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## Using Induced Abortion to Measure Contraceptive Efficacy

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Data from a 1989-1990 case-control study of contraceptive efficacy in Norway compare contraceptive use among women who requested an abortion (1,386 cases) with women who responded to a general fertility survey (2,627 controls). In a logistic regression analysis measuring contraceptive efficacy as the odds of avoiding a pregnancy that terminated in an induced abortion compared with the odds for nonuse, consistent condom use was found to lower fecundity by 88.9%, diaphragm use by 89.3%, the pill by 97.8%, the IUD by 97.6%, vasectomy by 99.5%, and female sterilization by 99.8%. The relative contraceptive efficacy of the condom, the IUD and the pill did not vary by marital status or parity but did vary with age; the proportion by which each of these methods reduced fecundity declined among successively older age-groups.

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In Scandinavia, the widespread availability of modern contraceptives at little or no cost is reflected in high rates of contraceptive use and low rates of induced abortion.<sup>1</sup> However, Scandinavian women still experience unplanned pregnancy, and many become pregnant while using methods with high efficacy rates.<sup>2</sup>

Contraceptive efficacy rates are usually presented as failure rates per 100 woman-years of use, with distinctions made between method and user failures. However, from the user's point of view, a contraceptive failure is always experienced as an unplanned pregnancy, whatever its reason. When studying the efficacy of a specific method prospectively, different types or formulations of the same method are usually compared;<sup>3</sup> a direct comparison between methods is almost impossible to do prospectively because of ethical considerations, problems of compliance when women are randomly allocated specific methods, and problems of sufficient sample size.<sup>4</sup>

The present study uses a case-control approach to compare the contraceptive experience of women who sought an induced abortion (the cases) with that of women who responded to a general Norwegian fertility survey (the controls). As such, the outcome measure is not an incidence rate, but the relative reduction in fecundity provided by use of a specific contraceptive method compared with nonuse.

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All women who terminated a pregnancy from January 1989 through December 1990 at the Department of Gynecology, University Hospital of Trondheim, Norway, served as cases. This is the only hospital in the city and has a catchment area of 250,000 inhabitants. Approximately 85% of all abortions induced annually in the county are performed by the department.

Precoded medical records data, which have been collected for all pregnancy terminations since 1983, include information on the woman's age, marital status, parity, previous abortion history, contraceptive use at the time of conception, and recommendations for future contraceptive use. Clinical data are also entered into the records. The year of birth for cases ranged from 1942 to 1974. So that cases were of approximately the same age range as controls, only women born between 1943 and 1968 were included in the analysis. Thus, there were 1,386 women (aged 20-45) who terminated a pregnancy at the department over the study period for whom complete data were available.

Participants in the 1988 Norwegian fertility study, the Family and Occupation Survey, served as controls. The survey was based on interviews from a stratified random sample of 4,933 women aged 20-43 selected from Norway's Central Population Registry. The full control group was drawn from the five-year cohorts for the midpoint years 1945, 1950, 1955, 1960, 1965 and for the single year 1968. The procedures used for selecting the sample are more fully described elsewhere.<sup>5</sup>

**Women** were interviewed in their homes between October 1988 and August 1989 by the regular interview staff of Statistics Norway, which conducted the survey. The response rate was 81%, which yielded a final sample size of 4,019 women. The mean age of nonrespondents did not differ from that of respondents; however, there were more older childless women and a larger proportion of previously married women among nonrespondents than among respondents.<sup>6</sup>

**So** only women in need of contraception were in the control group, we excluded those who had never had sexual intercourse (N=151), those who had not been sexually active in the four weeks preceding the interview (N=644), those who were infecund (N=177), those who were pregnant (N=187), and nonrespondents to the specific sexual activity or contraceptive use questions (N=78). Moreover, women who were not practicing contraception were excluded if they wanted to become pregnant within the next two years (N=155). These exclusions left a total sample of 2,627 women (65% of the original sample) who could be defined as fecund, sexually active and not currently planning a pregnancy.

Current contraceptive use was defined as the method used at the time of conception among the cases and the method (or methods) used in the month preceding the interview among the controls. Women who used more than one method were classified according to the method known to be more effective in preventing pregnancy, using the following ranking—female sterilization; male sterilization; the pill; the IUD; the diaphragm; the condom; foam, rhythm or withdrawal; and others.<sup>7</sup>

**Method** use was clinically confirmed among the 102 cases who became pregnant while using an IUD, since the device was removed by either the physician who referred the woman for the abortion or by the gynecologist who performed it. For the three

sterilized women who became pregnant, confirmation of the operation was made by checking the hospital's medical records. Checking the medical records of the referring doctors confirmed that the pill had been prescribed in three-fourths of the 184 cases who said that they were taking the pill when they conceived. However, evidence of a prescription is not proof that a woman was using the pill at the time of the conception. Three cases stated that their husbands were sterilized; however, whether the husband had received a vasectomy, or whether he really was the father, could not be validated.

A logistic regression model\* was used to estimate the relative odds of contraceptive failure among the users of different contraceptive methods, with pregnancy termination being the dependent variable. The probability of pregnancy among contraceptive users (i.e., of condoms, pills, the IUD and female sterilization) was compared with that among nonusers, expressed as adjusted odds ratios with 95% confidence intervals. One minus the adjusted odds ratio was interpreted as the estimate of the reduction in fec undity associated with the typical use of each method.

The model controlled for age, marital status and parity. A stepwise logistic regression approach was applied in the model-building. Variables that had a univariate chi square p-value of <.25 were considered as candidates for the multivariate model. The likelihood ratio test for the differences between models, with or without the specific variable, was used to identify the best fit (p<.05). Use of each method was compared separately with nonuse.

The presence of an interaction, which implies that the effect of one of the variables is not constant with respect to changes in the levels of others, was tested according to prior knowledge of how contraceptive use differs by marital status, parity and age (only first degree interaction terms), with statistical significance set at p<.01.

Interaction between marital status, parity and age per se was not tested. An interaction between contraceptive use and a specific confounding variable's effect on the dependent variable was tested at the time the confounding variable appeared in the model.

## RESULTS

Table 1 presents the demographic and contraceptive use characteristics of women having abortions and all women. Compared with all women, those having abortions were more likely to be young, single and to never have had children or to have had only one child. Well over half (57%) of women having abortions were not using any method at the time of conception, while less than 5% of the general population were not using a method in the month preceding the survey.

**Table 1. Percentage distribution of women who obtained an induced abortion and of women who responded to a general Norwegian fertility survey, by characteristic, 1988-1990**

Characteristic	Obtained abortion (N=1,386)	General population (N=2,627)
<b>Age</b>		
20-24	35.7	30.5
25-34	45.8	35.7
35-44	18.5	33.8
<b>Marital status</b>		

Single	52.0	19.4
Married or cohabiting	48.0	80.6
<b>Parity</b>		
0 or 1	62.5	46.7
>=2	37.5	53.3
<b>Contraceptive use*</b>		
None	56.5	4.3
Natural methods	2.8	5.8
Condom	22.7	16.4
Diaphragm	0.9	0.5
IUD	6.6	27.8
Pill	10.0	28.4
Vasectomy	0.2	4.3
Female sterilization	0.2	12.5
Total	100.0	100.0
*Among women obtaining an abortion, method used at time of conception, and among general population, method used in the month before the interview.		

Table 2 presents the proportion by which reliance on each specific method reduced fecundity in comparison with nonuse. For example, consistent reliance on the condom, or the diaphragm, reduced fecundity by 89%, compared with nonuse. The percentage by which condom use lowered fecundity compared with nonuse did not vary by women's marital status and parity, but decreased with age, going from 95% among 20-24-year-olds to 86% among 25-34-year-olds, and to 79% among 35-44-year-olds.

Method and age-group	% reduction in fecundity	95% C.I.
<b>Condom</b>	<b>88.9</b>	<b>85.7-91.5</b>
20-24	94.9	91.6-96.9
25-34	85.8	78.8-90.6
35-44	78.9	65.0-87.1
<b>Diaphragm</b>	<b>89.3</b>	<b>73.3-95.7</b>
<b>IUD</b>	<b>97.6</b>	<b>96.7-98.3</b>
20-24	98.8	97.2-99.5
25-34	98.3	98.1-98.9
35-44	96.2	93.5-97.7
<b>Pill</b>	<b>97.8</b>	<b>96.9-98.4</b>
20-24	99.0	98.3-99.4
25-34	96.0	93.7-97.4
35-44	92.0	79.2-96.9
<b>Vasectomy*</b>	<b>99.5</b>	<b>96.8-99.9</b>
<b>Female sterilization</b>	<b>99.8</b>	<b>99.4-99.9</b>
*Among married and cohabiting women only.		

Women who relied on the pill or the IUD had a nearly 98% reduction in fecundity, compared with women who used no method. As with the condom, the estimates were consistent regardless of marital status or parity, but decreased with age. Women who

had been sterilized experienced a 99.8% reduction in their fecundity compared with nonusers. Reliance on vasectomy relative to no method (calculated among married and cohabiting women only) reduced fecundity by 99.5%.

Data on the preventive effect of natural methods of family planning could not be presented because one-fifth of these users relied on more than one method. Of the 152 women in the general population survey who relied on natural methods, for example, 31 said they used both periodic abstinence and withdrawal in the month before the survey.

## DISCUSSION AND CONCLUSIONS

Our understanding of the relative efficacy of different contraceptive methods is limited by research design problems and because the analytic tools to adequately assess relative efficacy are lacking.<sup>9</sup> A population-based, case-control approach such as the current study, which uses abortion as the measure of contraceptive failure, can compare the effectiveness of different contraceptive methods. The outcome measure will not be the incidence of contraceptive failure per 100 woman-years of use, but the relative reduction in fecundity for a particular contraceptive method in comparison with nonuse.

The results of an analysis that uses abortion as a proxy for unintended pregnancy, however, may overestimate or underestimate a method's efficacy, depending on the distribution of pregnancy outcomes among nonusers and those who experience a contraceptive failure. That is, if nonusers are more likely than users to terminate their pregnancies, then method efficacy will be overestimated; but if nonusers are more likely to carry their pregnancies to term, the efficacy estimates will be underestimated.

To assess this form of selection bias, contraceptive data were reanalyzed from a 1983 study of 399 pregnant women aged 20-44 that examined the influence of social and demographic factors on how unplanned pregnancies were resolved.<sup>10</sup> After the data were adjusted for marital status, parity and age, nonusers were more likely than users to decide on abortion. In Norway, the ratio of induced abortions to births stayed relatively constant between 1983 and 1988-1989.<sup>11</sup> Thus, any bias created by using abortion as a proxy for unintended pregnancy would be toward underestimating reductions in fecundity.

Of course, women who choose to terminate a pregnancy caused by a contraceptive failure represent only a subset of all women who have experienced a contraceptive failure. If method use among women choosing pregnancy termination were similar to that among women carrying to term, then the estimate of contraceptive efficacy would be a "true" one. However, if the use of one particular method is overrepresented among women who choose abortion, the efficacy estimate for that method would be biased toward the null hypothesis (underestimated). Conversely, if use of specific methods is underrepresented among women seeking abortions, the estimates for such methods would be biased away from the null hypothesis (overestimated). This situation occurs when proportionately more contraceptive users who experience a method failure carry their pregnancies to term.

The variation in age-specific efficacy estimates for users of the condom, the pill and the IUD illustrates this selection problem. According to data from the 1983 study,

younger users of these methods (sample sizes were not large enough to analyze each method separately) were more likely than older users to choose to carry a pregnancy resulting from contraceptive failure to term;<sup>12</sup> this bias results in higher efficacy estimates among women in younger age-groups. Conversely, since older users were more likely to choose abortion, their efficacy estimates would be lower. Thus, the interaction in the current study between contraceptive efficacy and age can be explained by variation in pregnancy outcome choice by age, rather than by any variation in sexual activity by age.

Another earlier Norwegian study on the outcomes of pregnancies that occurred with the IUD in situ showed that proportionately more pregnancies were terminated than carried to term.<sup>13</sup> This indicates that the contraceptive effectiveness associated with the IUD might be higher than that found in this study.

As mentioned earlier, the fact that the pill had been prescribed by the referring physician was confirmed for 75% of the cases who claimed they became pregnant while taking the pill. However, it was impossible to validate pill use among women in the control group. In general, women who choose the pill are younger and have fewer children than those who select the IUD.<sup>14</sup> These differences might affect decisions regarding pregnancy outcome and explain the interaction between age and contraceptive efficacy that was found in the current study for the pill.

Pregnancy after a sterilization will always be a method failure, unless the woman was pregnant at the time of sterilization. An examination of the medical records of the three cases who said they had been sterilized uncovered no complications or discrepancies in operation procedures. The efficacy estimate for female sterilization would seem to be valid, since the data conform to the method's low clinical rate of failure.

Three of the 13 diaphragm users who became pregnant combined use of the diaphragm and the condom, thus limiting the ability to analyze a pure diaphragm effect; the simultaneous use of both methods will overestimate the effect of the diaphragm alone. This analysis found no major difference in efficacy estimates between the condom and the diaphragm.

Natural methods of birth control were excluded because of a tendency among users to use more than one method and because we suspect that if pregnancy occurs, women relying on periodic abstinence or withdrawal are likely to report that they were not using any method at the time of conception. If the latter speculation is true, reliance on natural methods is effectively underreported. This will bias the results away from the null hypothesis, and thus overestimate the contraceptive effectiveness of such methods.

As mentioned earlier, this analysis used data on women who sought an abortion at the University Hospital of Trondheim, where 85% of abortions in the county take place. Data were also examined from women who sought an abortion during a two-month period in 1990 at the other county hospital where the remaining 15% of abortions are performed.<sup>15</sup> There were no differences in patterns of contraceptive use between the abortion patients in the two hospitals over the same two-month period. Therefore, it is unlikely that a skewed selection of cases has biased the efficacy estimates.

Data on the control group were collected during the fall of 1988 through the spring of



1989 from a representative sample of women from all over Norway. Patterns of contraceptive use among women interviewed for this survey who lived in the county did not differ from those among women living elsewhere in Norway. The women who comprised the cases—those who sought an abortion at the University Hospital of Trondheim—are representative by age of all women who sought an abortion in Norway in 1989 and 1990.<sup>16</sup> Thus, data on contraceptive efficacy from the current study may be valid for Norway in general.

As the need for contraception is dependent on sexual activity, the reduction in fecundity associated with specific methods will also be dependent on the frequency of intercourse. Norwegian studies of sexual activity carried out in 1987 and 1988 indicate that married and cohabiting women had intercourse significantly more frequently than did single women.<sup>17</sup> However, the current study found no interaction between marital status and contraceptive efficacy.

Nearly two-thirds of Norway's female population of reproductive age is sexually active and fecund, and potentially in need of contraception; about 2% of these women have an abortion each year.<sup>18</sup> About 60% of the abortions occur among the approximately 5% of all women who do not practice contraception; the other women having a pregnancy termination come from the 95% of the population of sexually active females at reproductive age who are using a method. Thus, shifting reliance from less effective methods (i.e., natural family planning, condoms and the diaphragm) to more effective methods (the pill and the IUD) will not affect the magnitude of the abortion rate to any significant extent. Switching from non use to consistent use of a less effective method such as the condom, or to use of any of the more effective methods, would have a substantial effect on the abortion rate.

The great majority of pregnancies that occur to the 5% of Norwegian women who do not use any method, however, lead to a live birth.<sup>19</sup> As the overall ratio of births to induced abortions has remained at 4:1 for many years, improved contraceptive practice would more likely lead to a marked reduction in births, particularly among married and cohabiting women who are less likely to terminate an unplanned pregnancy than are single women.

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