nonpledgers. Comparison of birth control is restricted to singles who have had sex (*n* = 154 pledgers, 393 nonpledgers). Cohen's effect size *d* is computed for significant differences.

ing feeling guilty if they had sex and weekly attendance at church and/or religious youth group, conceptually distinct items with the largest mean prematching differences between pledgers and nonpledgers (Table 1). Propensity scores are the estimated probability of taking a virginity pledge calculated from a stepwise logistic regression.

Nearest-neighbor matching within propensity score calipers locates the 3 nonpledgers "closest" to each pledger, preferentially within calipers of 0.25 SDs in propensity score. The Mahalanobis metric measures the correlation-adjusted distance between respondents on the basis of respondents' values of continuous variables. The variables used in the distance measure are derived through trial and error by including and excluding variables until balance is achieved. Balance was achieved by using 4 composite variables in the metric: religious involvement, negative attitudes about birth control, parent religiosity, and pubertal development.

Match adequacy is determined by "balance," the similarity of the covariate distributions of pledge and nonpledge groups. The *t* test is commonly used to assess balance at mean, but there is not yet consensus on the best way to assess balance across the entire distribution.<sup>25,26,30</sup> This

study assessed balance by using the *t* test and visual inspection of empirical quantile-quantile plots.<sup>26,30</sup>

Once balance was achieved, the outcomes of virginity pledgers and matched nonpledgers were compared with a *t* test. Cohen's effect size *d*, a measure independent of sample size, was calculated for significant differences: 0.2 is classified as small, 0.5 as medium.<sup>40</sup>

For illustrative comparison of differences between our restricted group and adolescents nationwide, survey-adjusted means of wave 3 outcomes were computed in Stata (Stata Corp, College Station, TX).

## RESULTS

In ordinary regression, virginity pledgers would be compared with all nonpledgers, but these groups differed 1 year before taking the pledge. Comparing the 289 pledgers and 3151 nonpledgers at wave 1 before matching, pledgers were less sexually experienced and expected more negative and fewer positive psychosocial effects of sex and birth control use, with lower birth control efficacy and knowledge. Pledgers had greater levels of religious belief, involvement, Born Again affiliation, more religious parents, and fewer substance-using friends and were more likely to expect marriage before age 25. Pledgers also were dis-

proportionately female, Asian, with foreign-born parents, and had lower Peabody vocabulary test scores (Table 1 and Appendix). Survey design parameters (region, cluster, and weight) were attempted as covariates in the propensity score model but were not significant.

The 3:1 matching with replacement matched 645 nonpledgers to the 289 pledgers. Matched pledgers and nonpledgers did not differ on average in propensity score, 16 composite variables and their 85 component items, and 27 other variables (Table 1 and Appendix). By simple chance, 5% of comparisons on average will be significant at the .05 level; 0 of the 128 comparisons are significant, so balance is better than expected by chance.

Turning to outcomes, 5 years after the pledge, 81.9% (confidence limits [CLs]: 76.2%, 87.6%) of virginity pledgers claimed to have never pledged. Virginity pledgers and matched nonpledgers did not differ in 12 of 14 sexual behaviors, 3 of 3 STD test results, and 4 of 4 marriage-related outcomes (Table 2). Pledgers reported an average of 1.09 past-year vaginal sex partners, 0.11 (CLs: 0.02, 0.19) fewer than nonpledgers, and 2.31% (CLs: 0.08%, 4.53%) fewer pledgers reported having been paid for sex than nonpledgers.

Unmarried pledgers were less likely to report using birth control and condoms in the last year, and birth control at last sex, but did not differ in reporting condom use at last sex or in condom breakage (Table 2).

The pledgers and matched nonpledgers together are a highly religious group of adolescents and would be expected to be more sexually conservative.<sup>18–21</sup> Pledgers and matched nonpledgers together reported substantially more conservative sexual behavior at wave 3 than the general population of adolescents—with fewer reporting premarital vaginal sex, oral and anal sex, birth control and condom use, and multiple sex partners and more reporting being married—but did not differ in 2 of the 3 STD tests: fewer had positive test results for *Neisseria gonorrhoeae* but did not differ in the proportion testing positive for *Chlamydia trachomatis* or *Trichomonas vaginalis* compared with the general adolescent population in Add Health wave 3 (data not shown). Among wave 2–matched nonpledgers, 8.7% (CLs: 5.3%, 12.1%) reported a pledge at wave 3.

## DISCUSSION

Pledgers were not less sexually active than matched nonpledgers despite prepledge similarities on 128 factors. Past findings that pledgers were less sexually active than the general population of nonpledgers may be attributable to regression models' failure to adjust for vast prepledge differences between the groups. Our refined sample (both pledgers and matched nonpledgers) is more religious and sexually conservative than the general population of adolescents and would be predicted to delay sex without virginity pledges.<sup>18–21</sup>

Despite having had similar birth control attitudes 1 year before pledging, virginity pledgers were substantially less likely than matched nonpledgers to protect themselves against STDs and pregnancy, consistent with earlier studies.<sup>10,12</sup>

Virginity pledgers may be less likely to use condoms

and contraception because many abstinence programs cause participants to develop negative attitudes about their effectiveness.<sup>7,41</sup>

More than 90% of abstinence funding does not require that curricula be scientifically accurate,<sup>6,9</sup> and a 2004 review found incorrect information in 11 of 13 federally funded abstinence programs, primarily about birth control and condom effectiveness.<sup>42</sup>

Most virginity pledgers reported having had premarital vaginal and oral sex but did not seem to substitute oral and anal sex for vaginal sex, contrary to earlier studies.<sup>10</sup> Virginity-pledge programs do not prepare pledgers to protect their health if they have sex, although most pledgers do have sex. Pledge programs have guidance for pledgers who initiate sex, such as the True Love Waits publication *When True Love Doesn't Wait*,<sup>43</sup> the recommendations of which include a medical examination and a second, mentored pledge.

Virginity pledgers have 0.1 fewer past-year sexual partners on average, but this modest difference is unlikely to affect STD risk, because pledgers do not differ in the average number of lifetime partners (~3 each) or age of sexual initiation (age 21) or in empirical STD prevalence.

Few virginity pledgers continue to identify with their pledges 5 years after pledging, with >80% claiming to have never pledged, consistent with an earlier finding that half of pledgers disaffiliated within 1 year.<sup>38</sup> This high rate of disaffiliation may imply that nearly all virginity pledgers view pledges as nonbinding.

## Limitations

Matching adjusts only for observed characteristics, but the finding of no difference is robust to matching adequacy. Even if unobserved differences remained after matching, the data could falsely indicate no difference between groups only if pledgers were less abstinent than nonpledgers. Differences between groups may be attributable to an unobserved characteristic, but large differences such as a 10 percentage-point difference in past-year condom use require finding unobserved characteristics with more effect than the 128 factors already matched on, which is unlikely.<sup>44</sup>

Outcome differences are biased toward showing a pledge effect, because the pledge is an intermediate variable to an unobserved treatment variable: abstinence education program participation, unmeasured in the Add Health survey. Approximately 5% of the 32 outcomes compared may be statistically significant by chance because of multiple comparisons. These biases are unlikely to cause a full 10 percentage-point difference at all levels of condom use.

Sexual behavior reports are likely biased toward showing a pledge effect because virginity pledgers may underreport sex<sup>38</sup>; failure to observe a difference in sexual behavior reinforces the likelihood of no true difference.

Pledges were taken in 1996, but the prevalent pledge text and curriculum have not changed substantially since then, according to virginity pledge co-creator (Rev. James Hester, personal communication, September 20, 2007). Pledge programs differ in their educational pro-

grams, continued contact with pledgers, and possible effectiveness, but this study cannot differentiate among programs and computes an average difference over all programs.

Measurement is of self-reported virginity pledges, but within 1 year, half of the virginity pledgers denied having pledged.<sup>38</sup> Adolescents who pledged and ended identification with the pledge before wave 2 were counted as nonpledgers, and 8.7% of wave 2 nonpledgers reported a pledge at wave 3; these bias results to show no pledge effect.

Adolescents were  $\geq 15$  years of age at wave 1 because of unavailability of sex and contraceptive attitude data for younger adolescents. Younger virginity pledgers may be more likely to delay sex over a period of 1 year, as a previous study found,<sup>12</sup> but as was true for older adolescents, part of the delay is likely attributable to pledgers' prepledge attitudes, not the pledge.

Pre marital sex, condom, and birth control use cannot be detected for married respondents and were not imputed. Anal and oral sex prevalence come from respondents' descriptions of each of their past relationships and, thus, are likely to be underestimates: 75% of respondents reported having had vaginal sex, but only 63.8% of respondents reported vaginal sex in describing past relationships.

This article maximizes internal validity, with sacrifice to external: the restricted subsample is not nationally representative.

### Policy Implications

The results suggest that the virginity pledge does not change sexual behavior. One cannot make causal inferences given the pledge's voluntary nature, but if the pledge decreased sexual activity, we would expect to observe a difference between virginity pledgers and comparable nonpledgers; indeed, this estimate is biased in favor of showing a pledge effect.

Given this evidence that pledgers are less likely than comparable nonpledgers to use condoms and birth control, and previous evidence that AOSE programs do not affect sexual behavior,<sup>7,8</sup> federal AOSE funds should be shifted to evidence-based sex education programs that teach birth control and have been demonstrated to delay sexual initiation<sup>3,4</sup> and increase safer sex practices.<sup>1,3-5</sup>

Virginity pledges are not a marker for less sexual activity and should not be used as a measure of abstinence sex education program effectiveness.

### CONCLUSIONS

Adolescents who take virginity pledges are not less sexually active than closely matched adolescents who do not take pledges, but they are less likely to use birth control and condoms. Clinicians should provide birth control information to all adolescents, especially AOSE participants.

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## APPENDIX

Tables 3 through 5 show factors considered as potential predictors of taking a virginity pledge, categorized according to their origin. Potential predictors of taking a virginity pledge were derived from the past virginity-pledge literature and the National Institute of Mental Health integrated model for health behavior. Potential predictors are listed under model components as an aid to the reader, although many other categorizations are possible. Covariates were added separately to the logistic regression model in a “flat” manner, so their categorization did not influence the logistic regression model for predicting probability of pledging. All variables were included in the propensity score model separately, rather than in index format. Variables were combined into indices so that they are continuous for use in the nearest-neighbor matching. All binary variables were defined as 1 if endorsed and 0 otherwise.

Table 6 shows the logistic regression model results predicting taking a wave 2 virginity pledge from wave 1 characteristics. The logistic regression model was determined from stepwise logistic regression in Stata by using the factors listed in Tables 3 through 5.

Tables 7 through 10 show the means before and after matching for each of the variables listed in Tables 3 through 5. These tables were extracted into Table 1.

**TABLE 3 Factors From the Literature Considered As Potential Predictors of Virginity Pledge**

Factor	Variables
Demographics	Gender Age Region Born in United States Black, Asian, Latino BMI Height Height z score for age
Parent-reported (child proxy, if missing)	Parent education Public assistance Household income, income missing Enough money to pay bills Parent born in United States
Family	Live with biological mother, father, both Close to mother/father Mother/father warm and loving Satisfied with communication with mother/father Satisfied with relationship with mother/father Mother encourages independence Mother explains if do something wrong
School attachment	Close to others at school Belong to school community Get along with other students, teachers Number of school sports participate in

Parent-reported income was not significant in any model and was missing for many respondents. Thus, stepwise regressions were all repeated with it omitted and results did not differ, so household income was not used in the final model. Family variables are defined as 0 for respondents without the specified parent.

### Variable Selection

The following details how variables were selected by using the past pledge literature<sup>11-14</sup> and the National Institute of Mental Health integrated health behavior model.<sup>33</sup>

The past pledge literature was used for identifying variables associated with pledging. I attempted to use all available variables in every article that examined predictors of pledging and all significant variables.

### Variable Coding and Missing Data

All items were coded for endorsement or nonendorsement; skipping a question counted as nonendorsement. Peabody vocabulary scores and parent-reported household incomes were median-imputed, and an indicator for missingness was created. Height and weight were imputed by using regression on age, gender, interaction, and each other and median-imputed for the remaining cases. Median imputation artificially decreases SE and may cause a nonsignificant factor to be included in the matching model, but that does not compromise match quality. Sex and birth control outcomes for respondents who never had sex were coded as missing. The number of lifetime and past-year sex partners was truncated at the 90th percentile for each gender: females at 8 lifetime and 2 past-year partners and males at 10 and 3, respectively. Past-year and lifetime partners and age of first sex at wave 3 were each skipped by <1% of respondents; number of times the respondent had sex in the past year was skipped by 7% of respondents. These continuous outcomes were regression-imputed by using wave 1 age,

**TABLE 4 Factors From the National Institute of Mental Health Integrated Health Behavior Model: Intention to Abstain**

Model Component	Factor	Variables
Attitude	Attitude toward birth control	Partner would not use Friends see birth control as "looking for sex" Birth control morally wrong, difficult to use Birth control expensive, requires planning, interferes Mother would disapprove
Sexual expectations	Positive psychosocial	If had sex, would have pleasure Gain respect, be more attractive Feel less lonely, feel relaxing
	Negative psychosocial	Would lose partner's respect Feel guilty, upset mother
	Risks	Probability pregnancy, 1 act unprotected sex Probability HIV, 1 mo unprotected sex Chances of HIV, STD
Emotions about sex		Expectations of pleasure, lonely, relaxing, guilty
Self-image	Personal religiosity	Prayer frequency, religion important Bible literally true, Born Again Christian
	Life expectations	Want to attend college Will attend college, marry by age 25 Live to age 35, killed by age 21, get HIV
Self-efficacy	Birth control efficacy	Would use birth control; would plan ahead to use, resist sex without birth control
	General efficacy	Lots of energy, seldom sick, recover quickly, well-coordinated, lots of good qualities, physically fit, lots to be proud of like self as are, doing everything just about right Socially accepted, loved, and wanted
Social norms	Religious behavior	Youth group, religious service attendance
	Parent religiosity	Church attendance, religion important Prayer frequency, Bible divine
	Delinquency Friend risks	Drinking, trouble with school peers and teachers Number of friends who smoke daily, use marijuana and alcohol monthly, attempt suicide

**TABLE 5 Factors From the National Institute of Mental Health Integrated Health Behavior Model: Knowledge/Skills, Absence Environmental Constraints, Saliency, Habit**

Model Component	Factor	Variables
Knowledge/skills	General knowledge	Peabody vocabulary test score (median-imputed) Grade-point average (nonmissing grades)
	Birth control knowledge	10-item quiz on condom use and pregnancy risk
	Health education	Learned in school about HIV, STDs, pregnancy, drug abuse, drinking, suicide
Absence constraints	Romantic history	Relationship past 18 mo Tell someone like/love, hold hands, kiss, consider self part of couple, touch on or under clothing, touch genitals
Saliency	Pubertal development	Female: breast, body development; menarche Male: facial, body hair; voice change Both: appearance relative to same-age peers Items averaged and scaled 0 to 1, not analyzed separately
	Religious involvement	Attendance youth group, religious services
Habit	Abstinence	All subjects have never had intercourse, so are abstaining from sexual intercourse

The 3 sex-specific components of the puberty index are asked in an absolute way, but in a linear regression pubertal development is associated with gender, but not age, and only marginally associated with an interaction between age and gender. Respondents may answer these questions with reference to other people their age regardless of the absolute wording of the question.

gender, race/ethnicity, church attendance, and parent education and income as predictors. Because pregnancy and STD prevention are generally unimportant for mar-

ried respondents, these questions were coded as missing for respondents unmarried at wave 3.

**TABLE 6 Logistic Regression Results: Prepledge Characteristics (Wave 1) Associated With Taking a Virginity Pledge (Wave 2)**

Factor	Odds Ratio (95% CLs)
Live with both biological parents <sup>a</sup>	0.55 (0.42, 0.73)
Parents born in United States <sup>a</sup>	0.67 (0.47, 0.95)
Male <sup>a</sup>	0.68 (0.51, 0.92)
Age, y <sup>a</sup>	0.85 (0.74, 0.97)
Born in United States	0.75 (0.49, 1.14)
White	1.27 (0.92, 1.76)
Asian	1.43 (0.90, 2.26)
West region	1.33 (0.97, 1.81)
Puberty score	2.06 (0.99, 4.26)
Vocabulary test score (maximum: 100) <sup>a</sup>	0.99 (0.97, 1.00)
Lots of good qualities <sup>a</sup>	0.39 (0.15, 1.00)
Teachers fair	1.77 (1.02, 3.07)
Socially accepted	2.32 (0.97, 5.54)
Feel loved	1.78 (0.70, 4.48)
Born Again Christian <sup>a</sup>	1.93 (1.43, 2.60)
Weekly youth group attendance <sup>a</sup>	1.65 (1.21, 2.24)
Weekly church attendance <sup>a</sup>	1.57 (1.13, 2.17)
Religion is very important <sup>a</sup>	1.41 (1.05, 1.91)
Parent attends church at least monthly	1.27 (0.94, 1.71)
Sex would make feel guilty <sup>a</sup>	1.49 (1.12, 1.97)
If I used birth control people would think I had been looking for sex <sup>a</sup>	1.49 (1.11, 1.99)
Would plan ahead for birth control <sup>a</sup>	0.68 (0.50, 0.90)
Friends know how to use condoms <sup>a</sup>	0.62 (0.43, 0.90)
Sex would be relaxing <sup>a</sup>	0.66 (0.44, 0.99)
Birth control knowledge quiz score <sup>a</sup>	0.53 (0.29, 0.98)
Would not have sex without birth control	1.33 (0.98, 1.79)
Will marry by age 25	1.40 (0.85, 2.33)

Data are from respondents who at wave 1 had not taken a virginity pledge, never had sex, and were at least 15 years of age ( $n = 3440$ ). Factors shown are from logistic regression with  $P < .2$ . All variables except age and vocabulary test score are on a scale of 0 to 1. Variables are grouped by theme and sorted according to significance.

<sup>a</sup> Factors significant at  $P < .05$ .

**TABLE 7 Demographics and Family Background: Before and After Matching**

	Mean		t Test	Mean After Match (n = 645)	t Test
	Pledge (n = 289)	Nonpledge (n = 3151)			
Male	38.8	52.3	-4.42	39.0	-0.07
Asian	17.3	9.9	3.90	15.9	0.51
White	56.4	66.5	-3.47	58.6	-0.02
West region	32.9	25.2	2.86	27.7	1.47
Midwest region	21.1	28.8	-2.79	25.5	-1.35
South region	36.0	28.8	2.57	34.5	0.48
Born in United States	61.2	67.1	-2.02	62.1	-0.19
Age, y	15.9	16.0	-1.87	15.9	-0.04
Height z score	-0.04	0.28	-1.68	0.07	-0.07
Black	17.6	14.6	1.38	18.1	-0.16
Latino	20.1	17.8	0.96	19.0	0.23
BMI	22.7	22.7	-0.15	22.2	0.16
Speak English at home	81.3	86.4	-2.36	81.5	-0.06
Live with both biological parents	59.2	67.5	-2.87	60.3	-0.38
Live with biological father	61.6	68.1	-2.27	63.6	-0.64
Parent has enough money to pay bills	66.1	71.5	-1.94	72.1	-1.70
Parent graduated high school	77.2	81.6	-1.86	78.0	-0.15
Household income (\$1000)	36.2	38.5	-1.24	35.5	0.12
Father data missing	24.2	21.3	1.16	23.3	0.46
Live with foster parent or guardian	1.0	1.8	-0.93	1.3	-0.04
Parent education	78.3	72.8	0.83	71.8	1.52
Parent on public assistance	6.2	7.2	-0.64	7.7	-1.70
Mother data missing	5.5	4.8	0.59	4.5	0.45
Live with biological mother	88.6	88.7	-0.05	87.5	0.27
Relations with mother index	78.7	78.0	0.61	79.0	-0.08
Relations with father index	56.7	59.7	-1.35	60.0	-1.78
Mom warm and loving	82.4	82.8	-0.28	83.1	-0.12
Mom encourages independence	76.1	77.7	-1.16	77.5	-0.90
Mom explains when wrong	78.4	75.1	2.39	77.0	0.87
Mom communication good	75.3	74.2	0.76	76.0	-0.46
Mom overall relationship	81.1	80.3	0.56	81.6	-0.32
Dad warm and loving	58.0	61.7	-1.62	61.8	-1.85
Dad communication	54.8	56.9	-0.94	57.3	-0.93
Dad overall relationship	57.4	60.6	-1.37	60.8	-1.27

Data show the means for pledgers versus nonpledgers, compared with t test, before and after matching. Age and income are integers. Demographic and household variables are dichotomous, reported as percent endorsing. Parent variables are reported by respondents' parent, preferably the mother. Mom and dad relationship items were measured using the Likert scale and normalized to a scale from 0 to 100. Household income was analyzed on a log scale and transformed back. Index variables are at the top of the section of their components.

**TABLE 8 School Integration, Positive Expectancies, Self-efficacy**

	Mean		t Test	Mean After Match (n = 645)	t Test
	Pledge (n = 289)	Nonpledge (n = 3151)			
School integration index	70.5	68.8	1.61	71.4	-0.34
Teachers fair	68.7	64.2	2.91	66.7	1.11
Happy at school	71.7	69.5	1.38	73.3	-1.02
Close to people at school	70.3	68.7	1.16	71.5	-0.42
Feel part of school	73.2	71.7	1.06	74.7	-0.95
Feel safe at school	68.5	69.9	-0.90	70.9	-1.34
Number of school sports played	0.82	0.79	0.40	0.76	0.01
Positive expectancies index	84.7	84.8	-0.18	85.1	-0.25
Will marry by age 25	57.4	53.5	2.47	55.7	0.73
Will live to age 35	82.6	85.2	-2.10	82.9	-0.16
Will not get HIV	88.0	86.3	1.49	87.3	0.42
Want to go to college	88.7	87.6	0.71	89.0	-0.04
Not killed by age 21	82.9	83.5	-0.55	83.2	-0.14
Will go to college	81.2	81.4	-0.11	82.8	-0.90
Self-efficacy index	74.9	75.3	-0.44	75.5	-0.53
Have many good qualities	78.5	80.3	-1.73	80.2	-1.18
Do everything right	70.0	68.2	1.35	69.4	0.37
Socially accepted	77.0	75.4	1.32	75.9	0.72
Seldom sick	68.3	70.4	-1.31	68.6	-0.15
Feel loved and wanted	81.7	80.3	1.26	81.2	0.37
Well-coordinated	75.7	77.1	-1.19	76.6	-0.54
Physically fit	69.4	70.9	-1.08	70.9	-1.15
Proud of a lot	80.4	81.4	-0.96	82.2	-1.03
Get better quickly	72.7	73.5	-0.62	73.8	-0.62
Have a lot of energy	76.6	77.1	-0.34	78.3	-1.12
Like self	73.7	73.4	0.22	73.9	-0.17

Data show the means for pledgers versus nonpledgers, compared with t test, before and after matching. All variables are dichotomous, reported as the proportion endorsing or agreeing with the statement. Index variables are at the top of the section of their components and are sorted within category in declining order of prematch significance.

**TABLE 9 Parent Religiosity, Respondent Religiosity, Romantic Experience, Friend Birth Control Knowledge, and Friend Risk Behavior**

	Mean		t Test	Mean After Match (n = 645)	t Test
	Pledge (n = 289)	Nonpledge (n = 3151)			
Parent religiosity index	66.9	59.8	3.22	71.4	-0.55
Parent church attendance weekly	46.4	32.1	4.91	49.6	-0.90
Parent church attendance at least monthly	64.0	49.1	4.84	66.0	-0.53
Parent born in United States	58.8	70.3	-4.03	61.0	-0.69
Parent says religion very important	64.4	52.7	3.79	68.5	-1.23
Parent prays daily	61.9	55.3	2.17	68.2	-1.87
Parent: scripture divine	58.8	48.8	3.26	64.4	-1.65
Religious involvement index	66.1	46.4	10.72	65.9	0.03
Youth group weekly or more	40.8	17.6	9.52	39.1	0.43
Church attendance weekly or more	64.0	36.1	9.33	62.4	0.51
Church or youth group weekly	67.1	39.7	9.04	65.7	0.38
Religion very important	62.6	36.2	8.82	61.2	0.44
Born Again Christian	40.8	19.0	8.74	38.9	0.57
Youth group monthly or more	56.7	32.4	8.35	54.4	0.63
Church attendance monthly or more	77.9	55.1	7.49	77.3	0.16
Pray weekly or more	78.5	60.3	6.10	80.2	-0.42
Pray daily or more	55.7	38.3	5.77	59.2	-0.93
Scripture divine	75.8	58.9	5.60	75.5	0.18
Romantic relationship experience index	26.3	31.3	-3.24	27.1	-0.24
Touched, last 18 mo	17.6	27.1	-3.50	18.1	-0.12
Touched genitals, last 18 mo	11.4	19.3	-3.28	11.9	-0.17
Kissed, last 18 mo	40.8	47.4	-2.14	42.1	-0.36
Considered couple, last 18 mo	40.5	46.6	-1.99	42.1	-0.52
Romantic relationship, past 18 mo	37.7	43.3	-1.83	39.3	-0.53
Ever hold hands	29.4	32.4	-1.05	31.4	-0.56
Ever kiss	19.4	20.2	-0.33	18.6	0.24
Ever tell like/love	13.8	13.9	-0.01	13.5	0.12
Friends know how to use condoms	14.2	21.0	-2.75	16.3	-0.87
Friends know withdrawal method	12.5	14.2	-0.80	12.9	-0.09
Friends know rhythm method	7.6	9.2	-0.92	8.8	-0.44
Friend risk behavior index	18.3	22.5	-2.85	16.9	0.73
≥1 of 3 best friends drinks monthly	42.9	52.5	-3.12	43.5	-0.18
≥1 of 3 best friends uses marijuana monthly	21.5	28.4	-2.53	17.9	0.91
Friend attempted suicide	17.6	14.7	1.35	13.6	1.11
≥1 of 3 best friends smokes daily	35.6	39.1	-1.14	34.3	0.46

Data show means for pledgers versus nonpledgers, compared with *t* test, before and after matching. All variables are dichotomous, reported as the proportion endorsing or agreeing with the statement. Index variables are at the top of the section of their components and are sorted within category in declining order of prematch significance.

**TABLE 10 Learned Health Behavior in School: Attitudes Toward Sex and Birth Control**

	Mean		t Test	Mean After Match (n = 645)	t Test
	Pledge (n = 289)	Nonpledge (n = 3151)			
Learned health in school index	89.1	89.0	0.12	87.8	0.42
Learned in school about drug abuse	93.8	95.9	-1.69	94.8	-0.58
Learned in school about suicide	74.7	72.0	1.00	70.6	1.77
Learned in school about drinking	93.4	94.2	-0.55	93.2	0.04
Learned in school about HIV/AIDS	94.1	93.5	0.39	92.6	0.65
Learned in school about pregnancy	89.6	89.3	0.15	87.9	1.03
Efficacy to use birth control index	54.8	58.3	-3.84	54.8	-0.05
Partner would not use birth control	18.0	9.6	4.48	13.7	1.83
Would plan ahead for birth control	42.6	54.9	-4.04	43.9	-0.40
Birth control is a hassle	13.5	8.5	2.87	11.0	0.87
Birth control requires too much planning	13.1	9.0	2.33	12.0	0.56
Would use birth control if aroused	34.9	41.6	-2.21	37.4	-0.74
Birth control is hard to get	21.1	17.5	1.51	21.7	-0.27
No sex without birth control	57.4	55.3	0.71	52.7	1.32
Birth control is bad index	40.2	32.6	6.90	38.9	0.33
Birth control is looking for sex	31.5	20.3	4.44	28.5	1.17
Birth control is morally wrong	12.5	6.8	3.52	10.0	0.81
Birth control is expensive	9.7	7.6	1.24	9.1	0.25
Birth control interferes with pleasure	8.7	8.0	0.41	8.0	0.27
Negative expectations about sex index	67.2	59.5	6.12	68.8	-0.63
Feel guilty if had sex	64.0	44.0	6.54	64.5	-0.11
Partner lose respect if had sex	29.4	18.0	4.75	29.4	0.00
Upset mom if had sex	79.9	73.4	2.43	81.4	-0.42
Positive expectations about sex index	37.0	42.4	-4.98	37.0	-0.03
Sex would be relaxing	11.8	21.4	-3.87	12.5	-0.21
Pleasure if had sex	27.0	38.1	-3.74	26.0	0.22
More attractive if had sex	7.3	8.5	-0.71	6.3	0.39
Less lonely if had sex	12.8	14.3	-0.70	13.0	-0.13
More respect if had sex	11.4	11.3	0.06	8.4	0.60
Perceive sex high risk index	61.4	60.8	0.51	61.8	-0.33
Negative expectations about pregnancy index	71.8	71.2	0.72	73.0	-0.28
High risk pregnancy from 1 sex act	41.2	39.0	0.71	38.3	0.78
High risk HIV from 1 sex act	58.5	59.3	-0.26	62.1	-0.94

Data show means for pledgers versus nonpledgers, compared with *t* test, before and after matching. All variables are dichotomous, reported as the proportion endorsing or agreeing with the statement. Index variables are at the top of the section of their components and are sorted within category in declining order of prematch significance.